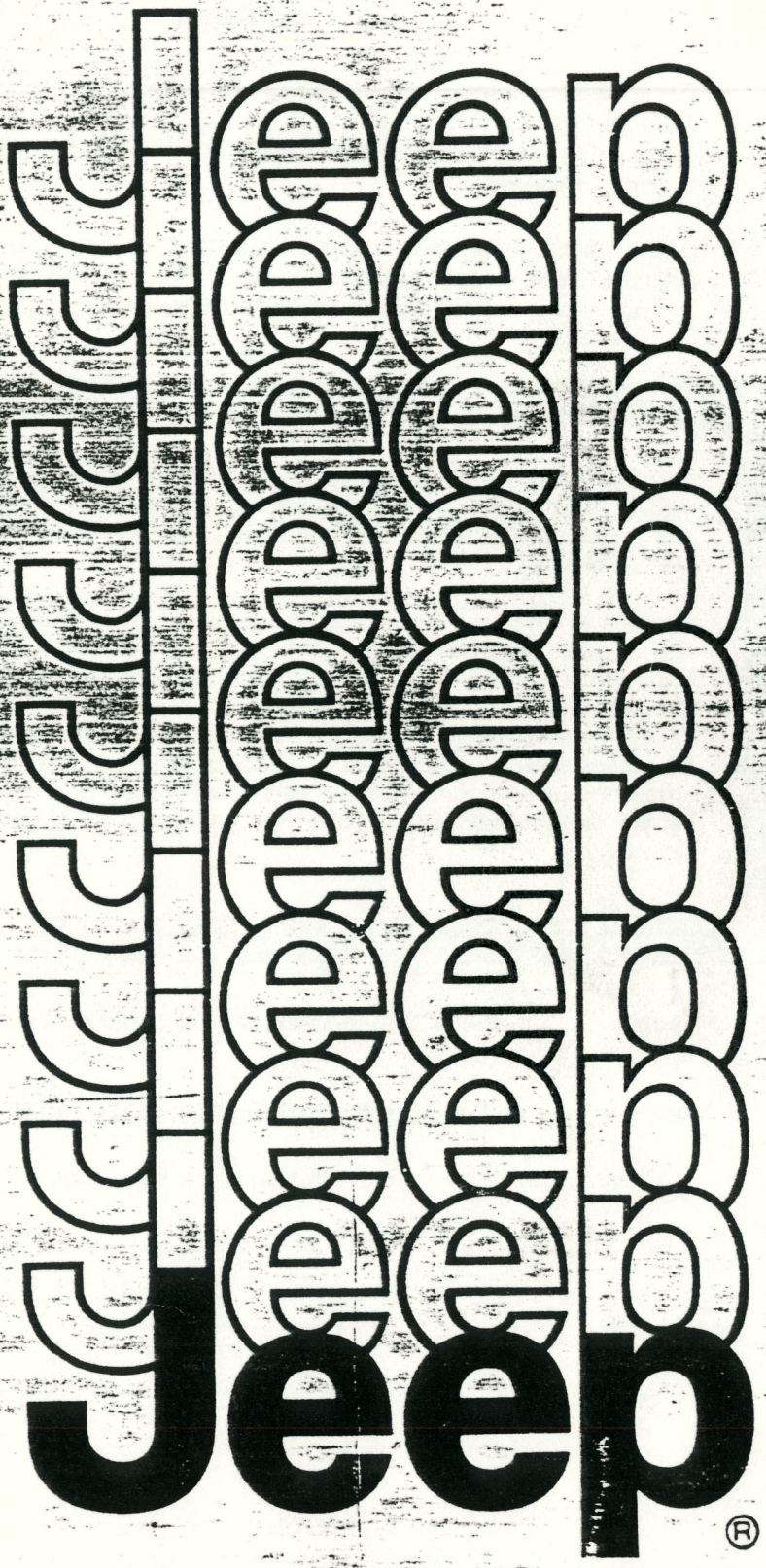
1981

TECHNICAL SERVICE MANUAL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FOREWORD

All information and specifications in this manual are based on the latest data available at the time of publication. Jeep Corporation reserves the right to discontinue models and change specifications or design without notice or incurring obligation.

Brand names mentioned in this manual are for convenience only and are not intended as a recommendation to use a specific brand of product. They are indicative of a class or type and may be substituted by their equivalent.

Proper service and repair are essential to the safe and reliable operation of a motor vehicle. This manual contains recommended methods for performing proper service and repair. Use of improper methods could cause personal injury and render the vehicle unsafe.

Detailed descriptions of standard workshop safety procedures are not included in this manual. This manual does contain WARNINGS for some service procedures that could cause personal injury, and CAUTIONS for some procedures that could damage the vehicle or its components. Please understand that these WARNINGS and CAUTIONS do not cover all conceivable ways which service might be done or all possible hazardous consequences of each conceivable way. Anyone using service procedures or tools (whether or not recommended by Jeep Corporation) must satisfy himself that neither personal nor vehicle safety will be jeopardized by the procedures or tools selected.

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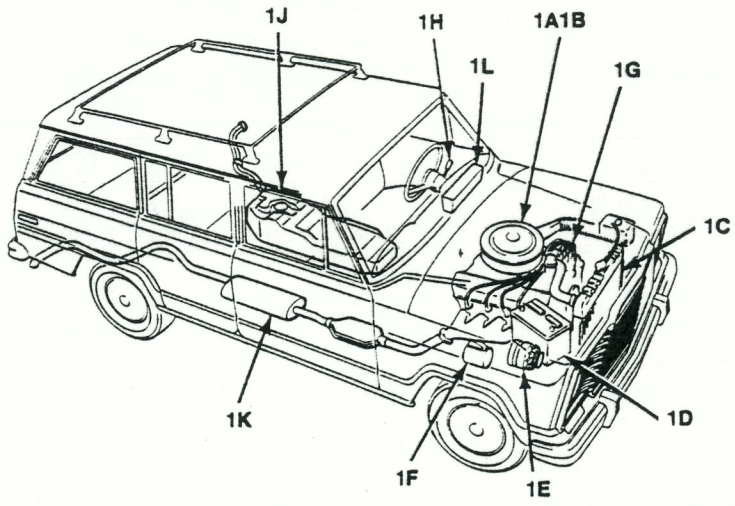
1981 JEEP TECHNICAL SERVICE MANUAL

General Information A
Maintenance B



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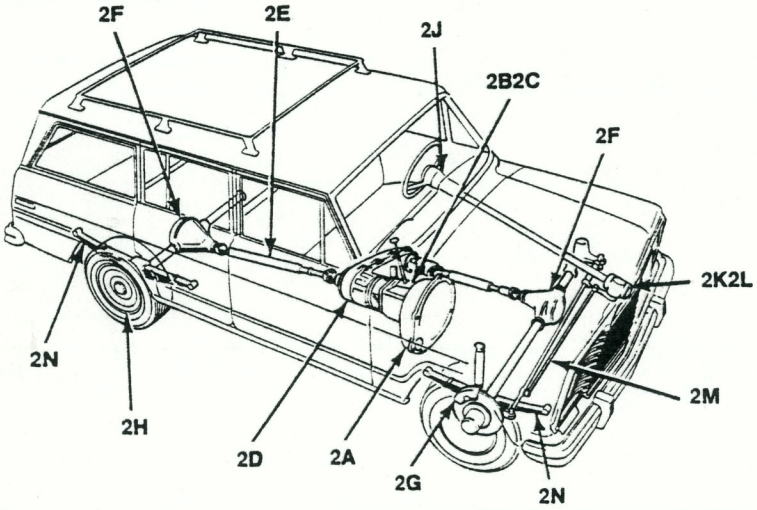

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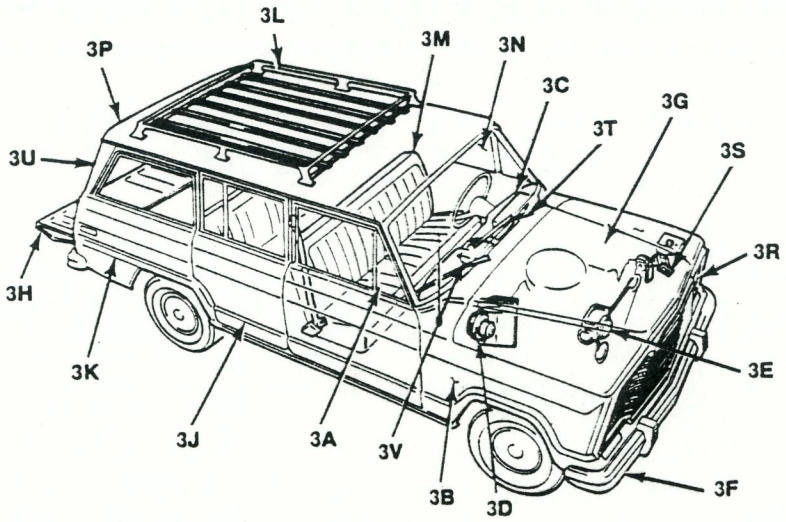

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Jeep Corporation
Service Department

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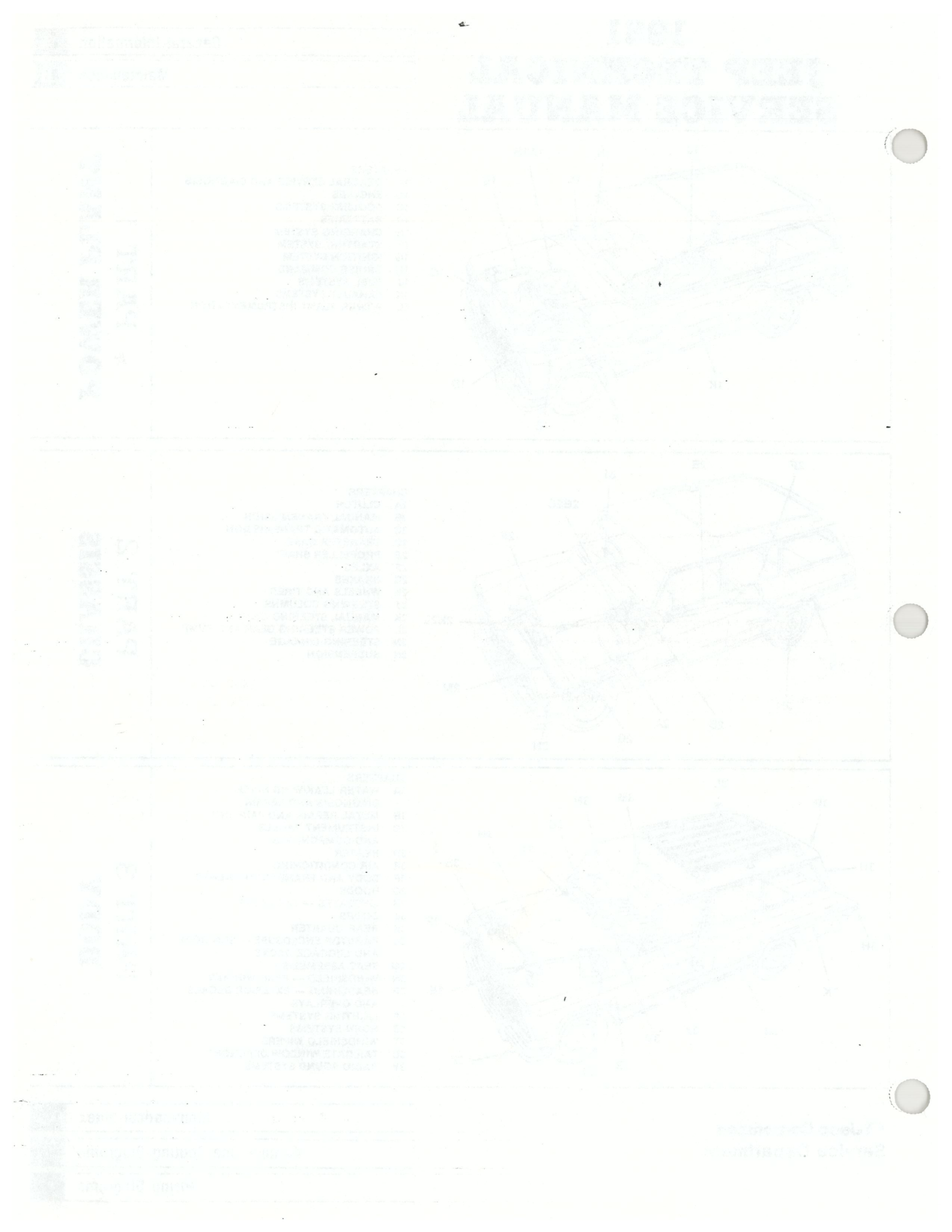

GENERAL INFORMATION A

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HOW TO USE THIS MANUAL

Organization

This manual is divided into three major parts: Part 1—Power Plant, Part 2—Chassis and Part 3—Body. These parts are comprised of chapters pertaining to the various topics. The Index at the front of this manual has a locator tab for each part.

The first page of each chapter in this manual contains a black tab in a position corresponding to the tab on the Chapter Index page for each part. To locate a desired chapter, simply fold back the manual slightly so that the outside edges of the pages are exposed. Find the black tab that aligns with the tab on the Chapter Index page and open to the desired chapter.

Each chapter begins with an alphabetical index of subjects. Locate the desired subject and turn to the appropriate page. If the subject is broad, the chapter is divided into sections and a subject index of each section is also included. An alphabetical index of all subjects is located at the back of this manual.

Each chapter ends with specifications, torque charts and special tools pertinent to that chapter.

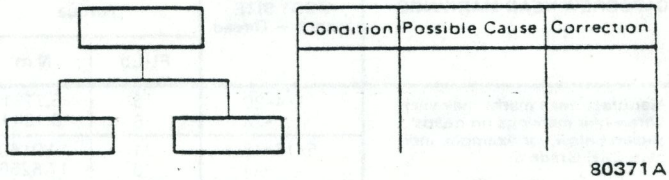
Warnings and Cautions

Detailed descriptions of standard workshop safety procedures are not included in this manual. This manual does contain WARNINGS for some service procedures that could cause personal injury, and CAUTIONS for some procedures that could damage the vehicle or its components. Please understand that these WARNINGS and CAUTIONS do not cover all conceivable ways which service might be done or all possible hazardous consequences of each conceivable way. Anyone using service procedures or tools (whether or not recommended by Jeep Corporation) must satisfy himself that neither personal nor vehicle safety will be jeopardized by the procedures or tools selected.

Diagnosis and Repair Simplification (DARS) Charts

In several places throughout this manual, Jeep Corporation's new Diagnosis and Repair Simplification (DARS) charts provide a graphic method of diagnosis and troubleshooting through the use of pictures and symbols.

The DARS charts are different from the ones you have used before. They are not "go-no go" decision trees or tables.



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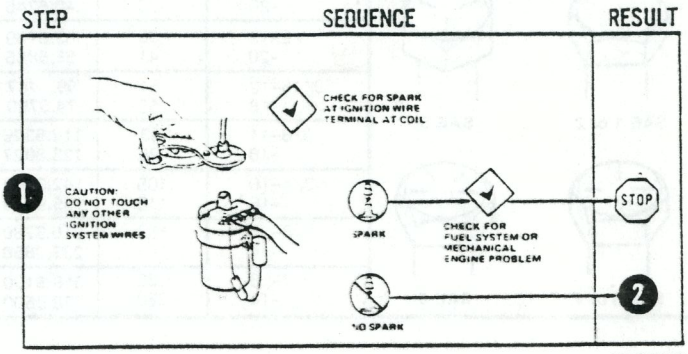
Instead, the new DARS charts use pictures plus a few words to help you solve a problem. . .



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and symbols and words help guide you through each step. . .

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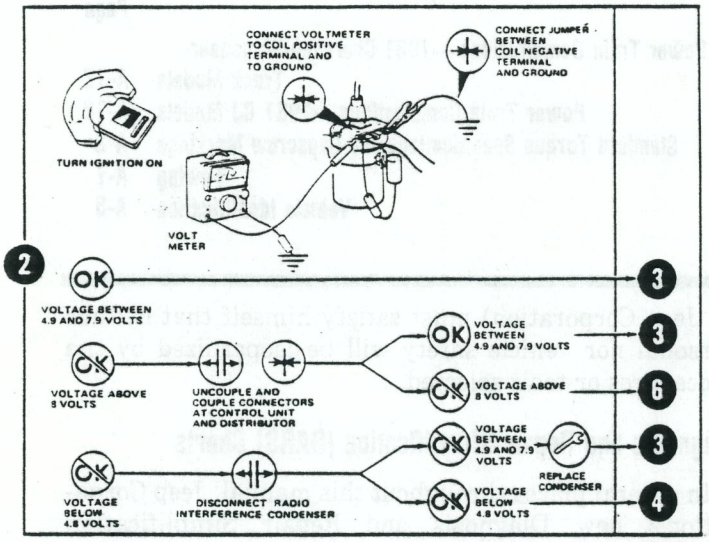
The charts are divided into three sections: **step, sequence** and **result.** Always start at the first step and go through the complete sequence from left to right.



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A sequence could be checking pressure in all tires and inflating to specified pressures. If the problem is solved, the symbol OK will send you to STOP. If the problem is not solved, the symbol OK will send you through another sequence of checks which ends with a result and tells you the next step to go to.

Work through each step of the DARS charts until the system is repaired STOP.

Service Diagnosis Charts

You will also find Service Diagnosis Charts throughout this manual. These charts list causes of specific problems in descending order of probability. It is more likely that a problem would result from the first listed "possible cause" than the fourth, for instance.

Visual inspection often leads directly to the correct solution. All service procedures should begin with a careful visual inspection of any suspected part or assembly.

Torque Information

Individual torque charts appear at the end of each chapter. Torque values are expressed two ways, Set-To and In-Use Recheck. The Set-To value is used when assembling components. The In-Use Recheck value is used to check pretightened items.

Refer to the Standard Torque Specifications and Capscrew Markings Chart in this chapter for torques not listed in individual torque charts. Note that torque specifications given in the chart are based on use of clean and dry threads. Reduce torque by 10 percent when threads are lubricated with engine oil and by 20 percent if new plated capscrews are used.

Standard Torque Specifications and Capscrew Markings Chart

CAPSCREW HEAD MARKINGS	CAPSCREW BODY SIZE Inches – Thread	SAE GRADE 1 or 2 (Used Infrequently)		SAE GRADE 5 (Used Frequently)		SAE GRADE 6 or 7 (Used at Times)		SAE GRADE 8 (Used Frequently)	
		Torque		Torque		Torque		Torque	
		Ft-Lb	Nm	Ft-Lb	Nm	Ft-Lb	Nm	Ft-Lb	Nm
Manufacturer's marks may vary. Three-line markings on heads shown below, for example, indicate SAE Grade 5. SAE 1 or 2 SAE 5 SAE 6 or 7 SAE 8	1/4-20	5	6.7791	8	10.8465	10	13.5582	12	16.2698
	-28	6	8.1349	10	13.5582			14	18.9815
	5/16-18	11	14.9140	17	23.0489	19	25.7605	24	32.5396
	-24	13	17.6256	19	25.7605			27	36.6071
	3/8-16	18	24.4047	31	42.0304	34	46.0978	44	59.6560
	-24	20	27.1164	35	47.4536			49	66.4351
	7/16-14	28	37.9629	49	66.4351	55	74.5700	70	94.9073
	-20	30	40.6745	55	74.5700			78	105.7538
	1/2-13	39	52.8769	75	101.6863	85	115.2445	105	142.3609
	-20	41	55.5885	85	115.2445			120	162.6960
	9/16-12	51	69.1467	110	149.1380	120	162.6960	155	210.1490
	-18	55	74.5700	120	162.6960			170	230.4860
	5/8-11	83	112.5329	150	203.3700	167	226.4186	210	284.7180
	-18	95	128.8027	170	230.4860			240	325.3920
	3/4-10	105	142.3609	270	366.0660	280	379.6240	375	508.4250
	-16	115	155.9170	295	399.9610			420	569.4360
	7/8- 9	160	216.9280	395	535.5410	440	596.5520	605	820.2590
	-14	175	237.2650	435	589.7730			675	915.1650
	1- 8	235	318.6130	590	799.9220	660	894.8280	910	1233.7780
	-14	250	338.9500	660	894.8280			990	1342.2420

70090

Torx-Head Fasteners

Various sizes of internal and external hex-lobular (Torx) head fasteners are used as attaching hardware on numerous components and assemblies in 1981 Jeep vehicles. Due to the ever-changing usage and application of automotive fasteners, Torx-head fasteners may not be identified as such throughout this manual. However, these fasteners may be removed or installed using Tool Set J-25359-C.

Service Manual Improvements

You are encouraged to report any errors, omissions, or recommendations for improving this publication. A form provided for this purpose is included at the end of this chapter.

1981 MODEL JEEP VEHICLES

CJ Models

Two CJ models are available for 1981: the 83.5-inch wheelbase CJ-5, model 85, and the 93.5-inch wheelbase CJ-7, model 87. See figures A-1 and A-2. Beyond the 10-inch difference in wheelbase, CJ-5 and CJ-7 differ primarily in available options. CJ-7 models are available with an automatic transmission, soft top with metal doors, moulded hardtop and moon roof. These options are not available on CJ-5 models.

The Renegade package continues to be offered on CJ models for 1981. The package features "Tracker PG" L78x15 tubeless tires mounted on 8-inch wide, styled-steel wheels along with unique exterior and interior trim.

The Laredo package is available on CJ models for 1981. It includes unique exterior paint and decals; chrome front bumper, rear bumperettes, mirror heads and arms, and body side steps; 15-inch x 8-inch chrome styled-steel wheels with 9Rx15 "Wrangler" radial tires, and a deluxe interior with tachometer and clock.

Refer to the Power Train Combinations Chart in this section for engine and transmission availability.

Cherokee Models

For 1981, three Cherokee models are offered: the base 2-door model 16, the Wide Track model 17, and the 4-door model 18. See figures A-3, A-4 and A-5.

The 2-door model 16 is a dual purpose vehicle in the sports/utility class featuring an all-steel top, front disc brakes and foldup rear seat as standard.

The Wide Track model 17 features steel wheel opening extensions to accommodate L78x15 tubeless tires mounted on 8-inch wide, styled-steel wheels.

The 4-door model 18 features the convenience of rear doors in a station wagon-type vehicle. The model 18 has the same grille and taillamps as other Cherokee models.

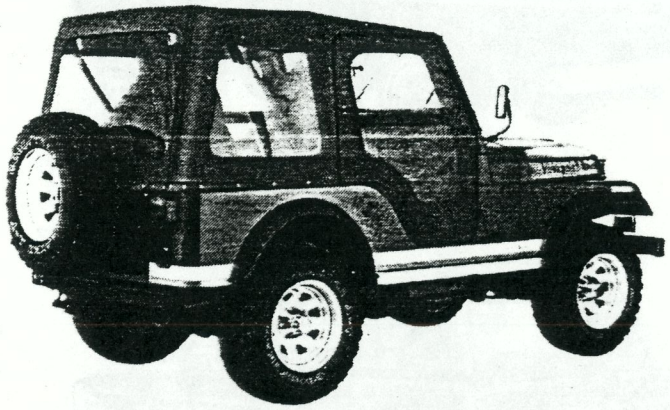

Fig. A-1 CJ-5 Model

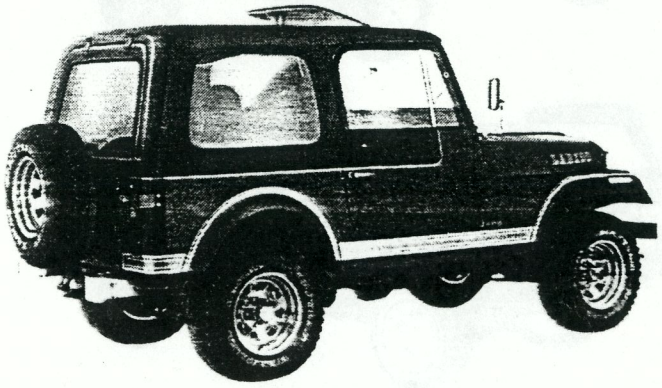

Fig. A-2 CJ-7 Model

Three trim packages are offered for 1981 Cherokee models. The "S" package is available on all Cherokee models. The Chief and Laredo packages are available on the model 17. All three packages feature deluxe interior trim and carpeting, chrome bumpers, and unique exterior trim.

Refer to the Power Train Combinations Chart in this section for engine and transmission availability.

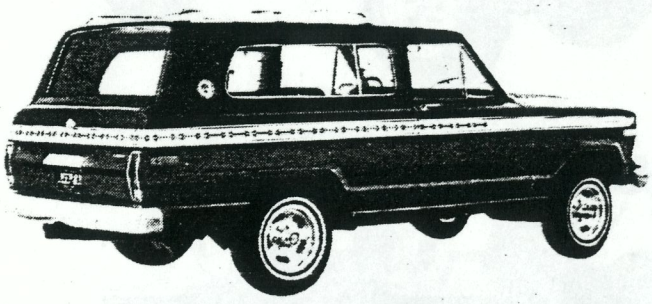

Fig. A-3 Cherokee Model 16

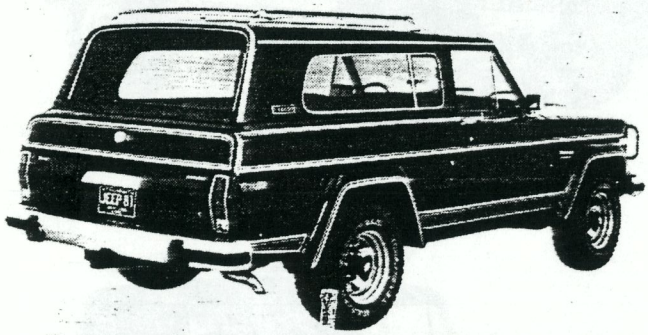

Fig. A-4 Cherokee Model 17

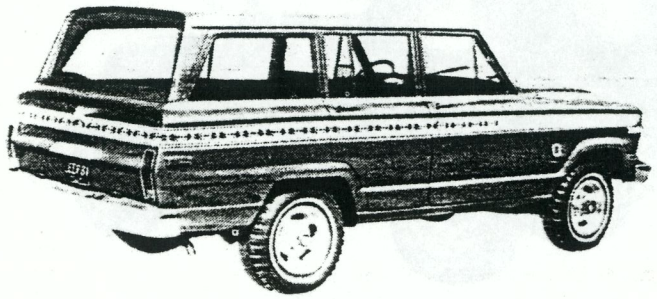

Fig. A-5 Cherokee Model 18

Wagoneer Model

For 1981, one Wagoneer model is offered: the model 15. The 4-door Wagoneer station wagon features deluxe interior trim and carpeting, chrome bumpers, power steering, and automatic transmission with Quadra-Trac full-time 4-wheel drive as standard. A luxury trim package, the Limited, is offered. It features a leather and corduroy interior, unique exterior woodgrain with vinyl surround mouldings, and forged aluminum wheels. See figure A-6.

Refer to the Power Train Combinations Chart in this section for engine transmission and transfer case availability.

Fig. A-6 Wagoneer Model 15

Truck Models

The truck models are available in two series: the J-10 Series model 24, 25 and 26, and the J-20 Series model 27 (figs. A-7, A-8 and A-9).

The J-10 models differ from the J-20 model in gross vehicle weight (GVW) ratings. For 1981, the J-10 Series GVW for models 24, 25 and 26 is 6200 while the J-20 model 27 GVW remains at 6800 with optional GVW of 7600 and 8400.

The Truck models are also identified by wheelbase. Models 24 and 25 have a 119-inch wheelbase; models 26 and 27 have a 131-inch wheelbase. The following chart outlines Truck differences by wheelbase and GVW ratings.

Truck Model Identification

Series	Model Number	Wheelbase (Inches)	Gross Vehicle Weight Rating		
			Standard	Option 1	Option 2
J-10	24	119	6200	–	–
J-10	25	119	6200	–	–
J-10	26	131	6200	–	–
J-20	27	131	6800	7600	8400

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Three trim packages are available on Truck models: Custom, Honcho and Laredo. The Custom package is available on all Trucks and features deluxe interior and exterior trim. The Honcho package is only available on model 25 and features denim interior, unique exterior trim, and 10-inch by 15-inch tires mounted on 8-inch wide, styled-steel wheels.

The Laredo package is available on 1981 J-10 model 25 Trucks. The package includes unique exterior paint and decals, 10-inch by 15-inch radial tires mounted on 8-inch wide chrome styled-steel wheels, chrome rear step bumper, and deluxe interior.

Refer to the Power Train Combinations Chart in this section for engine and transmission availability.

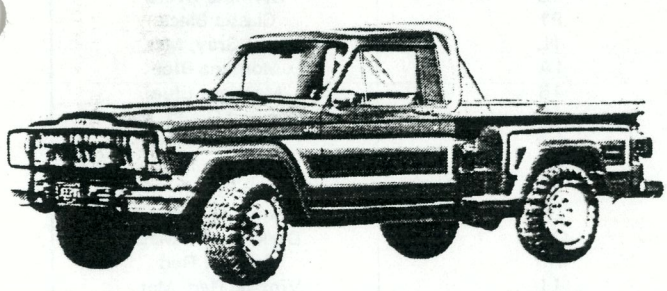


Fig. A-7 J-10 Truck Model 24

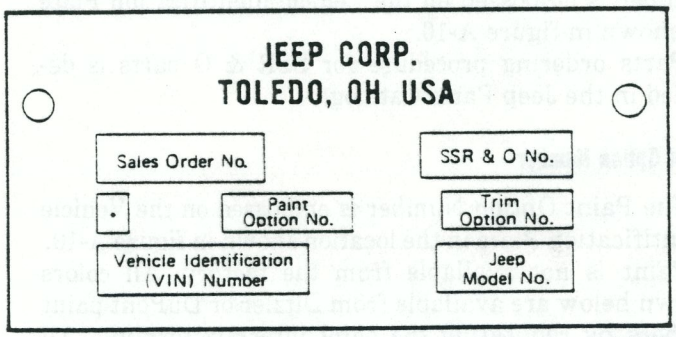
Fig. A-8 J-10 Truck Model 25

Fig. A-9 J-20 Truck Model 27

VEHICLE IDENTIFICATION

Vehicle Identification Plate

A metal vehicle identification plate is affixed to the left-hand side of the dash panel under the hood (fig. A-10). The plate shows the Sales Order Number; the Vehicle Identification Number (VIN); Special Sales Request & Order (SSR & O) Number; Paint Option Number; Trim Option Number; and the Jeep Model Number.



*Disregard – for factory use only

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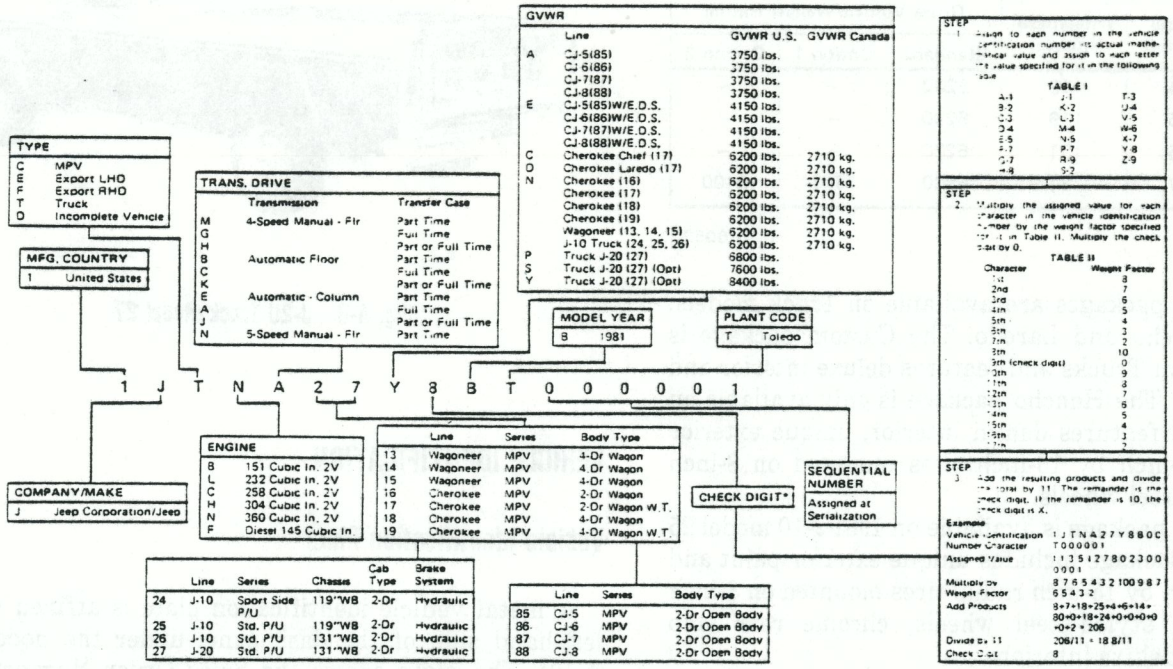
Fig. A-10 Vehicle Identification Plate

Vehicle Identification Number (VIN)

All Vehicle Identification Numbers contain 17 characters in a combination of letters and numbers that provide specific information about the vehicle. VIN's for all Jeep vehicles can be decoded using the following chart.

VIN Decoding Chart



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Special Sales Request and Order (SSR & O) Number

Certain Jeep vehicles are built to special order with other than standard parts or equipment. To assist the dealer in ordering correct replacement parts, an SSR & O number is assigned and a permanent record of the deviation is maintained by the factory. The SSR & O number is embossed on the Vehicle Identification Plate as shown in figure A-10.

Parts ordering procedure for SSR & O parts is detailed in the Jeep Parts Catalog.

Paint Option Number

The Paint Option Number is embossed on the Vehicle Identification Plate in the location shown in figure A-10.

Paint is not available from the factory. All colors shown below are available from Ditzler or DuPont paint jobbers by requesting the paint intermix formula. All colors are available from Sherwin-Williams in factory package cans. Option No. 999 indicates special paint. To obtain information on special paint, contact your Jeep Parts Distribution Center and provide the Vehicle Identification Number (VIN).

Trim Option Number

The Trim Option Number is embossed on the Vehicle Identification Plate as shown in figure A-10. Consult your Jeep Parts Catalog for trim ordering procedure. Special trim is indicated by trim option number 999. To obtain information on special trim, contact your Jeep Parts Distribution Center and provide the Vehicle Identification Number (VIN).

Paint Option Numbers

Paint Option Number	Color
9B	Olympic White
P1	Classic Black
1L	Steel Gray, Met.
1A	Montana Blue
1B	Moolight Blue
1C	Sherwood Green, Met.
1D	Autumn Gold
OK	Cameo Tan
1E	Copper Brown, Met.
1H	Chestnut Brown, Met.
OM	Dark Brown, Met.
1M	Oriental Red
1J	Vintage Red, Met.
1K	Deep Maroon, Met.

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Safety Certification Sticker

A safety sticker is placed on all vehicles to show that they meet federal motor vehicle safety certification standards (fig. A-11). It lists the VIN, month and year built, Gross Vehicle Weight Rating (GVWR), and Gross Axle Weight Rating (GAWR).

The sticker is located on the inside panel directly below the door opening on the drivers side on CJ-5 and CJ-7 models. On Cherokee, Wagoneer and Truck models, it is on the door lock pillar on the driver's side.

KEYS AND LOCKS

Two square-headed and two oval-headed keys are provided, as applicable, with each vehicle. The square-headed (code D) key operates the ignition switch, front door locks, and Cherokee/Wagoneer tailgates. The oval-

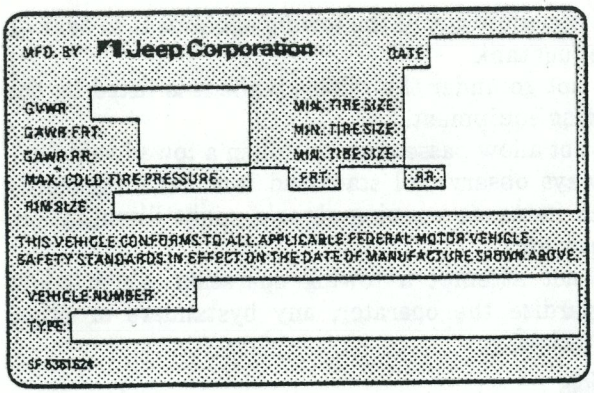

Fig. A-11 Safety Sticker

headed (code E) key operates the glove box lock. Each key has a code number stamped on the knock-out plug. In the event a key is lost, a new key can be made by converting the key code number to a key bitting number. Key bitting numbers can be obtained from a key cutting machine manufacturer's cross-reference list or by contacting your Zone office.

If a key is lost and the key code number is unknown, the correct number can be identified by the Zone office from the vehicle identification number.

If the ignition key is lost and the key code number is not available, a new key can be made by removing a door lock and taking it to a locksmith. The locksmith can determine the key bitting by inserting a blank key into the lock cylinder and cutting the blank to match the tumblers.

If the ignition switch lock is defective and the key is available, the cylinder and individual tumblers can be ordered and matched to the existing key. To determine the tumbler arrangement, place the key over the template (fig. A-12). Starting from the left, read across the horizontal lines and record first digit (number 1 position) of the key code. Continue this process for subsequent numbers 2 through 5.

NOTE: *The template shown in figure A-12 may be used to determine the key bitting code of a key for which the key code number is unknown.*

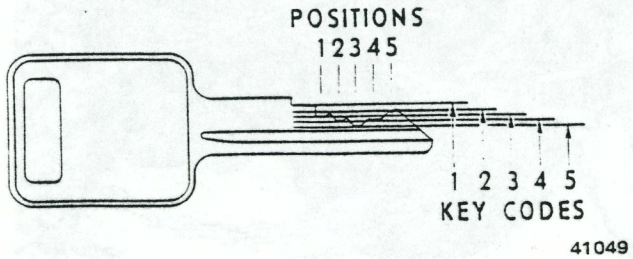

Fig. A-12 Key Coding Template

TOWING

General

A conventional towing sling is recommended for use on all Jeep vehicles because of its stability and reduced likelihood of damage. The following instructions apply only to this device. When using other than sling-type towing equipment, be sure to follow the manufacturer's instructions.

A safety chain system that is completely independent of the lifting and towing attachment must be used. Be careful when installing safety chains so that they do not damage the vehicle.

If additional ground clearance is required, a towing dolly may be used. The end of the vehicle to be placed on the dolly should be lifted with the same equipment as when towing.

CJ Models

Front Towing—Front End Raised

Part Time Transfer Case

Do not exceed a towing speed of 30 mph (48 km/h) and do not exceed a towing distance of 15 miles (24 km). Index and disconnect rear propeller shaft or place a dolly under rear wheels.

Rear Towing—Rear End Raised

Part Time Transfer Case

Do not exceed a towing speed of 30 mph (48 km/h) and do not exceed a towing distance of 15 miles (24 km). Index and disconnect front propeller shaft or place a dolly under front wheels.

If ignition key is available, turn ignition to Off position to unlock steering column. Clamp the steering wheel in the straight-ahead position. Do not use the steering column lock as a substitute for a clamping device.

If ignition key is not available, place front wheels on a dolly.

Cherokee-Wagoneer-Truck Models

Front Towing—Front End Raised

Part Time Transfer Case—Manual Transmission

Do not exceed a towing speed of 30 mph (48 km/h) and do not exceed a towing distance of 15 miles (24 km).

(1) Shift transmission into gear and the transfer case into N (Neutral).

Part Time Transfer Case—Automatic Transmission

Do not exceed a towing speed of 30 mph (48 km/h) and do not exceed a towing distance of 15 miles (24 km).

(1) Shift automatic transmission into Park.

(2) Shift transfer case into Neutral position.

Quadra-Trac—Automatic Transmission

Do not exceed a towing speed of 30 mph (48 km/h) and do not exceed a towing distance of 15 miles (24 km).

(1) Turn ignition switch to Off position to unlock steering wheel.

(2) Shift automatic transmission into Park.

(3) Shift transfer case into Neutral position.

Rear Towing—Rear End Raised

Part Time Transfer Case—Manual Transmission

Do not exceed a towing speed of 30 mph (48 km/h) and do not exceed a towing distance of 15 miles (24 km).

If ignition key is available, turn ignition to Off position to unlock steering column. Clamp the steering wheel in the straight-ahead position. Do not use steering column lock as a substitute for a clamping device. Shift transmission into gear and transfer case into Neutral. Turn selective drive hubs to 4 x 4/LOCK position.

If ignition key is not available, place front wheels on a dolly.

Part Time Transfer Case—Automatic Transmission

Do not exceed a towing speed of 30 mph (48 km/h) and do not exceed a towing distance of 15 miles (24 km).

If ignition key is available, turn ignition to Off position to unlock steering column. Clamp the steering wheel in the straight-ahead position. Do not use steering column lock as a substitute for a clamping device. Shift transmission into Park and transfer case into Neutral. Turn selective drive hubs to 4 x 4/LOCK position.

If ignition key is not available, place front wheels on a dolly.

Quadra-Trac—Automatic Transmission

Do not exceed a towing speed of 30 mph (48 km/h) and do not exceed a towing distance of 15 miles (24 km).

If ignition key is available, turn ignition to Off position to unlock steering column. Clamp steering wheel in the straight-ahead position. Do not use steering column lock as a substitute for a clamping device. Shift transmission into Park and transfer case into Neutral.

If ignition switch is not available, place front wheels on a dolly.

Safety Precautions

- Whenever possible, tow the vehicle from the rear to prevent damage to the transmission or rear axle.
- Secure loose or protruding parts of a damaged vehicle.
- The end of the vehicle being towed should be lifted a minimum of four inches off the ground. Check opposite end for adequate ground clearance.
- Always use a safety chain system that is independent of the lifting and towing attachment.
- Do not allow any of the towing equipment to bear on the fuel tank.
- Do not go under the vehicle while it is lifted by the towing equipment.
- Do not allow passengers to ride in a towed vehicle.
- Always observe all state and local laws regarding such items as warning signals, night illumination, speed, etc.
- Do not attempt a towing operation which could jeopardize the operator, any bystanders or other motorists.

CJ Models

Front (Refer to Figure A-13)

(1) Attach J-hooks over axle outboard of springs.

(2) Place towbar under spring shackles.

(3) Attach safety chains around spring shackles.

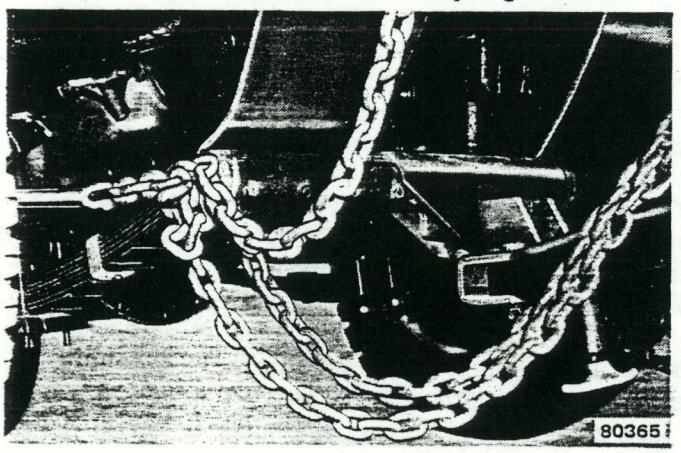

Fig. A-13 Front Towing—CJ Models

Rear (Refer to Figure A-14)

(1) Attach J-hooks around axle outboard of springs.

(2) Place towbar under bumper plate.

(3) Attach safety chains around spring shackles.

CAUTION: *To prevent damage to drive line members shift the transmission and transfer case into the correct position as outlined in the general towing instructions.*

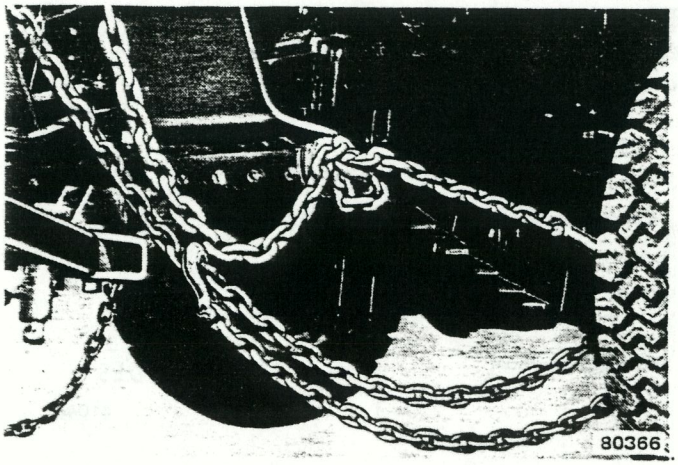

Fig. A-14 Rear Towing—CJ Models

Cherokee and Wagoneer Models

Front (Refer to Figure A-15)

(1) Attach J-hooks around axle outboard of shock absorbers.
(2) Place towbar under spring shackles.
(3) Attach safety chains around spring shackles.

CAUTION: *To prevent damage to drive line members, shift the transmission and transfer case into the correct position as outlined in the general towing instructions.*

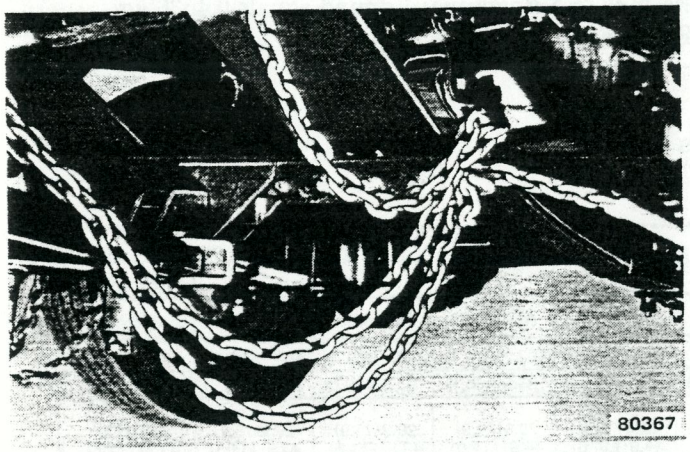

Fig. A-15 Front Towing—Cherokee and Wagoneer Models

Rear (Refer to Figure A-16)

(1) Attach J-hooks around axle outboard of shock absorber brackets.
(2) Place towbar under bumper.
(3) Attach safety chains around frame rails.

CAUTION: *To prevent damage to drive line members, shift the transmission and transfer case into the correct position as outlined in the general towing instructions.*

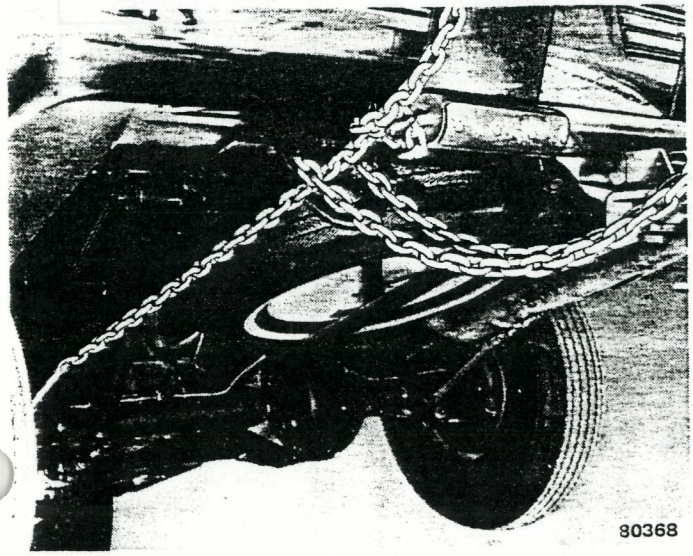

Fig. A-16 Rear Towing—Cherokee and Wagoneer Models

Truck Models

Front (Refer to Figure A-17)

(1) Attach J-hooks around axle outboard of shock absorbers.
(2) Place towbar under spring shackles.
(3) Attach safety chains around spring shackles.

CAUTION: *To prevent damage to drive line members, shift the transmission and transfer case into the correct position as outlined in the general towing instructions.*

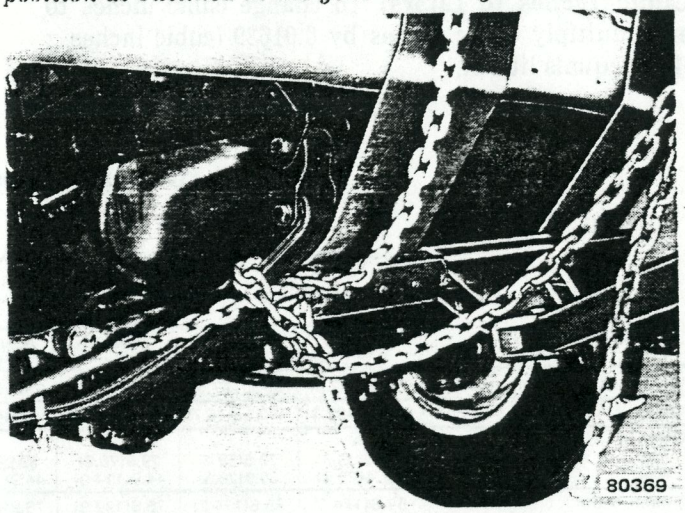

Fig. A-17 Front Towing—Truck Models

Rear (Refer to Figure A-18)

(1) Attach J-hooks around axle outboard of shock absorbers.
(2) Place towbar under frame cross rail.
(3) Attach safety chains around spring shackles.

CAUTION: *To prevent damage to drive line members, shift the transmission and transfer case into the correct position as outlined in the general towing instructions.*

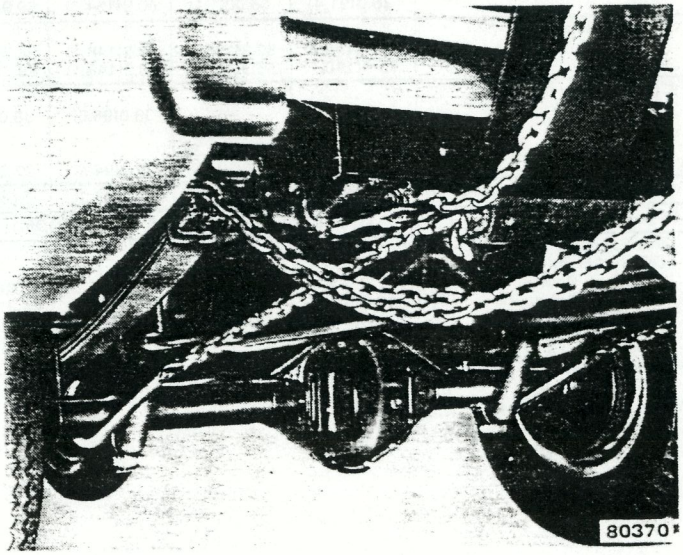

Fig. A-18 Rear Towing—Truck Models

CONVERSION OF ENGLISH AND METRIC MEASURES

Cubic Centimeters to Inches: To change cubic centimeters to cubic inches, multiply cubic centimeters by 0.061 (cc x 0.061 equals cubic inch).

Cubic Inches to Centimeters: To change cubic inches to cubic centimeters, multiply cubic inches by 16.39 (cubic inch x 16.39 equals cc).

Liters to Cubic Inches: To change liters to cubic inches, multiply liters by 61.02 (liter x 61.02 equals cubic inches).

Cubic Inches to Liters: To change cubic inches to liters, multiply cubic inches by 0.01639 (cubic inches x 0.01639 equals liters).

Cubic Centimeters to Liters: To change centimeters to liters, divide by 1000 (simply move the decimal point three figures to the left).

Liters to Cubic Centimeters: To change liters to cubic centimeters, move the decimal point three figures to the right.

Miles to Kilometers: To change miles to kilometers, multiply miles by 1.609 (miles x 1.609 equals kilometers).

Kilometers to Miles: To change kilometers to miles, multiply kilometers by 0.6214 (kilometers x 0.6214 equals miles).

Pounds to Kilograms: 1 pound equals 0.4536 kg.

Kilograms to Pounds: 1 kg equals 2.2046 pounds.

General Dimensions (Inches)

	CJ Models		Cherokee Models			Wagoneer Models	Truck Models		
							J-10 Series		J-20 Series
	CJ-5	CJ-7	Model 16 2-Dr.	Model 17 2-Dr.	Model 18 4-Dr.	Model 15	Model 25	Model 26	Model 27
Wheelbase	83.5(212.0)	93.5(237.5)	108.7(276.1)	108.7(276.1)	108.7(276.1)	108.7(276.1)	118.7(301.5)	130.7(332.0)	130.7(332.0)
Overall Length	138.4(402.3)	147.9(375.7)	183.5(466.1)	183.5(466.1)	183.5(466.1)	183.5(466.1)	192.5(489.0)	204.5(519.4)	204.5(519.4)
Overhang									
Front	23.5(59.7)	23.5(59.7)	29.9(75.9)	29.9(75.9)	29.9(75.9)	29.9(75.9)	29.9(75.9)	29.9(75.9)	29.9(75.9)
Rear	31.4(79.8)	30.9(78.5)	44.9(114.0)	44.9(114.0)	44.9(114.0)	44.9(114.0)	43.9(111.5)	43.9(111.5)	43.9(111.5)
Overall Width	68.6(174.2)	68.6(174.2)	75.6(192.0)	78.9(200.4)	75.6(192.0)	75.6(192.0)	78.9(200.4)	78.9(200.4)	78.9(200.4)
Overall Height	–	–	66.9(169.9)	67.6(171.7)	66.9(169.9)	66.7(169.4)	69.3(176.0)	69.1(175.5)	70.7(179.6)
Open Body	67.6(171.7)	67.6(171.7)	–	–	–	–	–	–	–
Soft Top	71.4(181.4)	71.3(181.1)	–	–	–	–	–	–	–
Hard Top	71.3(181.1)	70.5(179.1)	–	–	–	–	–	–	–
Step Height									
Front	27.0(68.6)	26.1(66.3)	19.9(50.5)	20.7(52.6)	19.9(50.5)	19.9(50.5)	20.7(52.6)	20.7(52.6)	22.1(56.1)
Rear	–	–	–	–	20.8(52.8)	20.8(52.8)	–	–	–
Front Tread	51.5(130.8)	51.5(130.8)	59.4(150.9)	65.4(166.1)	59.4(150.9)	59.4(150.9)	63.3(160.8)	63.3(160.8)	64.6(164.1)
Rear Tread	50.0(127.0)	50.0(127.0)	57.8(146.8)	62.3(158.2)	57.8(146.8)	57.8(146.8)	63.8(162.1)	63.8(162.1)	65.9(167.4)
Minimum Ground Clearance	6.9(17.5)	6.9(17.5)	7.7(19.6)	8.6(21.8)	7.7(19.6)	7.7(19.6)	7.7(19.6)	7.7(19.6)	8.1(20.6)
Min. Turning Diameter-feet(m)	33.5(10.2)	35.9(10.9)	37.7(11.5)	39.4(12.0)	37.7(11.5)	37.7(11.5)	40.6(12.4)	44.5(13.6)	44.5(13.6)
Effective Leg Room									
Front (Accelerator)	37.9(96.3)	39.1(99.3)	41.6(105.7)	4.16(105.7)	41.6(105.7)	41.6(105.7)	41.6(105.7)	41.6(105.7)	41.6(105.7)
Rear (Minimum)	30.5(77.5)	35.0(88.9)	37.0(94.0)	37.0(94.0)	37.0(94.0)	37.0(94.0)	–	–	–
Hip Room									
Front	55.4(140.7)	53.8(136.7)	60.5(153.7)	60.5(153.7)	60.5(153.7)	60.5(153.7)	60.5(153.7)	60.5(153.7)	60.5(153.7)
Rear	36.0(91.4)	36.0(91.4)	60.9(154.7)	60.9(154.7)	60.9(154.7)	60.9(154.7)	–	–	–
Shoulder Room									
Front	55.4(140.7)	53.8(136.7)	58.3(148.1)	58.3(148.1)	58.3(148.1)	58.3(148.1)	58.3(148.1)	58.3(148.1)	58.3(148.1)
Rear	55.4(140.7)	56.3(143.0)	58.3(148.1)	58.3(148.1)	58.3(148.1)	58.3(148.1)	–	–	–
Effective Head Room									
Front	–	–	38.0(96.5)	38.0(96.5)	38.0(96.5)	38.0(96.5)	40.2(102.1)	40.2(102.1)	40.2(102.1)
Soft Top	39.8(101.1)	40.6(103.1)	–	–	–	–	–	–	–
Hard Top	40.8(103.6)	39.9(101.3)	–	–	–	–	–	–	–
Rear Hard Top	40.9(103.9)	39.6(100.6)	37.2(94.5)	37.2(94.5)	37.2(94.5)	37.2(94.5)	–	–	–
Cargo Floor Height	25.2(64.0)	25.1(63.8)	24.9(63.2)	25.6(65.0)	24.9(63.2)	24.7(62.7)	26.8(68.0)	26.4(67.0)	28.2(71.6)
Cargo Capacity-cubic feet ( )	10.2(288.8)*	13.6(385.1)*	95.1(2692.9)*	95.1(2692.9)*	95.1(2692.9)*	95.1(2692.9)*	67.0(1897.2)	76.6(2169.1)	76.6(2169.1)
Cargo Space									
Overall Length	–	–	–	–	–	–	86.5(219.7)	98.5(250.2)	98.5(250.2)
Length at Floor	40.2(102.1)	46.8(118.9)	81.6(207.3)	81.6(207.3)	81.6(207.3)	81.6(207.3)	83.6(212.3)	95.6(242.8)	95.6(242.8)
Width at Wheelhouse	36.0(91.4)	36.0(91.4)	44.3(112.5)	44.3(112.5)	44.3(112.5)	44.3(112.5)	50.0(127.0)	50.0(127.0)	50.0(127.0)
Width at Floor	36.0(91.4)	36.0(91.4)	60.9(154.7)	60.9(154.7)	60.9(154.7)	60.9(154.7)	68.0(172.7)	68.0(172.7)	68.0(172.7)
Width of Tailgate Opening	35.8(90.9)	34.5(87.6)	54.9(139.4)	54.9(139.4)	54.9(139.4)	54.9(139.4)	57.2(145.3)	57.2(145.3)	57.2(145.3)
Height of Sides and Tailgate	–	–	–	–	–	–	20.5(52.1)	20.5(52.1)	20.5(52.1)

*With rear seat removed.

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Metric System-SI

The International System of Units (Systeme International d'Unites) officially abbreviated "SI" in all languages – the modern metric system

QUANTITY	EXAMPLES OF APPLICATIONS	METRIC UNIT	SYMBOL
Length	Dimensions Tire rolling circumference Turning circle/ radius Braking distance	meter	m
	Greater than 999 meter	kilometer	km
	Dimensions	millimeter	mm
	Depth of surface finish	micrometer	um
Area	Glass & Fabrics Brake & Clutch linings Radiator area etc.	square centimeter	cm^2
	Small areas	square millimeter	mm^2
Volume	Car Luggage Capacity	cubic meter	m^3
	Engine Capacity	liter	l
	Vehicle fluid capacity	cubic centimeter	cm^3
Volume Flow	Gas & Liquid	liter per second	l/s
Time Interval	Measurement of elapsed time	second minute hour day	s min h d
Velocity	General use Road speed	meter per second kilometer per hour	m/s km/h
Acceleration & Deceleration	General use	meter per second squared	m/s^2
Frequency	Electronics	hertz kilohertz megahertz	Hz kHz mHz
Rotational Speed	General use	revolution per minute revolution per second	rpm rps
Mass	Vehicle mass Legal load rating	megagram	t
	General use Small masses	kilogram gram milligram	kg g mg
Density	General use	kilogram per cubic meter gram per cubic centimeter kilogram per liter	kg/m^3 g/cm^3 kg/l
Force	Pedal effort Clutch spring force Handbrake lever effort etc.	newton	N
Moment of Force (Torque)	Torque	newton meter	N-m
Power, Heat Flow Rate	General use Bulbs Alternator output Engine performance Starter performance	watt kilowatt	W kW

QUANTITY	EXAMPLES OF APPLICATIONS	METRIC UNIT	SYMBOL
Celsius Temperature	General use	degree Celsius	^oC
Thermodynamic Temperature	General use	kelvin	k
Electric Current	General use	ampere milliampere microampere	A mA µA
Potential Difference (Electromotive Force)	General use	kilovolt volt millivolt microvolt	kV V mV µV
Electric Resistance	General use	megohm kilohm ohm	MΩ kΩ Ω
Electric Capacitance	General use	farad microfarad picofarad	F µF pF
Fuel Consumption	Vehicle performance	liter per 100 kilometer	l/100 km
Oil Consumption	Vehicle performance	liter per 1000 kilometer	l/1000 km
Stiffness	Linear stiffness	kilonewton meter	kN/m
Tire Revolutions	Tire Data	revolution per kilometer	rev/km
Pressure	Tire Coolant Lubricating oil Fuel pump delivery Engine compression Manifold Brake line (hydraulic) Car heating & ventilation Barometric pressure	kilopascal	kPa
Luminous Intensity	Bulbs	candela	cd
Accumulator Storage Rating	Battery	ampere hour	A-h

U.S.A./METRIC COMPARISON

QUANTITY	USA	METRIC – SYMBOL	
Length	Inch-Foot-Mile	Meter	m
Weight (mass)	Ounce-Pound	Kilogram	Kg
Area	Square inch/Foot	Square Meter	m^2
Volume-Dry	Cubic inch/Foot	Cubic Meter	m^3
-Liquid	Ounce-Pint-Quart-Gallon	Liter	l
Velocity	Feet Per Second	Meter per Second	m/s
Road Speed	Miles Per Hour	Kilometer per Hour	km/h
Force	Pound-Force	Newton	N
Torque	Foot-Pounds	Newton meter	N-m
Power	Horsepower	Kilowatt	kW
Pressure	Pounds Per Square Inch	Kilopascal	kPa
Temperature	Degrees Fahrenheit	Degrees Kelvin and Celsius	K ^oC

Power Train Combinations—1981 CJ Models

Series	GVRW	Engine	Transmission			Transfer Case		Clutch (in.)	Axle Ratio		Trac-Lok	Axle Model		Brakes (in.)		Standard Wheels
			SR-4	T-176	A	300	QT		S	O		Front	Rear	Front	Rear	
CJ-7 Model 87 93.5 Inch Wheelbase	Open Body 3750 W/EDS. 4/50 (1)	4-151-2V	S		NA	S	NA	9.250	3.73		O	Dana 30 Open End	AMC/ Jeep	11.7 Inch Dics. Std.	11 x 2 Drum	15 x 6 5 Bolt 5.50 B.C.
		6-258-2V	S	S	NA	S	NA	10.50	2.73	3.31						
		8-304-2V		S	NA	S	NA	10.50	2.73	3.31						
CJ-5 Model 85 83.5 Inch Wheelbase	Open Body 3750 W/EDS. 4/50 (1)	4-141-2V	S		904	S	NA	9.250	3.73		O	Dana 30 Open End	AMC/ Jeep	11.7 Inch Dics. Std.	11 x 2 Drum	15 x 6 5 Bolt 5.50 B.C.
		6-258-2V	S	S	999	S	NA	10.50	2.73	3.31						
		8-304-2V		S	999	S	NA	10.50	2.73	3.31						

Notes:

(1) With Extra Duty Suspension

Abbreviations:

B.C. - Bolt Circle
GVWR - Gross Vehicle Weight Rating
O - Optional Equipment
QT - Quadra-Trac
S - Standard Equipment

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Power Train Combinations—1981 Cherokee-Wagoneer-Truck Models

Series	GVWR	Engine	Transmission			Transfer Case		Clutch (in.)	Axle Ratio (2)			Trac-Lok (3)	Axle Model		Brakes		Standard Wheels
			176 4M	T-18 4M	727 Auto.	208	QT		2.73	3.31	3.73		Front	Rear	Front	Rear	
Cherokee Models 16, 17 & 18 168.7 Inch Wheelbase	6200	6-258-2V (1)	S(1)			S(1)		11.0		S		O	Dana Open End	AMC/ Jeep	12 Inch Disc	11 x 2 Drum	15 x 6 6 Bolt 5.5 B.C. Models 16-18
					O(1)		O(1)										
		8-360-2V	S(1)			S(1)		11.0(1)		S*		O					15 x 8 6 Bolt 5.5 B.C. Model 17
					O		O		S(5)(6)	S(4)** O(5)(6)							
Wagoneer Model 15 109 Inch Wheelbase	6200	6-258-2V (1)	O(1)			O(1)		11.0	S	O		O	Dana Open End	AMC/ Jeep	12 Inch Disc	11.2 Drum	15 x 6 6 Bolt 5.5 B.C.
					S(1)		S(1)										
		8-360-2V	O(1)			O(1)		11.0									
					S		S										
J-10 Truck Mod.24&25 119 Inch Wheelbase Model 26 131 Inch Wheelbase	6200	6-258-2V (1)	S(1)			S(1)		11.0	S(5)(6)	S(4) O(5)(6)		O	Dana Open End	AMC/ Jeep	12 Inch Disc	11 x 2 Drum	15 x 6 6 Bolt 5.5 B.C.
					O(1)		O(1)										
		8-360-2V	S(1)			S(1)		11.0	S(5)(6)	S(4) O(5)(6)		O					
					O		O										
J-20 Truck Model 27 130.7 Inch Wheelbase	6800 (Std.) 7600 (Opt.) 8400 (Opt.)	8-360-2V		S(1)		S(1)		11.0			S	O	Dana Open End	Dana 60	12.5 Inch Disc.	12 x 2.50 Drum	16.5 x 6 8 Bolt 6.5 B.C.
					O		O										

Notes:

(1) NA California
(2) Trac-Lok available with all ratios.
(3) NA with QT
(4) Manual Transmission/Part-Time Transfer Case
(5) Automatic Transmission/Part-Time Transfer Case
(6) Automatic Transmission/Quadra-Trac

Abbreviations:

B.C. - Bolt Circle
GVWR - Gross Vehicle Weight Rating
NA - Not Available
O - Optional Equipment
S - Standard Equipment

*Model 17
**Models 16 and 18

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Decimal Equivalents

Milli-meter	Decimal	Fraction	Drill Size
.1	.0039		
.15	.0059		
.2	.0079		
.25	.0098		
.3	.0118		
	.0135		80
.35	.0138		
	.0145		79
.39	.0156	1/64	
.4	.0157		
	.0160		78
.45	.0177		
	.0180		77
.5	.0197		
	.0200		76
	.0210		75
.55	.0217		
	.0225		74
.6	.0236		
	.0240		73
	.0250		72
.65	.0256		
	.0260		71
	.0280		70
.7	.0276		
	.0292		69
.75	.0295		
	.0310		68
.79	.0312	1/32	
.8	.0315		
	.0320		67
	.0330		66
.85	.0335		
	.0350		65
.9	.0354		
	.0360		64
	.0370		63
.95	.0374		
	.0380		62
	.0390		61
1.0	.0394		
	.0400		60
	.0410		59
1.05	.0413		
	.0420		58
	.0430		57
1.1	.0433		
1.15	.0452		
	.0465		56
1.19	.0469	3/64	
1.2	.0472		
1.25	.0492		
1.3	.0512		
	.0520		55
1.35	.0531		
	.0550		54
1.4	.0551		
1.45	.0570		
1.5	.0591		
	.0595		53
1.55	.0610		
1.59	.0625	1/16	
1.6	.0629		
	.0635		52
1.65	.0649		
1.7	.0669		
	.0670		51
1.75	.0689		
	.0700		50
1.8	.0709		
1.85	.0728		
	.0730		49
1.9	.0748		
	.0760		48
1.95	.0767		
1.98	.0781	5/64	
	.0785		47
2.0	.0787		
2.05	.0807		
	.0810		46
	.0820		45
2.1	.0827		
2.15	.0846		
	.0860		44
2.2	.0866		
2.25	.0885		
	.0890		43
2.3	.0905		
2.35	.0925		
	.0935		42
2.38	.0937	3/32	
2.4	.0945		
	.0960		41
2.45	.0964		
	.0980		40
2.5	.0984		
	.0995		39
	.1015		38
2.6	.1024		
	.1040		37
2.7	.1063		
	.1065		36
2.75	.1082		
2.78	.1094	7/64	
	.1100		35
2.8	.1102		
	.1110		34
	.1130		33
2.9	.1141		
	.1160		32
3.0	.1181		
	.1200		31
3.1	.1220		
3.18	.1250	1/8	
3.2	.1260		
3.25	.1279		
	.1285		30
3.3	.1299		
3.4	.1338		
	.1360		29
3.5	.1378		
	.1405		28
3.57	.1406	9/64	
3.6	.1417		
	.1440		27
3.7	.1457		
	.1470		26
3.75	.1476		
	.1495		25
3.8	.1496		
	.1520		24
3.9	.1535		
	.1540		23
3.97	.1562	5/32	
	.1570		22
4.0	.1575		
	.1590		21
	.1610		20
4.1	.1614		
4.2	.1654		
	.1660		19
4.25	.1673		
4.3	.1693		
	.1695		18
4.37	.1719	11/64	
	.1730		17
4.4	.1732		
	.1770		16
4.5	.1771		
	.1800		15
4.6	.1811		
	.1820		14
4.7	.1850		13
4.75	.1870		
4.76	.1875	3/16	
4.8	.1890		12
	.1910		11
4.9	.1929		
	.1935		10
	.1960		9
5.0	.1968		
	.1990		8
5.1	.2008		
	.2010		7
5.16	.2031	13/64	
	.2040		6
5.2	.2047		
	.2055		5
5.25	.2067		
5.3	.2086		
	.2090		4
5.4	.2126		
	.2130		3
5.5	.2165		
5.56	.2187	7/32	
5.6	.2205		
	.2210		2
5.7	.2244		
5.75	.2263		
	.2280		1
5.8	.2283		
5.9	.2323		
	.2340		A
5.95	.2344	15/64	
6.0	.2362		
	.2380		B
6.1	.2401		
	.2420		C
6.2	.2441		
6.25	.2460		D
6.3	.2480		
6.35	.2500	1/4	E
6.4	.2520		
6.5	.2559		
	.2570		F
6.6	.2598		
	.2610		G
6.7	.2638		
6.75	.2657	17/64	
6.75	.2657		
	.2660		H
6.8	.2677		
6.9	.2716		
	.2720		I
7.0	.2756		
	.2770		J
7.1	.2795		
	.2811		K
7.14	.2812	9/32	
7.2	.2835		
7.25	.2854		
7.3	.2874		
	.2900		L
7.4	.2913		
	.2950		M
7.5	.2953		
7.54	.2968	19/64	
7.6	.2992		
	.3020		N
7.7	.3031		
7.75	.3051		
7.8	.3071		
7.9	.3110		
7.94	.3125	5/16	
8.0	.3150		
	.3160		O
8.1	.3189		
8.2	.3228		
	.3230		P
8.25	.3248		
8.3	.3268		
8.33	.3281	21/64	
8.4	.3307		
	.3320		Q
8.5	.3346		
8.6	.3386		
	.3390		R
8.7	.3425		
8.73	.3437	11/32	
8.75	.3445		
8.8	.3465		
	.3480		S
8.9	.3504		
9.0	.3543		
	.3580		T
9.1	.3583		
9.13	.3594	23/64	
9.2	.3622		
9.25	.3641		
9.3	.3661		
	.3680		U
9.4	.3701		
9.5	.3740		
9.53	.3750	3/8	
	.3770		V
9.6	.3780		
9.7	.3819		
9.75	.3838		
9.8	.3858		
	.3860		W
9.9	.3898		
9.92	.3906	25/64	
10.0	.3937		
	.3970		X
	.4040		Y
10.32	.4062	13/32	
	.4130		Z
10.5	.4134		
10.72	.4219	27/64	
11.0	.4330		
11.11	.4375	7/16	
11.5	.4528		
11.51	.4531	29/64	
11.91	.4687	15/32	
12.0	.4724		
12.30	.4843	31/64	
12.5	.4921		
12.7	.5000	1/2	
13.0	.5118		
13.10	.5156	33/64	
13.49	.5312	17/32	
13.5	.5315		
13.89	.5469	35/64	
14.0	.5512		
14.29	.5625	9/16	
14.5	.5709		
14.68	.5781	37/64	
15.0	.5906		
15.08	.5937	19/32	
15.48	.6094	39/64	
15.5	.6102		
15.88	.6250	5/8	
16.0	.6299		
16.27	.6406	41/64	
16.5	.6496		
16.67	.6562	21/32	
17.0	.6693		
17.06	.6719	43/64	
17.46	.6875	11/16	
17.5	.6890		
17.86	.7031	45/64	
18.0	.7087		
18.26	.7187	23/32	
18.5	.7283		
18.65	.7344	47/64	
19.0	.7480		
19.05	.7500	3/4	
19.45	.7656	49/64	
19.5	.7677		
19.84	.7812	25/32	
20.0	.7874		
20.24	.7969	51/64	
20.5	.8071		
20.64	.8125	13/16	
21.0	.8268		
21.03	.8281	53/64	
21.43	.8437	27/32	
21.5	.8465		
21.83	.8594	55/64	
22.0	.8661		
22.23	.8750	7/8	
22.5	.8858		
22.62	.8906	57/64	
23.0	.9055		
23.02	.9062	29/32	
23.42	.9219	59/64	
23.5	.9252		
23.81	.9375	15/16	
24.0	.9449		
24.21	.9531	61/64	
24.5	.9646		
24.61	.9687	31/32	
25.0	.9843		
25.03	.9844	63/64	
25.4	1.0000	1	

NOTES

MAINTENANCE B

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GENERAL

This section describes the service procedures required to keep Jeep vehicles in good running condition. These services are based on changes in driving conditions, accumulated odometer mileage or time intervals (whichever comes first), or are unscheduled as required by changes in usage, handling or performance. The section is divided into three parts: (1) Maintenance Schedule, (2) Description of Services according to components (listed alphabetically), (3) Unscheduled Maintenance.

Maintenance Schedule

Two maintenance schedules are listed: one for Engine Maintenance; one for Chassis Maintenance (including body).

The services listed are those which experience and testing have indicated are most likely needed at the time or distance intervals shown.

Perform the maintenance services as indicated in the **Engine Maintenance Schedule** and the **Chassis Maintenance Schedule**. The schedule tells you the component and required service, followed by the time and/or distance interval (mileage) at which the service should be performed, under both normal and heavy-duty operation.

For example:

Miles (Thousands)	Each Fuel Fill	5	12.5	20
Kilometers (Thousands)		8	20	32
Months		5	12.5	20
1) Check Engine Oil	•			
2) Change Engine Oil		•	•	•

Number 1 tells you that the engine oil level should be checked at each fuel fill. Number 2 tells you to change the engine oil every five months or 5,000 miles (8 000 km), whichever comes first, **under normal use**. The numbers appearing to the left of each component correspond with those on the **Engine and Chassis Illustrations** (figs. B-1, B-2, B-3 and B-4).

Fuel Requirements

U.S. Models

All engines require the use of unleaded fuel to reduce exhaust emissions, and to protect the catalytic converters. Use a fuel with an antiknock index (AKI) of at least 87. A lower octane AKI is acceptable at elevations above 1,500 feet (450 meters).

Canadian Models

1981 Jeep model J-20 Truck vehicles only, sold in Canada, are equipped with a catalytic converter and must operate on unleaded fuel only. All Jeep CJ, Cherokee, Wagoneer and J-10 Truck models sold in Canada are designed to operate on regular, low-lead, or unleaded fuel. Select a fuel with a Research Octane Number of at least 91 and a Motor Octane Number of at least 83 (Antiknock Index of at least 87).

Owner's Responsibility

It is the owner's responsibility to determine driving conditions (normal or heavy-duty operation), to have the vehicle serviced according to the **Maintenance Schedule**, and to pay for the necessary parts and labor.

CAUTION: *Failure to perform maintenance services at the proper intervals as outlined in the Maintenance Schedule constitutes negligence and may void provisions of the new-vehicle warranty.*

Heavy-Duty Operation

Heavy-duty operation consists of off-road or dusty conditions for over thirty percent of use, commercial

load-carrying or delivery, snow plowing, pulling trailers weighing over 2,000 pounds (900 kg) loaded, or extended engine idling during normal use. If your vehicle is used in heavy-duty operation, perform the service listed in the **Engine Maintenance Schedule** and the **Chassis Maintenance Schedule** according to the intervals designated under heavy-duty. (If no heavy-duty service is indicated for a particular component, perform the service at the normal time and/or distance interval noted.)

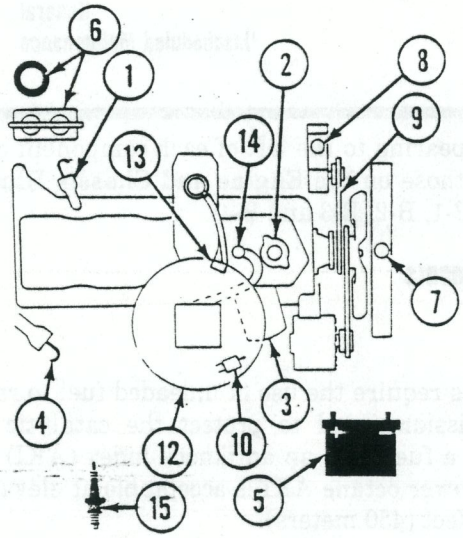
CAUTION: *Immediately after extended operation in sand, mud or water, thoroughly clean brakelinings, brakedrums and front axle U-joints and yokes, to prevent undue wear and unnecessary part failure.*

CAUTION: *If the vehicle is driven through water deep enough to cover the hubs, the wheel ends and axle differentials should be disassembled and inspected for water damage or contamination.*

After First 200 Miles (300 km)

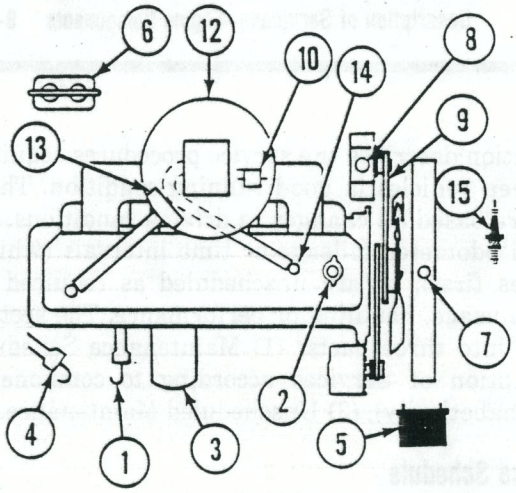
Check and retighten wheel nuts securely, if necessary. Tighten CJ models to 80 foot-pounds (108 N•m) torque, Cherokee, Wagoneer and J-10 Truck models to 75 foot-pounds (102 N•m) torque. Tighten J-20 (6800, 7600, 8400 GVWR) Truck to 130 foot-pounds (176 N•m) torque.

1981 JEEP MAINTENANCE SCHEDULE



(11) NOT APPLICABLE

Fig. B-1 Four-Cylinder Engine



(11) NOT APPLICABLE

Fig. B-2 Six-Cylinder Engine

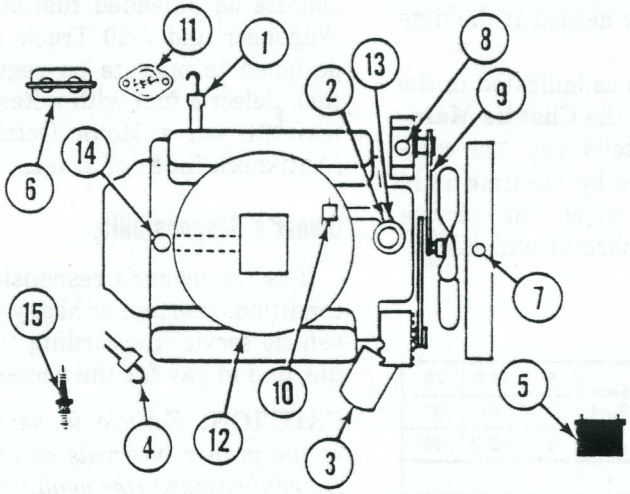


Fig. B-3 Eight-Cylinder Engine

1981 JEEP ENGINE MAINTENANCE SCHEDULE

Miles (Thousands) / Kilometers (Thousands) / Months	Each Fuel Fill	5 / 8 / 5	12.5 / 20 / 12.5	20 / 32 / 20	27.5 / 44 / 27.5	30 / 48 / 30	35 / 56 / 35	42.5 / 68 / 42.5	50 / 80 / 50
1) Check Engine Oil	●								
2) Change Engine Oil		●	●	●	●		●	●	●
3) Change Engine Oil Filter (6 and 8 Cylinder)		●	●	●	●		●	●	●
3) Change Engine Oil Filter (4 Cylinder)		●	◆	●	◆		●	◆	●
4) Check Automatic Transmission Fluid		●	●	●	●		●	●	●
5) Check Battery		●	●	●	●		●	●	●
6) Check Brake Master Cylinder Fluid Level		●	●	●	●		●	●	●
6) Check Hydraulic Clutch Reservoir (4 Cylinder Manual Transmission)		●	●	●	●		●	●	●
7) Check Coolant Level		●	●	●	●		●	●	●
7) Drain, Flush and Change Coolant ①			●						
8) Check Power Steering Pump Fluid Level		●	●	●	●		●	●	●
9) Check Drive Belt Tension (California)		◆				●		◆	
9) Check Drive Belt Tension (49 State)		●				●		●	
10) Fuel Filter (California)			◆		◆			◆	
10) Fuel Filter (49 State)			●		●			●	
11) Lubricate Exhaust Heat Valve (8 Cylinder Only)						●			
12) Replace Air Cleaner Filter ②						●			
13) Replace PCV Filter (4 Cylinder)						●			
13) Clean PCV Filter (6 and 8 Cylinder) ③						●			
14) Replace PCV Valve (California)						◆			
14) Replace PCV Valve (49 State)						●			
14) Check PCV Hoses and Connections (California)						◆			
14) Check PCV Hoses and Connections (49 State 6 and 8 Cylinder)						●			
14) Check PCV Hoses and Connections (49 State 4 Cylinder)			●		●			●	
15) Tune-Up									
Check and Adjust Curb and Fast Idle Speed (California)		●				◆			
Check and Adjust Curb and Fast Idle Speed (49 State 6 Cylinder)		●				◆			
Check and Adjust Curb and Fast Idle Speed (49 State 4 and 8 Cylinder)		●				●			
Check Distributor Vacuum and Centrifugal Advance Mechanism (49 State 6 Cylinder and All California)						◆			
Check Distributor Vacuum and Centrifugal Advance Mechanism (49 State 8 Cylinder)						●			
Check Distributor Vacuum and Centrifugal Advance Mechanism (49 State 4 Cylinder)			●		●			●	
Check Distributor Cap and Rotor (California)						◆			
Check Distributor Cap and Rotor (49 State)						●			
Check and Adjust Carburetor Mounting Bolts (4 Cylinder)		●							
Clean Choke System (49 State)		●			●			●	
Clean Choke System (California)						●			
Check TAC Control System (49 State 6 and 8 Cylinder)						●			
Check TAC Control System (California)						◆			
Check TAC Control System (49 State 4 Cylinder)		●			●				
Check Fuel System Filler Cap, Tank, Lines, Hoses and Connections			●		●			●	
Check Air System Hoses (8 Cylinder)						●			
Check Vacuum Fittings, Hoses and Connections						◆			
Check Exhaust System		●	●	●	●		●	●	●
Check Coil and Spark Plug Wires			◆		◆			◆	
Check Ignition Timing (California)						◆			
Check Ignition Timing (49 State 4 and 6 Cylinder)						●			
Check Ignition Timing (49 State 8 Cylinder)			●		●			●	
Replace Spark Plugs						●			
Replace Oxygen Sensor (California 4 Cylinder)						●			
Reset Oxygen Sensor Signal (California 4 Cylinder)						●			
Inspect and Lubricate Exhaust Manifold Heat Valve (8 Cylinder)						●			
Replace Charcoal Canister Air Inlet Filter (49 State 4 and 8 Cylinder)						●			

● - Required ◆ - Recommended, But Not Required

① Change engine coolant at 12,500 miles or 12-1/2 months, whichever comes first, then at the start of each winter season. Maintain a 50/50 mixture of coolant and water (−34°F/−36°C freezing point) for corrosion protection during summer.

② Replace air cleaner element once in between each normally scheduled change when driving under predominantly dusty conditions.

③ On 4- and 6-cylinder models, clean PCV filter in air cleaner assembly. On 8-cylinder models, clean PCV filter in oil filler cap.

1981 JEEP CHASSIS MAINTENANCE SCHEDULE

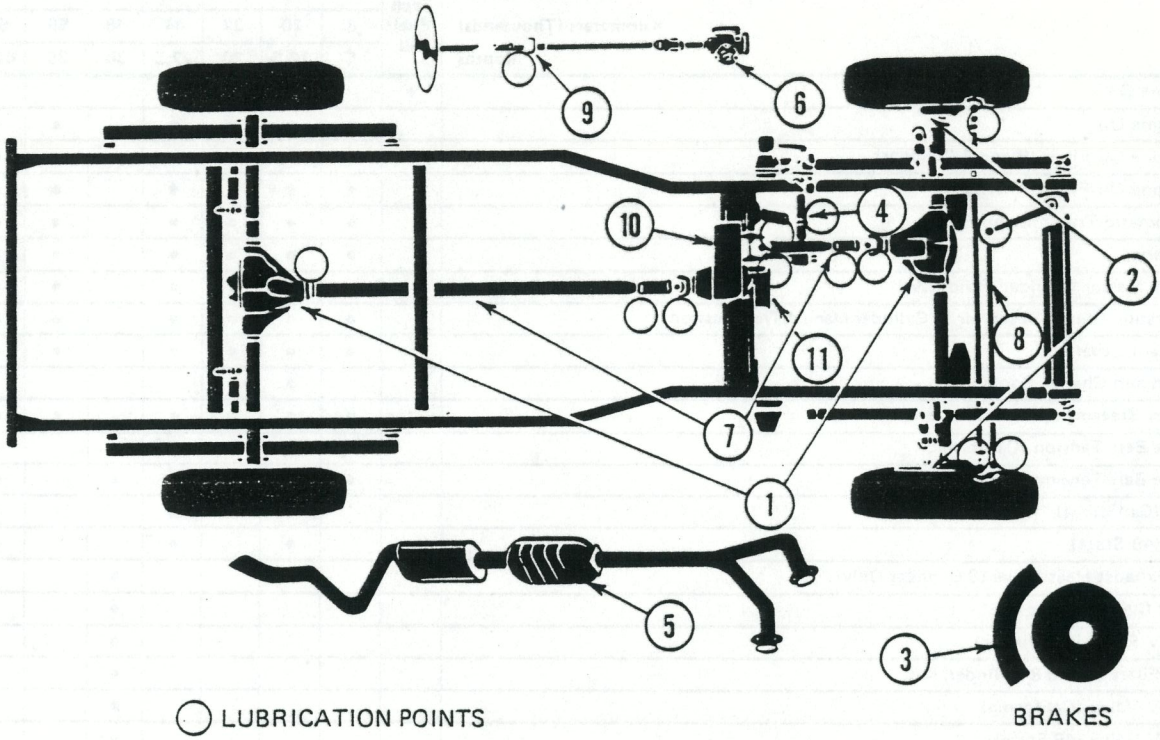


Fig. B-4 Chassis Illustration

Perform the maintenance services at the intervals shown. The symbol tells you what service is required, followed by the time and/or distance interval. For example: Front Wheel Bearings (Number 2) should be lubricated every 30,000 miles (48 000 km) under normal use, and every 15,000 miles (24 000 km) under heavy-duty operation. (The footnotes provide additional information about certain components and services.)

1981 JEEP CHASSIS MAINTENANCE SCHEDULE

Miles (Thousands)	Each Fuel Fill	3	5	6	7.5	9	10	12	15	18	20	21	22.5	24	25	27	30	33	35	36	37.5	39	40	42	45	48	50	51
Kilometers (Thousands)		5	8	10	12	14	16	19	24	29	32	34	36	38	40	43	48	53	56	58	60	62	64	67	72	77	80	82
Months		3	5	6	7.5	9	10	12	15	18	20	21	22.5	24	25	27	30	33	35	36	37.5	39	40	42	45	48	50	51
1) Check Axle Differentials (Front & Rear)		HO	•	HO		HO	•	HO	HO	HO	•	HO		HO	•	HO	HO	HO	•	HO		HO	•	HO	HO	HO	•	HO
1) Replace Axle Differential Fluid (Front & Rear)															•												•	
2) Lubricate Front Wheel Bearings④									HO								HO								HO			
2) Lubricate Manual Locking Hubs									HO								HO								HO			
3) Check Brakes & Chassis⑤			HO				HO		HO		HO				HO		HO		HO				HO		HO		HO	
3) Lubricate Body Components⑥			HO				HO		HO		HO				HO		HO		HO				HO		HO		HO	
4) Lubricate Clutch Lever & Linkage (CJ)		HO	•	HO		HO	•	HO	HO	HO	•	HO		HO	•	HO	HO	HO	•	HO		HO	•	HO	HO	HO	•	HO
4) Lubricate Clutch Lever & Linkage (Cherokee, Wagoneer, Truck)			HO				HO		HO		HO				HO		HO		HO				HO		HO		HO	
5) Inspect Exhaust System⑦			HO				HO		HO		HO				HO		HO		HO				HO		HO		HO	
6) Check Manual Steering Gear		HO	•	HO		HO	•	HO	HO	HO	•	HO		HO	•	HO	HO	HO	•	HO		HO	•	HO	HO	HO	•	HO
7) Lubricate Propeller Shafts (Front & Rear)(CJ)⑧		HO	•	HO		HO	•	HO	HO	HO	•	HO		HO	•	HO	HO	HO	•	HO		HO	•	HO	HO	HO	•	HO
7) Lubricate Propeller Shafts (Front & Rear) (Cherokee, Wagoneer, Truck)⑧			HO				HO		HO		HO				HO		HO		HO				HO		HO		HO	

1981 JEEP CHASSIS MAINTENANCE SCHEDULE (Continued)

8) Check and Lubricate Steering Linkage (CJ)[e]		HO	•	HO		HO	•	HO	HO	HO	•	HO		HO	•	HO	HO	HO	•	HO		HO	•	HO	HO	HO	•	HO
8) Check and Lubricate Steering Linkage (Cherokee, Wagoneer, Truck)[e]			HO				HO		HO		HO				HO		HO		HO				HO		HO		HO	
9) Lubricate Steering Shaft U-Joint			HO				HO		HO		HO				HO		HO		HO				HO		HO		HO	
10) Check Transfer Case Fluid		HO	•	HO		HO	•	HO	HO	HO	•	HO		HO	•	HO	HO	HO	•	HO		HO	•	HO	HO	HO	•	HO
10) Replace Transfer Case Fluid (Model 208 & Model 300)																	HO											
10) Replace Transfer Case Fluid (Quadra-Trac)[d]																	HO											
11) Check Manual Transmission Fluid		HO	•	HO		HO	•	HO	HO	HO	•	HO		HO	•	HO	HO	HO	•	HO		HO	•	HO	HO	HO	•	HO
11) Replace Manual Transmission Fluid																	HO											
11) Replace Automatic Transmission Fluid & Filter							HO				HO				•		HO						HO				HO	
12) Check Windshield Washer Fluid			•				•		•		•				•		•		•				•		•		•	

[a] Replace spindle oil and bearing seals on front wheel bearings (rear wheel bearings do not require periodic or scheduled lubrication).

[b] Check the following items as indicated. Correct to specifications as necessary: BRAKES—Front and rear brake linings for wear; rear brake self-adjusting mechanism for proper operation; master cylinder, calipers, wheel cylinders and differential warning valves for leaks; brake lines, fittings and hoses for condition and leaks; parking brake for proper operation; overall brake condition and action. STEERING/SUSPENSION—Manual or power steering gear and linkage for leaks, looseness or wear; springs, shock absorbers, steering damper and bushings for leaks, looseness or wear; tire condition; overall steering/suspension condition and action. BODY LUBRICATION—Lubricate the following items with the recommended lubricants: ashtray slides; courtesy light buttons; door, hood, liftgate, tailgate latches and hinges; front seat tracks; glove box door latch and hinge; locks; windshield hinges and holddown knobs (CJ only). ALSO—Adjust parking brake and manual transmission clutch free play, if necessary; adjust tire pressures to specifications; lubricate Model 300 transfer case linkage.

[c] Check exhaust system for leaks, damage, misalignment or grounding against body sheet metal or frame. Check catalytic converter for bulging or heat damage.

[d] Lubricate sleeve yokes (splines) and single and double cardan U-joints.

[e] Inspect and replace torn or ruptured grease seals, replace damaged steering components, and lubricate ball joints.

DESCRIPTION OF SERVICES—ENGINE COMPONENTS

1. Oil Check

Check engine oil level at each fuel fill. Add oil as necessary.

2. Oil Change

Change engine oil after the first 5,000 miles (8 000 km) and every 5,000 miles (8 000 km) thereafter. As periods for oil changes are affected by a variety of conditions, no single mileage figure applies for all types of driving.

Five-thousand miles (8 000 km) is the maximum amount of miles that should elapse between changes; more frequent changes are beneficial, and for this reason, oil should be changed every five months even though 5,000 miles (8 000 km) may not have elapsed on the vehicle odometer.

Drain crankcase only after engine has reached normal operating temperature to ensure complete drainage of used oil.

For maximum engine protection under all driving conditions, fill crankcase only with engine oil meeting API Engine Oil Service Classification "SE." These letters must appear on the oil container singly or in combination with other letters. SE engine oils protect against oil oxidation, high-temperature engine deposits, rust and corrosion.

Single viscosity or multi-viscosity oils are equally acceptable. Oil viscosity number, however, should be determined by the lowest anticipated temperature before the next oil change.

Engine Oil Viscosity

Lowest Temperature Anticipated	Recommended Single Viscosity	Recommended Multi-Viscosity
Above +40°F (+5°C)	SAE 30 or 40	SAE 10W-30, 20W-40, or 10W-40
Above 0°F (-18°C)	SAE 20W-20	SAE 10W-30 or 10W-40
Below 0°F (-18°C)	SAE 10W*	SAE 5W-20 or 5W-30

***Sustained high speeds (above 55 mph, 88 km/h) should be avoided when using SAE 10W engine oil since oil consumption may be greater under this condition.** 60542

Crankcase capacity is 3.0 quarts (2.84 liters) for four-cylinder engines, 4 quarts (3.8 liters) for six-cylinder engines, 4 quarts (3.8 liters) for eight-cylinder engines. Add one additional quart (1 liter) when the filter is changed. Do not add any additional oil when the filter is changed on four-cylinder engines.

3. Oil Filter

Change the oil filter every 5,000 miles (8 000 km) or every five months, whichever comes first, under normal conditions.

A full-flow oil filter is mounted on the lower center right side of six-cylinder engines, lower right side on four-cylinder engines and lower right side on eight-cylinder engines.

Remove the throwaway filter unit from the adapter with Oil Filter Removal Tool J-22700, or equivalent. To install, turn the replacement unit by hand until the gasket contacts the seat and then tighten an additional one-half turn.

CAUTION: *Use only a short-type, full-flow oil filter (AMC/Jeep Part No. 8993146, or equivalent) for replacement. Filters exceeding 4-1/4 inches (108 mm) in length could be punctured by the engine support or frame rail resulting in loss of oil and possible engine damage.*

4. Automatic Transmission (Fluid Check)

Inspect fluid level at scheduled interval. Check while the transmission is at normal operating temperature. This occurs after at least 15 miles (25 km) of expressway driving or equivalent city driving. At normal operating temperature, the gauge end of the dipstick will be too hot to make an accurate fluid level check perform the following steps:

(1) Bring transmission up to normal operating temperature as indicated above.

(2) Place vehicle on level surface.

(3) Have engine running at idle speed.

(4) Apply parking brake.

(5) Move gearshift lever through all positions, leaving it in Neutral.

(6) Remove dipstick, located in fill tube at right rear of engine near dash panel, and wipe clean.

(7) Insert dipstick until cap seats.

(8) Remove dipstick and note reading. The fluid level should be between the ADD and FULL marks. If at or below the ADD mark, add sufficient fluid to raise level to FULL mark.

Use AMC/Jeep Automatic Transmission Fluid, or equivalent, labeled Dexron® or Dexron II®.

CAUTION: *Do not overfill. Overfilling can cause foaming which can lead to overheating, fluid oxidation, or varnish formation. These conditions can cause interference with normal valve, clutch, and servo operation. Foaming can also cause fluid to escape from the transmission vent where it may be mistaken for a leak.*

When checking fluid level, also check fluid condition. If fluid smells burned or is full of metal or friction material particles, a complete transmission overhaul may be needed. Examine the fluid closely. If doubtful about its condition, drain out a sample for a double check.

Refer to Chassis Components for procedures on changing automatic transmission fluid and linkage adjustment.

5. Battery

WARNING: *Wear safety glasses, rubber gloves and protective clothing when servicing the battery. Battery fluid contains sulfuric acid and must be kept away from skin, eyes, clothing and the vehicle painted surfaces. If acid contacts any of these,* **flush immediately with large amounts of water. If acid contacts skin or eyes get medical attention.** *Do not smoke while checking or servicing the battery and keep open flames or sparks away from battery filler caps since explosive gas is always present.*

Check electrolyte level at scheduled interval. Lift the battery cell caps (fig. B-5) and look into each filler well. Maintain the fluid level above the battery plates to the bottom of the filler well ring. Add distilled water or drinking water free of high mineral content. In freezing weather, add water before driving to assure mixing with acid and to prevent freezing.

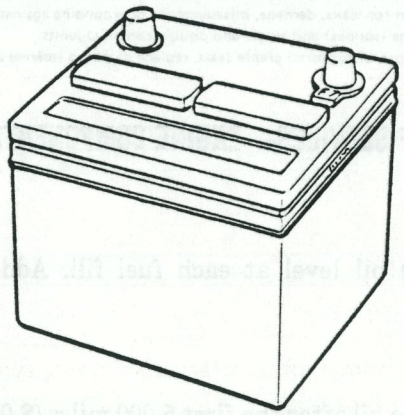


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Fig. B-5 Battery

In addition to regular fluid checks, inspect overall battery condition before every winter season according to the following procedure:

(1) Disconnect battery negative cable and then positive cable.

(2) Clean cables and terminal posts with a wire-brush terminal cleaner.

(3) Check battery fluid level and replenish if necessary (fig. B-4).

(4) Remove battery holddown and clean battery case and battery tray, if necessary, with a solution of baking soda and water; then rinse thoroughly.

(5) Position battery in tray and fasten holddown. Do not overtighten.

(6) Attach positive cable and then the negative cable.

(7) Apply a small amount of grease or protective coating to cable ends to minimize corrosion.

6. Brake Master Cylinder

Check fluid level at scheduled interval.

Clean the top of the cover and surrounding housing area. Unsnap the bail and remove the cover. The fluid should be 1/4 inch (6 mm) below the rim of each well in the reservoir. If not, add brake fluid as required and install cover. Use only Jeep Heavy-Duty Brake Fluid, or equivalent, meeting SAE Standard J1703, and Federal Standard No. 116, DOT 3 Fluid.

Refer to Chassis Components for procedures on brake and chassis inspection.

7. Coolant

Check coolant level at scheduled interval when the engine is cold. If coolant should be needed, fill radiator to approximately 1-1/2 to 2 inches (38 to 51 mm) below the filler neck when cold, or 1/2 to 1 inch (13 to 25 mm) at normal operating temperature. Add a 50/50 mixture of ethylene glycol antifreeze and pure water. In an emergency, water alone may be used. Check the freeze protection at the earliest opportunity, as the addition of water will reduce the antifreeze and corrosion protection afforded by the coolant mixture. Do not overfill, as loss of coolant—due to expansion—will result.

Year-round coolant is installed at the factory to last through two years of normal operation, if the coolant is maintained at the original concentration.

In normal operation, flush and refill the cooling system at the **Maintenance Schedule** interval.

When replacing coolant use a 50/50 mixture of high-quality, ethylene glycol antifreeze and water. Use this mixture year-round for protection against corrosion, boiling and engine damage.

8. Power Steering Pump

Check fluid level at scheduled interval.

Lubricant level can be checked with fluid either hot or cold. If below the FULL HOT or FULL COLD marking on the dipstick attached to the reservoir cap (fig. B-6), add AMC/Jeep Power Steering Fluid, or equivalent.

9. Drive Belts

Check belts driving fan, air pump, alternator, power steering pump and air conditioning compressor for cracks, fraying, wear, and general condition at scheduled interval. Use Tension Gauge J-23600 to check drive belt tension. Compare reading obtained against the tension specified for used belts in the following chart. If installing a new belt, use the new belt setting shown in the chart. Refer to Chapter 1C—Cooling for replacement or adjustment procedures.

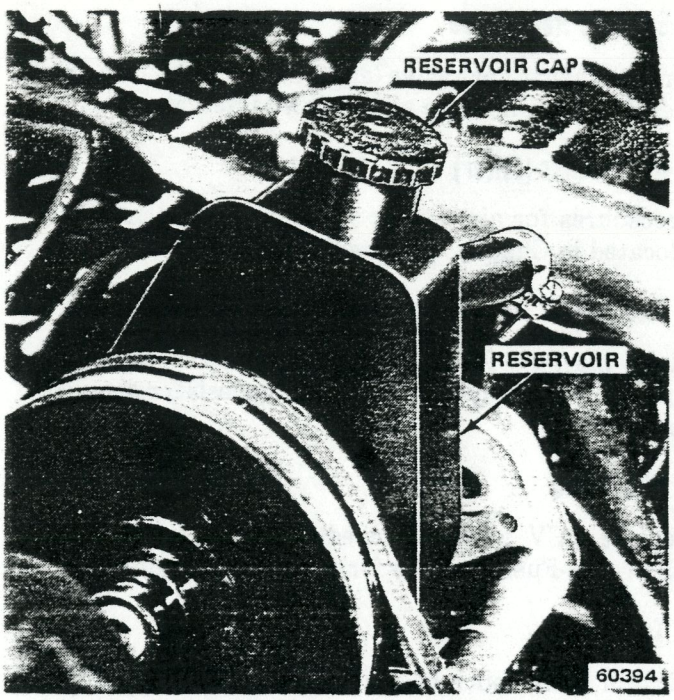

Fig. B-6 Power Steering Pump Dipstick Location

Drive Belt Tension

	Initial Newtons New Belt	Reset Newtons Used Belt	Initial Pounds New Belt	Reset Pounds Used Belt
Air Conditioner				
Six-Cylinder	556-689	400-512	125-155	90-115
Eight-Cylinder	556-689	400-512	125-155	90-115
Air Pump				
Six-Cylinder w/PS	289-334	267-311	65-75	60-70
Other Six-Cylinder and all Eight-Cylinder	556-689	400-512	125-155	90-115
Fan – All Engines	556-689	400-512	125-155	90-115
Power Steering – All Engines	556-689	400-512	125-155	90-115
Serpentine				
Six-Cylinder Calif.	800-890	623-712	180-200	140-160

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10. Fuel Filter

Replace the fuel filter at scheduled interval. Be sure to position the fuel return line at the top of the filter (fig. B-7).

For more detailed procedures on fuel filter replacement, refer to Chapter 1J—Fuel Systems.

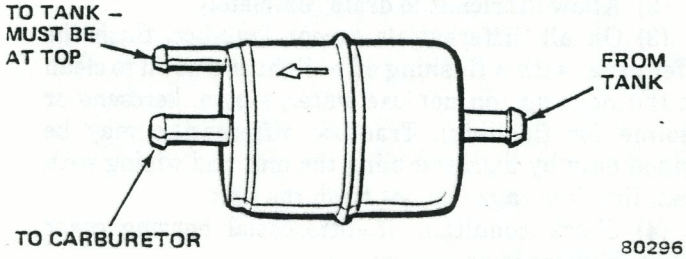


Fig. B-7 Correct Fuel Filter Installation

11. Exhaust Heat Valve

Check exhaust heat valve (eight-cylinder only) for free movement and lubricate at scheduled interval.

12. Air Cleaner (Filter)

Procedures for air cleaner servicing and replacement are located in Chapter 1J—Fuel Systems.

13. PCV Filter

Clean the PCV Filter at scheduled interval. Refer to Chapter 1A—General Service and Diagnosis for detailed procedure.

14. PCV Valve

Replace PCV valve at scheduled interval. Refer to Chapter 1J—Fuel Systems for detailed procedures.

15. Tune-Up

Certain items (such as the choke system and ignition timing) must be checked and serviced between regularly scheduled complete tune-ups on some models. Refer to the Engine Maintenance Schedule for details.

Perform a complete precision tune-up at the scheduled interval. Perform a precision electronic diagnosis whenever questionable engine performance occurs between scheduled tune-ups.

Refer to Chapter 1A—General Service and Diagnosis for detailed procedures and specifications.

DESCRIPTION OF SERVICES—CHASSIS COMPONENTS

1. Axle Differentials (Front and Rear)

Check fluid levels at scheduled interval.

The lubricant level of all differentials should be at the level of the fill hole (fig. B-8). If not, bring to level by adding the recommended lubricant.

Change fluid as recommended in the Chassis Maintenance Schedule. Fluid type and quantity required are listed in the Recommended Fluids and Lubricants chart and the Fluid Capacities chart at the end of this chapter by axle model. To change fluid:

(1) Remove axle differential housing cover.

(2) Allow lubricant to drain completely.

(3) On all differentials except Trac-Loc, flush the differential with a flushing oil or light engine oil to clean out the housing (do not use water, steam, kerosene or gasoline for flushing). Trac-Loc differentials may be cleaned only by disassembling the unit and wiping with clean, lint-free rags. Do not flush the unit.

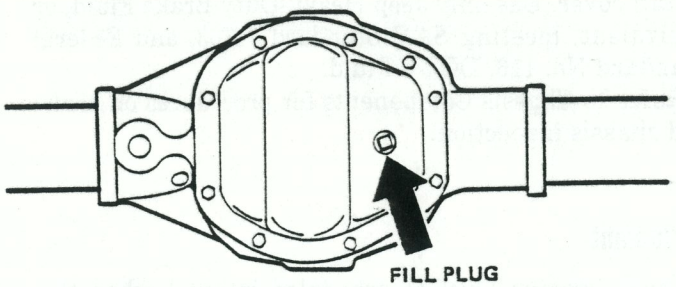
(4) Check condition of differential housing cover gasket. Replace if necessary.

(5) Install gasket and differential housing cover.

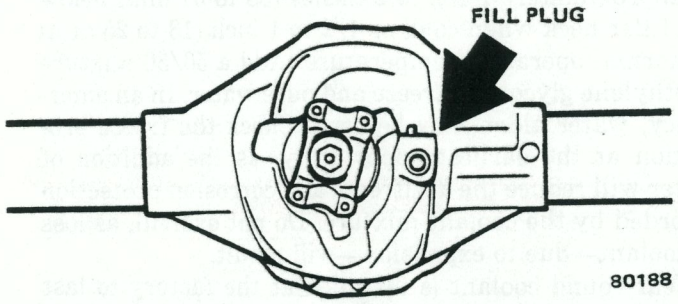
(6) Tighten cover bolts to 15 to 25 foot-pounds (20 to 34 N•m) torque.

(7) Remove fill plug and add new lubricant to fill hole level (fig. B-8).

(8) Install fill plug.



ALL FRONT AXLES AND J-20 TRUCK REAR AXLE



ALL REAR AXLES EXCEPT J-20 TRUCK

Fig. B-8 Axle Fill Plug Locations

2. Bearings—Front Wheel

Lubricate front wheel bearings as scheduled using a high quality wheel bearing lubricant (see Recommended Fluids and Lubricants chart). Be sure to force grease between rollers. Check the bearing races for signs of pitting, brinelling or overheating. Wipe the spindle clean and apply a small amount of grease to prevent rust. Wipe the wheel hub clean and apply a small amount of grease inside the hub.

CAUTION: *Do not overfill the wheel hub. Too much grease can cause overheating and bearing damage, or it can leak and contaminate brakelinings.*

Install the inner bearing and a new grease seal. Assemble the hub assembly and adjust bearings as described in Chapter 2F—Axles.

Inspect bearings, and clean and repack if necessary, when they are removed for other services.

Manual Locking Hubs

Inspect and lubricate manual locking hubs as scheduled using chassis lubricant. For a more detailed procedure, refer to Chapter 2F—Axles.

Brake and Chassis Inspection

Brakes

Inspect linings for wear, cracks, charred surfaces or broken rivets, and for contamination by brake fluid, axle lubricant or other contaminants. Refer to the following inspection procedures.

Front Brakelinings—CJ Models

Check both ends of the outboard lining by looking in at each end of the caliper (fig. B-9). These are the points at which the highest rate of wear normally occurs. At the same time, check the lining thickness of the inboard shoe to make sure that it has not worn prematurely. Look through the inspection port to view the inboard shoe and lining. Whenever the thickness of any lining is worn to the approximate thickness of the metal shoe, all shoe and lining assemblies on both brakes should be replaced.

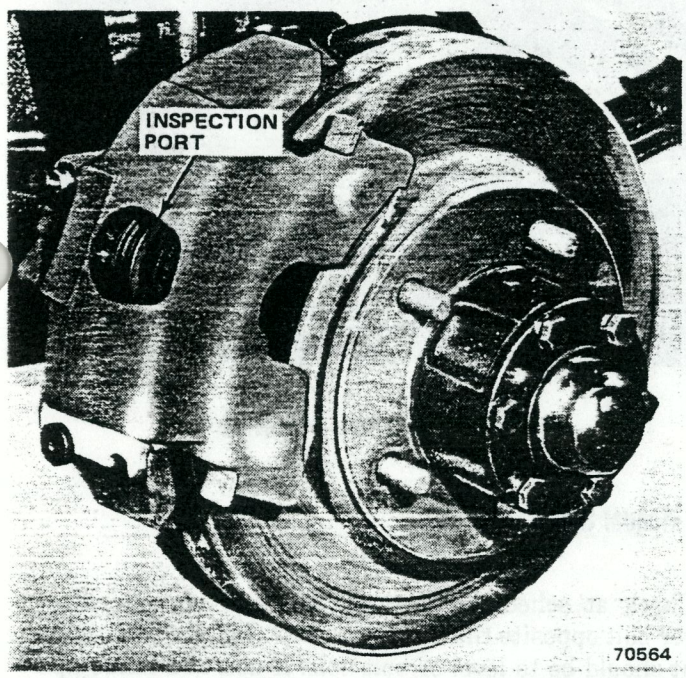


Fig. B-9 Disc Brake Assembly—CJ Models

Front Brakelinings—Cherokee-Wagoneer-Truck Models

Check brakelining thickness through caliper inspection port (fig. B-10).

A wear sensor is attached to the brakeshoes. When brakelining wears to the point that replacement is necessary, the sensor contacts the disc, making a screeching or scraping noise to warn the driver that brakeshoes need replacement.

Rear Brakelinings—All Models

Replace linings worn to within 1/32 inch (.78 mm) of rivet head.

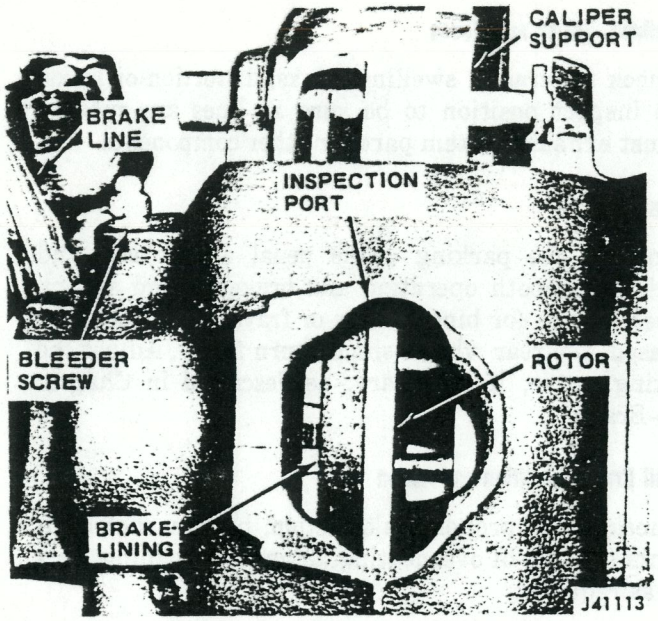


Fig. B-10 Caliper Inspection Port—Cherokee-Wagoneer-Truck Models

Rear Self-Adjusting Mechanism

Operate the adjuster cable (CJ) or adjuster lever and pivot (Cherokee, Wagoneer and Truck). Check for ease of operation of the adjuster screw assembly. Check condition of the adjuster components for bending, frayed cables, loose or overheated springs, or binding.

Master Cylinder

Inspect the cap bail for proper tension and fit. The cap should maintain a tight seal. Check the rubber diaphragm seal for cracks, cuts or distortion. Check fittings and housing for signs of leakage. If internal leaks are suspected or if fluid loss occurs but a leak is not evident, check for leaks at the rear of the master cylinder. Correct as required.

Disc Brake Calipers

Check dust boot for correct installation, tears or signs of leakage. Check slide surfaces (CJ) or bushings and pins (Cherokee, Wagoneer and Truck) for binding, corrosion or tears.

Rear Wheel Cylinders

Pull the dust boot back and inspect for leaks. Check the condition of the pistons and cylinder bores.

Differential Warning Valve

Check the valve and housing for signs of leaks, kinked lines or loose fittings.

Brakelines, Fitting and Hoses

Check for cracks, swelling, kinks, distortion or leaks. Also inspect position to be sure no lines are rubbing against exhaust system parts or other components.

Parking Brake

Operate the parking brake pedal and release and check for smooth operation and brake holding ability. Inspect cables for binds, kinks or frays. With the brake released, the rear wheels should turn freely. Adjust the parking brake, if necessary, as described in Chapter 2G—Brakes.

Overall Brake Condition and Action

Check for improper brake action, performance complaints or signs of overheating, dragging or pulling. Correct as required.

Chassis

Inspect spring bushings and mountings for looseness or wear. Check shock absorbers and bushings for loose mountings, wear or leaks. Correct as required.

Check for improper steering action or suspension noises, performance complaints or signs of shimmy, pulling, rubbing or undue tire wear.

Check tires for visible signs of wear which may indicate underinflation or need for front-end alignment, tire rotation or wheel balancing. Also check for bulging, cracks or other road hazard damage. Check and adjust inflation pressures according to the specifications listed in the tire pressure sticker on the glove box door.

3. Body Lubrication

Lubricate the items listed at scheduled interval using lubricant specified in the Recommended Fluids and Lubricants chart at the end of this section. Refer to figures B-11 through B-18 for application of lubricant. When lubricating weatherstrips and seals, apply the lubricant to a rag and wipe it on the seal to avoid dust-collecting overspray which can soil passenger clothing.

4. Clutch Lever and Linkage

Lubricate at scheduled interval. Apply AMC/Jeep All-Purpose Lubricant, or equivalent, or multi-purpose chassis lubricant (lithium base) to the one lube fitting on the clutch bell crank.

5. Exhaust System Inspection

Inspect the exhaust system at scheduled interval for the following conditions. Correct as required.

- Exhaust system leaks, damage, misalignment
- Grounding against body sheet metal or frame
- Catalytic converter "bulging" or heat damage

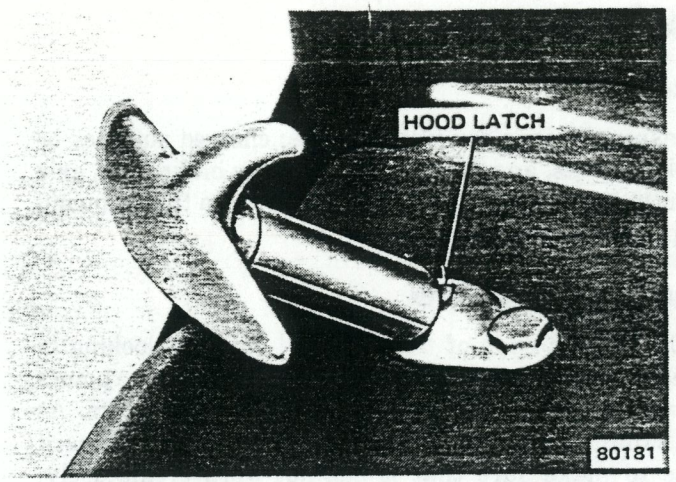


Fig. B-11 Hood Latch—CJ Models

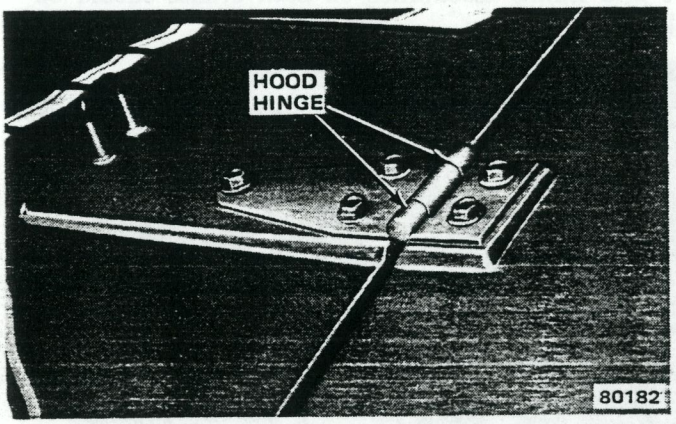


Fig. B-12 Hood Hinge—CJ Models

6. Manual Steering Gear

Check at scheduled interval by removing the side cover bolt opposite the adjuster screw (fig. B-19). Lubricant should be to level of bolt hole. If not, add make-up fluid such as AMC/Jeep All-Purpose Lubricant or multi-purpose lithium base chassis lubricant.

7. Propeller Shafts (Front and Rear)

Lubricate propeller shafts, single and double cardan U-joints, during the scheduled chassis lubrication with AMC/Jeep All-Purpose Lubricant or multi-purpose lithium base chassis lubricant grease.

NOTE: *Undercoating or rustproofing compounds could unbalance the propeller shafts and cause drivetrain vibrations. Remove any such compounds using the appropriate solvent.*

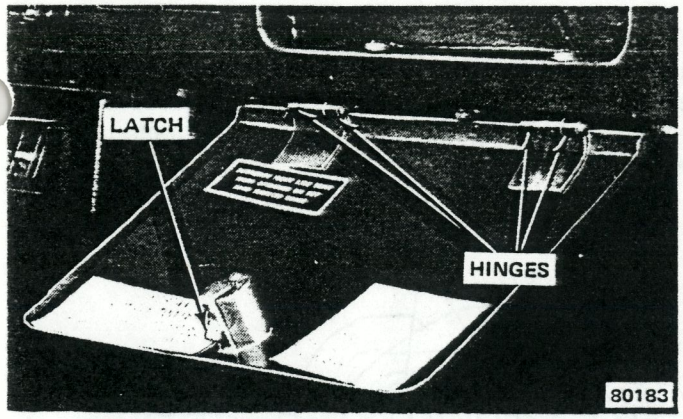


Fig. B-13 Glove Box Latch and Hinge—CJ Models

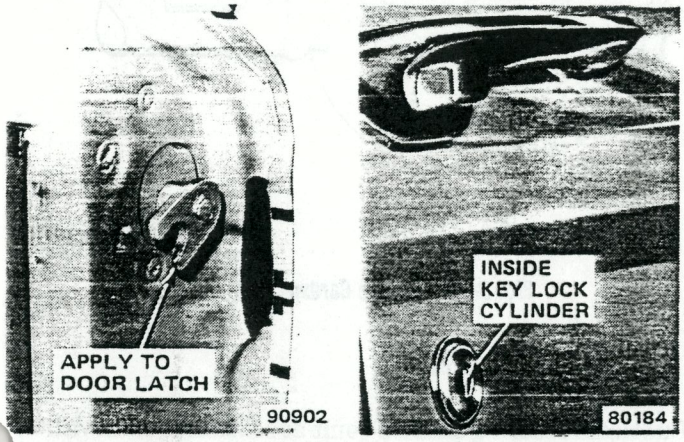


Fig. B-14 Door Latch and Lock—Cherokee-Wagoneer-Truck Models

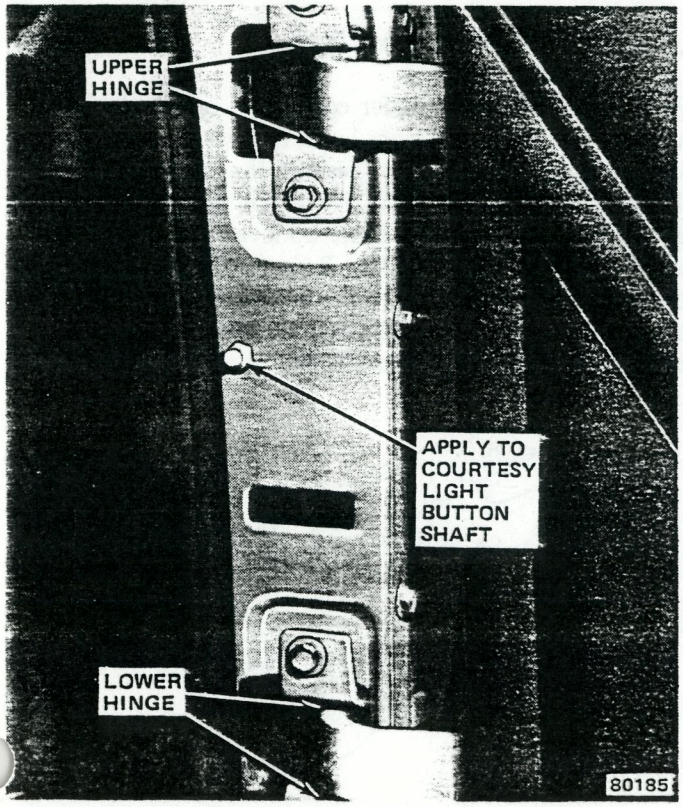


Fig. B-15 Door Hinges and Courtesy Light Button—
Cherokee-Wagoneer-Truck Models

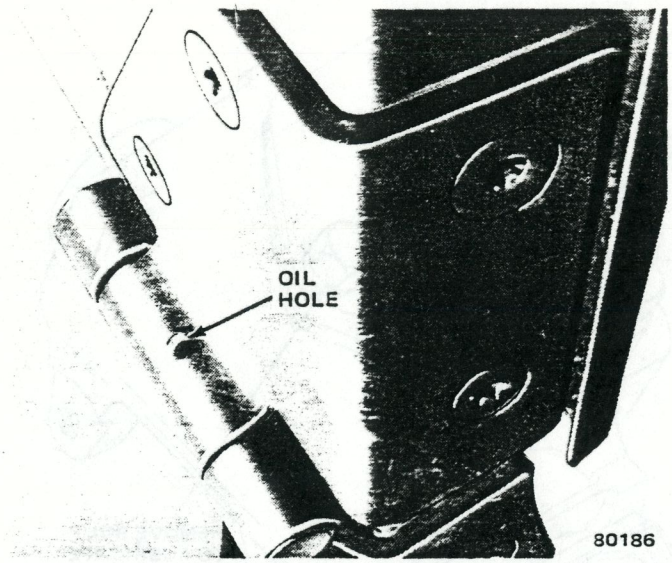


Fig. B-16 Windshield Hinge Lubrication Hole—CJ Models

Fig. B-17 Tailgate Lubrication Points—Cherokee-Wagoneer Models

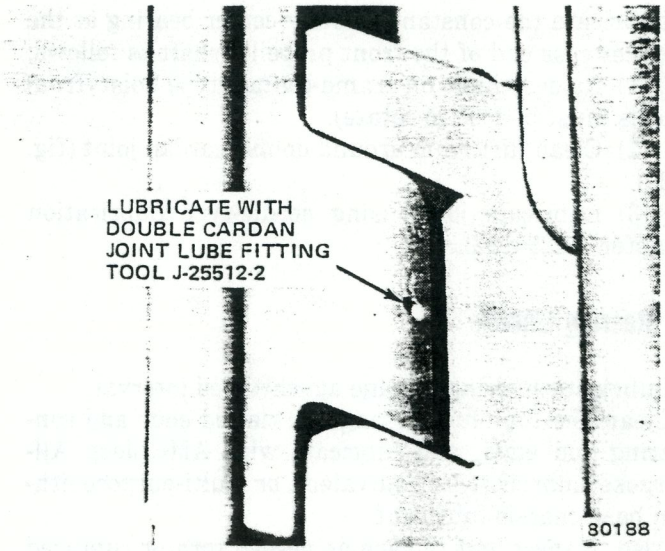


Fig. B-18 Tailgate Hinge Lubrication Hole—
Cherokee-Wagoneer Models

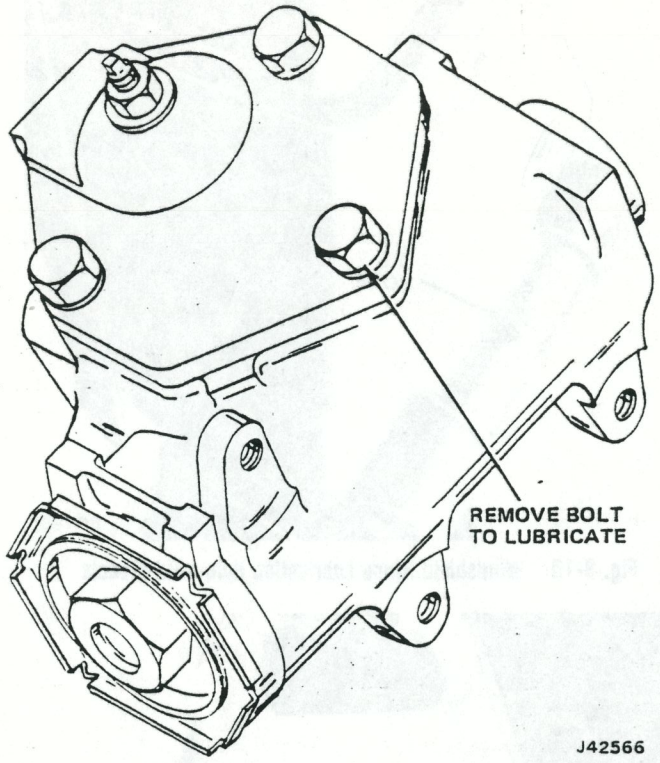


Fig. B-19 Manual Steering Gear Fill Hole Location

Sleeve Yokes (Splines)

Apply grease gun pressure to sleeve yoke grease fitting until lubricant appears at pressure relief hole in expansion plug at sleeve yoke end of spline. At this point, cover pressure relief hole with finger and continue to apply pressure until grease appears at sleeve yoke seal. This will ensure complete lubrication of spline.

Double Cardan Joint

Lubricate the constant velocity center bearing at the transfer case end of the front propeller shaft as follows:

(1) Raise vehicle on frame-contact type hoist (front wheels must be free to rotate).

(2) Clean dirt from around double cardan joint (fig. B-20).

(3) Lubricate joint using needle-type Lubrication Adapter J-225512-2.

8. Steering Linkage

Lubricate steering linkage at scheduled interval.

Clean the four lube fittings on tie-rod ends and connecting rod ends, and lubricate with AMC/Jeep All-Purpose Lubricant, or equivalent, or multi-purpose lithium base chassis lubricant.

Also, inspect and replace as needed torn or ruptured grease seals, replace damaged steering components and lubricate ball joints.

Check manual or power steering gear assembly for leaks, housing cracks or loose frame mounting. Inspect steering damper for leaks or loose mounting. Also, check steering tie rods and connecting rod for bending, looseness or wear.

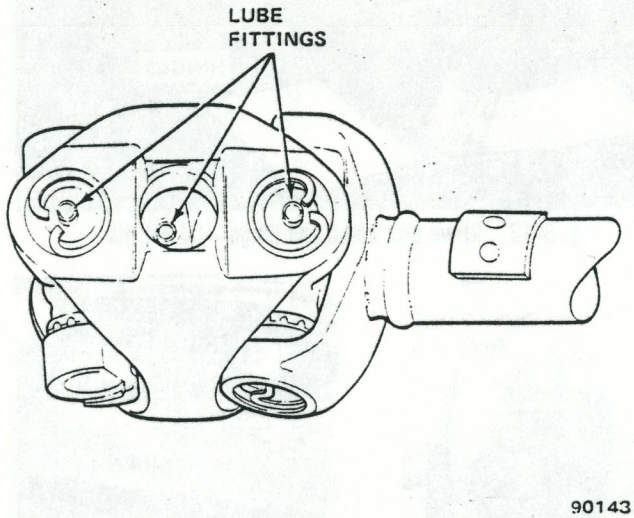


Fig. B-20 Double Cardan Joint

9. Steering Shaft U-Joint

Lubricate steering shaft U-joint at scheduled interval. (On Cherokee, Wagoneer and Truck models only.)

10. Transfer Case—Fluid Level Check

Fluid levels in the transfer case must be checked as scheduled. To check lubricant level, remove the transfer case fill plug located on the rear of the transfer case. Lubricant should be level with the fill plug hole (figs. B-21 through B-23). If not, bring up level with specified lubricant and install fill plug. Refer to Recommended Fluids and Lubricants chart located at the end of this chapter for lubricant specification and to Fluid Capacities chart for transfer case capacity.

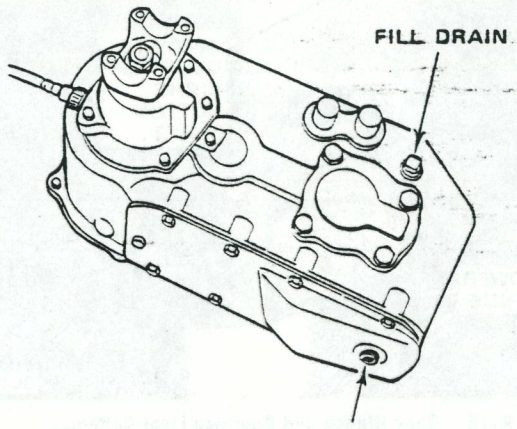


Fig. B-21 Transfer Case Drain and Fill Plugs—Model 300

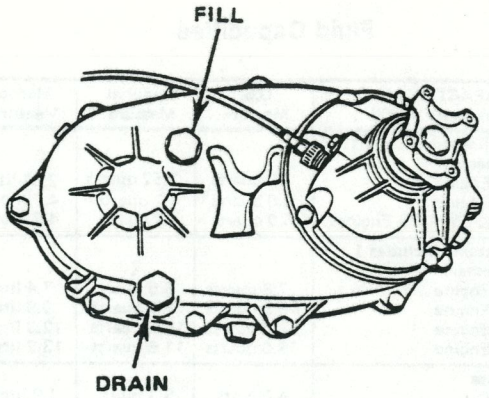


Fig. B-22 Transfer Case Drain and Fill Plugs—Model 208

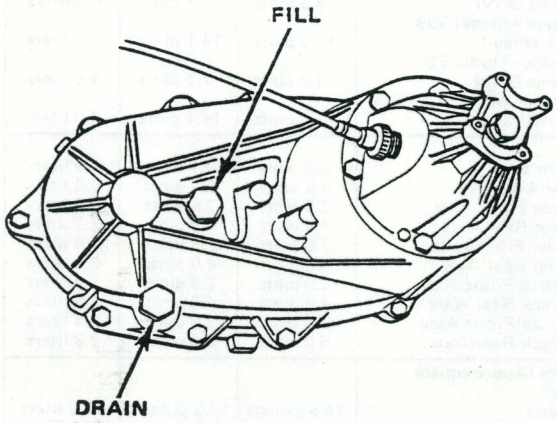


Fig. B-23 Transfer Case Drain and Fill Plugs—Quadra-Trac

Transfer Case—Fluid Change

Drain and change transfer case at scheduled interval. To change fluid:

(1) Remove fill plugs then drain plugs.
(2) Allow transfer case to drain completely.
(3) Install drain plugs.
(4) Fill with specified lubricant to level of fill hole.
(5) Install fill plugs.

CAUTION: *Do not overtighten fill and drain plugs. Tighten plugs to 15 to 25 foot-pounds (20.3 to 33.9 N•m) torque. Overtightening can strip threads or break the aluminum case.*

11. Transmission

Refer to Engine Components for procedure on checking fluid level for automatic transmission.

Fluid levels in the transfer case and manual transmission must be checked at the same time, as scheduled. Fill plugs for all manual transmissions are located on the right side of the assembly.

To check lubricant level, remove the transmission fill plug. Lubricant should be level with each fill plug hole. If not, bring up to level with specified lubricant and install fill plug. Refer to Recommended Fluids and Lubricants chart and Fluid Capacities chart at the end of this chapter.

Automatic Transmission Fluid Changes

Drain and refill the automatic transmission every 25,000 miles (40 000 km) for vehicles in normal service and every 10,000 miles (16 000 km) for vehicles in heavy-duty service. Change fluid immediately after vehicle operation, before it cools.

(1) Remove transmission pan screws, pan, and gasket.
(2) Remove and discard oil filter (fig. B-24).
(3) Remove and discard O-ring seal from pick-up pipe.
(4) Install new O-ring seal on pick-up pipe and install strainer and pipe assembly.
(5) Clean pan thoroughly and position new gasket on pan. Use petroleum jelly, or equivalent, to position gasket.
(6) Install pan. Secure with attaching screws and tighten to 10 to 13 foot-pounds (14 to 18 N•m) torque.
(7) Pour approximately 5 quarts (4.71 liters) of Dexron® or Dexron II® automatic transmission fluid into filler pipe. Be sure container spout, funnel, or other items in contact with fluid are clean.
(8) Start engine and allow it to idle a few minutes.
(9) Apply brake pedal and parking brake. Shift transmission into all positions then place the selector lever in N (Neutral).
(10) With transmission at operating temperature, check fluid level. Add fluid, if necessary, to bring level to FULL mark.

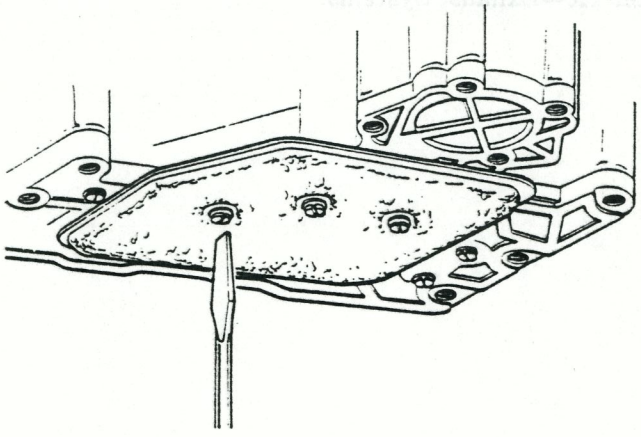


Fig. B-24 Removing Automatic Transmission Filter

Manual Transmission Fluid Change

Manual transmission and transfer case lubricating fluid should be changed at the same time, as scheduled. See Recommended Fluids and Lubricants at the end of this chapter for fluid specification, and the Fluid Capacities Chart for quantity. To change fluid:

(1) Remove fill plugs then drain plugs.
(2) Allow units to drain completely.
(3) Install drain plugs.
(4) Fill to level of fill holes.
(5) Install fill plugs.

UNSCHEDULED MAINTENANCE

General

Services detailed in this subsection are not listed in the Maintenance Schedule for performance at a specified interval. They are to be performed as required to restore vehicle to original specifications. Unscheduled maintenance services include such items as fuel system cleaning; engine carbon deposit removal; retightening loose parts and connections; replacement of manual transmission clutch components, brakelinings, shock absorbers, light bulbs, wiper blades, belts or hoses; replacement of interior trim, bright metal trim, painted parts and other appearance items or rubber-like parts. Need for these unscheduled services is usually indicated by a change in performance, handling, or the appearance of the vehicle or a particular component. Owners, users and service mechanics should be alert for indications that service or replacement is needed.

Catalytic Converter

The catalytic converter(s) used on 1981 Jeep models will become contaminated if leaded gas is used, or if the engine or emission controls are not maintained as scheduled. If this occurs, the catalyst—the alumina-coated beads in the converter—or the entire converter must be replaced. Refer to the catalyst replacement procedure in Chapter 1K—Exhaust Systems.

Fluid Capacities

CAPACITIES Approximate Refill	U.S. Measure	Imperial Measure	Metric Measure
Engine Oil (includes 1 quart for filter change)			
151 CID Engine	3.0 quarts	2.52 quarts	2.84 liters
258 CID Engine	5.0 quarts	4.2 quarts	4.7 liters
304 CID & 360 CID Engines	5.0 quarts	4.2 quarts	4.7 liters
Cooling System (includes 1 quart for heater)			
151 CID Engine	7.8 quarts	6.5 quarts	7.4 liters
258 CID Engine	10.5 quarts	8.7 quarts	9.9 liters
304 CID Engine	13.0 quarts	10.8 quarts	12.3 liters
360 CID Engine	14.0 quarts	11.6 quarts	13.2 liters
Transfer Case			
Model 300	4.0 pints	3.3 pints	1.9 liters
Model 208	6.0 pints	5.0 pints	2.8 liters
Quadra-Trac	4.0 pints	3.3 pints	1.9 liters
Transmission			
Manual 4-Speed—SR-4	3.0 pints	2.5 pints	1.4 liters
Manual 4-Speed—T-176	3.5 pints	2.9 pints	1.7 liters
Manual 4-Speed—T-18	6.5 pints	5.5 pints	3.1 liters
Automatic—Model 999 (Change Only)	8.5 pints	7.1 pints	4.0 liters
Automatic—Model 999 (At Overhaul)	17.0 pints	14.1 pints	8.0 liters
Automatic—Model 727 (Change Only)	8.5 pints	7.1 pints	4.0 liters
Automatic—Model 727 (At Overhaul)	17.0 pints	14.1 pints	8.0 liters
Axles			
CJ Front Axle	2.5 pints	2.1 pints	1.9 liters
CJ Rear Axle	4.8 pints	4.0 pints	2.3 liters
Cherokee Front Axle	3.0 pints	2.5 pints	1.4 liters
Cherokee Rear Axle	4.8 pints	4.0 pints	2.3 liters
Wagoneer Front Axle	3.0 pints	2.5 pints	1.4 liters
Wagoneer Rear Axle	4.8 pints	4.0 pints	2.3 liters
J-10 Truck Front Axle	3.0 pints	2.5 pints	1.4 liters
J-10 Truck Rear Axle	4.8 pints	4.0 pints	2.3 liters
J-20 Truck Front Axle	3.0 pints	2.5 pints	1.4 liters
J-20 Truck Rear Axle	6.0 pints	5.0 pints	2.8 liters
Gas Tanks (Approximate Capacity)			
CJ Models	14.8 gallons	12.3 gallons	56.0 liters
Cherokee Models	20.3 gallons	16.9 gallons	76.8 liters
Wagoneer Models	20.3 gallons	16.9 gallons	76.8 liters
Truck Models	19.0 gallons	15.8 gallons	71.9 liters

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Recommended Fluids and Lubricants

ENGINE	
COMPONENT	**SPECIFICATION**
Distributor rotor tip*	AMC/Jeep Silicone Dielectic Compound or equivalent.
Engine coolant	High quality ethylene glycol (permanent antifreeze) and clean water mixture.
Engine oil	API classification "SE" or "SF", if available. Refer to oil viscosity chart for correct SAE grade.
Exhaust manifold heat valve	AMC/Jeep Heat Valve Lubricant or equivalent.
CHASSIS	
COMPONENT	**SPECIFICATION**
Automatic transmission	AMC/Jeep Automatic Transmission Fluid or equivalent labeled Dexron® or Dexron II®.
Brake master cylinder*	AMC/Jeep Brake Fluid or equivalent marked FMVSS No. 116, DOT-3 and SAE J-1703. CAUTION: Use only recommended brake fluids.
Caliper Slide Rails (CJ only)	AMC/Jeep Brake Support Plate Lubricant or equivalent molydisulfide lubricant.
Clutch lever and linkage	AMC/Jeep All-Purpose Lubricant or equivalent lithium base chassis lubricant.
Conventional axle differentials	AMC/Jeep Rear Axle Lubricant or gear lubricant of SAE 85W-90 (API-GL5) quality.
Drum brake support plate ledges*	AMC/Jeep Brake Support Plate Lubricant or equivalent molydisulfide lubricant.
Front suspension ball joints, steering linkage, propeller shafts, single and double cardan joints and yokes	AMC/Jeep All-Purpose Lubricant or equivalent lithium base chassis lubricant.
Front wheel bearings	AMC/Jeep All-Purpose Lubricant or equivalent lithium base chassis lubricant.
Gearshift linkage-transmission and transfer case	AMC/Jeep All-Purpose Lubricant or equivalent lithium base chassis lubricant.
Manual locking hubs	AMC/Jeep All-Purpose Lubricant or equivalent lithium base chassis lubricant.

CHASSIS (Continued)	
COMPONENT	**SPECIFICATION**
Manual steering gear*	AMC/Jeep All-Purpose Lubricant or equivalent lithium base chassis lubricant.
Manual transmission	SAE 85W-90 gear lubricant (API-GL5).
Model 208 transfer case	10W-30 motor oil.
Model 300 transfer case	SAE 85W-90 gear lubricant (API-GL5).
Parking brake pedal mechanism*	3-M Spray Lube 8902 or equivalent.
Power steering pump and gear*	AMC/Jeep Power Steering Fluid or equivalent.
Quadra-Trac transfer case	10W-30 motor oil.
Steering shaft U-joint	AMC/Jeep All-Purpose Lubricant or equivalent lithium base chassis lubricant.
Trac-Lok axle differential	AMC/Jeep Rear Axle Lubricant or limited-slip gear lubricant of SAE 85W-90 (API-GL5) quality.
BODY	
COMPONENT	**SPECIFICATION**
Ashtray slides	3-M Spray Lube 8902 or equivalent.
Front seat tracks	3-M Spray Lube 8902 or equivalent.
Hinges: door, hood, liftgate, tailgate, glove box	3-M Spray Lube 8902 or equivalent.
Hinges: tailgate (Cherokee, Wagoneer)	AMC/Jeep All-Purpose Lubricant or equivalent lithium base chassis lubricant.
Key lock cylinders	Powdered graphite, AMC/Jeep Silicone Lubricant Spray or light oil.
Latches: door, hood, liftgate, tailgate, glove box	3-M Spray Lube 8902 or equivalent.
Moon roof	Petroleum Jelly
Weatherstrips: door, window, liftgate, tailgate	AMC/Jeep Silicone Lubricant Spray or equivalent.
Windshield hinges and holddown knobs (CJ)	3-M Spray Lube 8902 or equivalent.

***No routine drain and refill or application of lubricant is required. Specification is for maintaining fluid levels or reassembling components. Refer to the Maintenance Schedules for intervals.**

NOTES

PART 1
POWER PLANT

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Cooling Systems	1C
Batteries	1D
Charging System	1E
Starting System	1F
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GENERAL SERVICE AND DIAGNOSIS 1A

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GENERAL INFORMATION

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GENERAL

This chapter contains **general** information that applies to all Jeep engines: 151 CID four-cylinder, 258 CID six-cylinder, 304 CID eight-cylinder, and 360 CID eight-cylinder engines. Refer to Chapter 1B—Engines for **specific** procedures involving engine replacement, engine disassembly, internal component repair and replacement and mechanical specifications.

The Engine Diagnosis section of this chapter presents information and procedures useful for locating problems not normally encountered during routine maintenance and tune-ups.

The Engine Tune-Up section of this chapter presents a systematic approach to the performance of a complete, precision tune-up required at the interval specified in the Engine Maintenance Schedule.

EMISSION COMPONENTS

It is frequently helpful to know at a glance the emission control-related components that are installed on a particular vehicle. This information is contained in three emission component charts. Vehicles designated 49-state are certified for sale in all states (and Canada) except California. Vehicles designated California are the only vehicles certified for sale in the state of California. Hilly terrain components are applicable to vehicles that are normally driven in areas where the driveability is affected by the environmental conditions (e.g., altitude).

Emission Components—Hilly Terrain Light Duty Vehicles

Engine and Carb.	Vehicle and Series	Cooling System Type	Transmission	Air Injection	Air Switch Valve	Diverter Valve	Catalytic Converter	Pre-Cat Converter	EGR	EGR DELAY VALVE (F)	EGR TVS	EGR CTO Valve Temp.	TAC Type	TAC TVS	TAC Delay Valve (R) and Check Valve	Spark CTO Valve Temp.	Non-Linear Valve	HD Spark CTO Valve Temp.	Spark Delay Valve	Carb. Vent to Canister	Electric Choke	Sol-Vac Idle Control	Throttle Solenoid	Decel Valve	Microprocessor	Vacuum Switch Assembly	Trap Door (Air Cleaner)	PCV
304 CID 2V	CJ-5 7 (85) (87)	STD	M4	•	—	•	•	—	•	—	•	115°F (46°C)	V	•	•	155°F (68°C)	—	—	R •	•	•	—	—	—	—	—	•	•
		HD	M4	•	—	•	•	—	•	—	•	115°F (46°C)	V	•	•	155°F (68°C)	—	220°F (101°C)	R •	•	•	—	—	—	—	—	•	•

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Emission Components—49-State Light Duty Vehicles

Engine and Carb.	Vehicle and Series	Cooling System Type	Transmission	Air Injection	Air Switch Valve	Diverter Valve	Catalytic Converter	Pre-Cat Converter	EGR	EGR Delay Valve (F)	EGR TVS	EGR CTO Valve Temp.	TAC Type	TAC TVS	TAC Delay Valve (R) and Check Valve	Spark CTO Valve Temp.	Non-Linear Valve	HD Spark CTO Valve Temp.	Spark Delay Valve	Carb. Vent to Canister	Electric Choke	Sol-Vac Idle Control	Throttle Solenoid	Decel Valve	Microprocessor	Vacuum Switch Assembly	Trap Door (Air Cleaner)	PCV
151 CID 2V	CJ-5 (85) 7 (87) 8 (88)	STD	M4	—	—	—	•	—	•	—	•	100°F (38°C)	V	•	•	120°F (49°C)	—	—	DR •	•	•	—	•	—	—	—	—	•
		HD	M4	—	—	—	•	—	•	—	•	100°F (38°C)	V	•	•	120°F (49°C)	—	220°F (101°C)	DR •	•	•	—	•	—	—	—	—	•
		STD	A	—	—	—	•	—	•	—	•	100°F (38°C)	V	•	•	120°F (49°C)	—	—	DR •	•	•	—	•	—	—	—	—	•
		HD	A	—	—	—	•	—	•	—	•	100°F (38°C)	V	•	•	120°F (49°C)	—	220°F (101°C)	DR •	•	•	—	•	—	—	—	—	•
258 CID 2V	CJ-5 (85) 7 (87) 8 (88)	STD	M4	•	—	•	•	—	•	—	•	115°F (46°C)	V	•	•	155°F (68°C)	—	—	R •	•	•	•	—	—	—	—	•	•
		HD	M4	•	—	•	•	—	•	—	•	115°F (46°C)	V	•	•	155°F (68°C)	—	220°F (101°C)	R •	•	•	•	—	—	—	—	•	•
		STD	A	•	—	•	•	—	•	—	•	115°F (46°C)	V	•	•	155°F (68°C)	•	—	—	•	•	•	—	—	—	—	•	•
		HD	A	•	—	•	•	—	•	—	•	115°F (46°C)	V	•	•	155°F (68°C)	•	220°F (101°C)	—	•	•	•	—	—	—	—	•	•
	Cherokee 16, 17, 18 Wagoneer 15 J-10 Truck 25, 26	STD	M4	•	—	•	•	—	•	—	•	115°F (46°C)	V	•	•	155°F (68°C)	—	—	—	•	•	•	—	—	—	—	•	•
		HD	M4	•	—	•	•	—	•	—	•	115°F (46°C)	V	•	•	155°F (68°C)	—	220°F (101°C)	—	•	•	•	—	—	—	—	•	•
		STD	A	•	—	•	•	—	•	—	•	115°F (46°C)	V	•	•	155°F (68°C)	•	—	—	•	•	•	—	—	—	—	•	•
		HD	A	•	—	•	•	—	•	—	•	115°F (46°C)	V	•	•	155°F (68°C)	•	220°F (101°C)	—	•	•	•	—	—	—	—	•	•
304 CID 2V	CJ-5 (85) 7 (87)	STD	M4	•	—	•	•	—	•	—	•	115°F (46°C)	V	•	•	155°F (68°C)	—	—	R •	•	•	—	•	—	—	—	•	•
		HD	M4	•	—	•	•	—	•	—	•	115°F (46°C)	V	•	•	155°F (68°C)	—	220°F (101°C)	R •	•	•	—	•	—	—	—	•	•
		STD	A	•	—	•	•	—	•	—	•	115°F (46°C)	V	•	•	155°F (68°C)	•	—	R •	•	•	—	•	—	—	—	•	•
		HD	A	•	—	•	•	—	•	—	•	115°F (46°C)	V	•	•	155°F (68°C)	•	220°F (101°C)	R •	•	•	—	•	—	—	—	•	•
360 CID 2V	Cherokee 16, 17, 18 Wagoneer 15 Truck 25, 26, 27	STD	M4	•	—	•	•	—	•	•①	•	115°F (46°C)	V	•	•	155°F (68°C)	•①	—	R •②	•	•	—	•	—	—	—	•	•
		HD	M4	•	—	•	•	—	•	•①	•	115°F (46°C)	V	•	•	155°F (68°C)	•①	220°F (101°C)	R •②	•	•	—	•	—	—	—	•	•
		STD	A	•	—	•	•	—	•	•	•	115°F (46°C)	V	•	•	155°F (68°C)	•	—	R •	•	•	—	•	—	—	—	•	•
		HD	A	•	—	•	•	—	•	•	•	115°F (46°C)	V	•	•	155°F (68°C)	•	220°F (101°C)	R •	•	•	—	•	—	—	—	•	•

Trans. — Transmission Type: Manual (M4) or Automatic (A)
Cat. Conv. — Catalytic Converter
CTO — Coolant Temperature Override
EGR — Exhaust Gas Recirculation
TVS — Thermal Vacuum Switch
Delay Valve — R = Reverse Delay
— F = Forward Delay
— DR = Dual Reverse Delay

PCV — Positive Crankcase Ventilation
TAC — Thermostatically Controlled Air Cleaner (vacuum or mechanical)
• — On all models in vehicle specified
STD — Standard
HD — Heavy Duty
VSD — Vacuum Signal Dump
① J-20 Only
② Except J-20

NOTE: All vehicles have Fuel Tank Vapor Control, Vacuum Operated TAC Systems, and PCV Valves. All temperatures are nominal.

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Emission Components—California Light Duty Vehicles

Engine and Carb.	Vehicle and Series	Cooling System Type	Transmission	Air Injection	Air Switch Valve	Diverter Valve	Catalytic Converter	Pre-Cat Converter	EGR	EGR — Vacuum Signal Dump Valve (VSD)	EGR TVS	EGR CTO Valve Temp.	TAC Type	TAC TVS	TAC Delay Valve (R) and Check Valve	Spark CTO Valve Temp.	Non-Linear Valve	HD Spark CTO Valve Temp.	Spark Delay Valve	Carb. Vent to Canister	Electric Choke	Sol-Vac Idle Control	Throttle Solenoid	Decel Valve	Microprocessor	Vacuum Switch Assembly	Trap Door (Air Cleaner)	PCV
151 CID 2V	CJ-5 (85) 7 (87) 8 (88)	STD	M4	—	—	—	•	—	•	—	•	100°F (38°C)	V	•	•	120°F (49°C)	—	—	DR •	•	•	—	•	•	•	•	—	•
		HD	M4	—	—	—	•	—	•	—	•	100°F (38°C)	V	•	•	120°F (49°C)	—	—	DR •	•	•	—	•	•	•	•	—	•
		STD	A	—	—	—	•	—	•	—	•	100°F (38°C)	V	•	•	120°F (49°C)	—	—	DR •	•	•	—	•	•	•	•	—	•
		HD	A	—	—	—	•	—	•	—	•	100°F (38°C)	V	•	•	120°F (49°C)	—	—	DR •	•	•	—	•	•	•	•	—	•
258 CID 2V	CJ-5 (85) 7 (87) 8 (88)	STD	M4	•	•	•	•	—	•	—	•	115°F (46°C)	V	•	•	155°F (68°C)	—	—	R •	•	•	•	—	—	•	•	•	•
		HD	M4	•	•	•	•	—	•	—	•	115°F (46°C)	V	•	•	155°F (68°C)	—	220°F (105°C)	R •	•	•	•	—	—	•	•	•	•
		STD	A	•	•	•	•	—	•	—	•	115°F (46°C)	V	•	•	155°F (68°C)	•	—	R •	•	•	•	—	—	•	•	•	•
		HD	A	•	•	•	•	—	•	—	•	115°F (46°C)	V	•	•	155°F (68°C)	•	220°F (105°C)	R •	•	•	•	—	—	•	•	•	•
	Cherokee 16, 17, 18 Wagoneer 15 Truck 25, 26	STD	M4	•	•	•	•	—	•	—	•	115°F (46°C)	V	•	•	155°F (68°C)	—	—	R •	•	•	•	—	—	•	•	•	•
		HD	M4	•	•	•	•	—	•	—	•	115°F (46°C)	V	•	•	155°F (68°C)	—	220°F (105°C)	R •	•	•	•	—	—	•	•	•	•
		STD	A	•	•	•	•	—	•	—	•	115°F (46°C)	V	•	•	155°F (68°C)	•	—	R •	•	•	•	—	•	•	•	•	•
		HD	A	•	•	•	•	—	•	—	•	115°F (46°C)	V	•	•	155°F (68°C)	•	220°F (105°C)	R •	•	•	•	—	—	•	•	•	•

Trans. — Transmission Type: Manual (M4) or Automatic (A)
Cat. Conv. — Catalytic Converter
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TVS — Thermal Vacuum Switch
Delay Valve — R = Reverse Delay; F = Forward Delay; DR = Dual Reverse Delay
PCV — Positive Crankcase Ventilation
TAC — Thermostatically Controlled Air Cleaner (vacuum or mechanical)
• — On all models in vehicle specified
STD — Standard
HD — Heavy Duty
VSD — Vacuum Signal Dump

NOTE: All vehicles have Fuel Tank Vapor Control, Vacuum Operated TAC Systems and PCV Valves. All temperatures are nominal.

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ENGINE DIAGNOSIS

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GENERAL

An engine diagnosis is helpful for identifying the causes of malfunctions not remedied by routine maintenance and tune-ups. These malfunctions are classified as either **mechanical** (e.g. a strange noise), or **performance** (e.g. engine idles rough and stalls). Refer to the Service Diagnosis—Mechanical chart and the Service Diagnosis—Performance chart.

Additional tests and diagnostic procedures may be necessary to pinpoint a particular problem. This information is provided within Diagnosis with Scope Analyzer, Cylinder Compression Pressure Test, Cylinder Leakage Test, Blown Cylinder Head Gasket Diagnosis and Intake Manifold Leakage Diagnosis.

Service Diagnosis—Mechanical

Condition	Possible Cause	Correction
EXTERNAL OIL LEAKS	(1) Fuel pump gasket broken or improperly seated.	(1) Replace gasket.
	(2) Cylinder head cover gasket broken or improperly seated.	(2) Replace gasket; check cylinder head cover gasket flange and cylinder head gasket surface for distortion.
	(3) Oil filter gasket broken or improperly seated.	(3) Replace oil filter.
	(4) Oil pan side gasket broken or improperly seated.	(4) Replace gasket; check oil pan gasket flange for distortion.
	(5) Oil pan front oil seal broken or improperly seated.	(5) Replace seal; check timing case cover and oil pan seal flange for distortion.
	(6) Oil pan rear oil seal broken or improperly seated.	(6) Replace seal; check oil pan rear oil seal flange; check rear main bearing cap for cracks, plugged oil return channels, or distortion in seal groove.
	(7) Timing case cover oil seal broken or improperly seated.	(7) Replace seal.
	(8) Oil pan drain plug loose or has stripped threads.	(8) Repair as necessary and tighten.
	(9) Rear oil gallery plug loose.	(9) Use appropriate sealant on gallery plug and tighten.
	(10) Rear camshaft plug loose or improperly seated.	(10) Seat camshaft plug or replace and seal, as necessary.
EXCESSIVE OIL CONSUMPTION	(1) Oil level too high.	(1) Lower oil level to specifications.
	(2) Oil too thin.	(2) Replace with specified oil.
	(3) Valve stem oil deflectors are damaged, missing, or incorrect type.	(3) Replace valve stem oil deflectors.
	(4) Valve stems or valve guides worn.	(4) Check stem-to-guide clearance and repair as necessary.
	(5) Piston rings broken, missing.	(5) Replace missing or broken rings.
	(6) Incorrect piston ring gap.	(6) Check ring gap, repair as necessary.
	(7) Piston rings sticking or excessively loose in grooves.	(7) Check ring side clearance, repair as necessary.
	(8) Compression rings installed upside down.	(8) Repair as necessary.
	(9) Cylinder walls worn, scored, or glazed.	(9) Repair as necessary.
	(10) Piston ring gaps not properly staggered.	(10) Repair as necessary.
	(11) Excessive main or connecting rod bearing clearance.	(11) Check bearing clearance, repair as necessary.

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Service Diagnosis—Mechanical (Continued)

Condition	Possible Cause	Correction
NO OIL PRESSURE	(1) Low oil level.	(1) Add oil to correct level.
	(2) Oil pressure gauge or sending unit inaccurate.	(2) Refer to Oil Pressure Gauge in Chapter 1L.
	(3) Oil pump malfunction.	(3) Refer to Oil Pump in Chapter 1B
	(4) Oil pressure relief valve sticking.	(4) Remove and inspect oil pressure relief valve assembly. Refer to Chapter 1B.
	(5) Oil passages on pressure side of pump obstructed.	(5) Inspect oil passages for obstructions.
	(6) Oil pickup screen or tube obstructed.	(6) Inspect oil pickup for obstructions.
	(7) Loose oil inlet tube.	(7) Replace inlet tube.
LOW OIL PRESSURE	(1) Low oil level.	(1) Add oil to correct level.
	(2) Oil excessively thin due to dilution, poor quality, or improper grade.	(2) Drain and refill crankcase with correct grade oil.
	(3) Oil pressure relief spring weak or sticking.	(3) Remove and inspect oil pressure relief valve assembly.
	(4) Oil pickup tube and screen assembly has restriction or air leak.	(4) Remove and inspect oil inlet tube and screen assembly. (Fill pickup with lacquer thinner to find leaks.) Replace if defective.
	(5) Excessive oil pump clearance.	(5) Check clearances; refer to Oil Pump in Chapter 1B.
	(6) Excessive main, rod, or camshaft bearing clearance.	(6) Measure bearing clearances, repair as necessary.
HIGH OIL PRESSURE	(1) Improper grade oil.	(1) Drain and refill crankcase with correct grade oil.
	(2) Oil pressure gauge or sending unit inacurrate.	(2) Refer to Oil Pressure Gauge in Chapter 1L.
	(3) Oil pressure relief valve sticking closed.	(3) Remove and inspect oil pressure relief valve assembly.
	(4) Oil pressure relief valve anti-lock port blocked (eight-cylinder only).	(4) Check for obstruction; repair as necessary.
MAIN BEARING NOISE	(1) Insufficient oil supply.	(1) Check for low oil level or low oil pressure.
	(2) Main bearing clearance excessive.	(2) Check main bearing clearance, repair as necessary.
	(3) Crankshaft end play excessive.	(3) Check end play, repair as necessary.
	(4) Loose flywheel or drive plate.	(4) Tighten flywheel or drive plate bolts.
	(5) Loose or damaged vibration damper.	(5) Repair as necessary.

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Service Diagnosis—Mechanical (Continued)

Condition	Possible Cause	Correction
CONNECTING ROD BEARING NOISE	(1) Insufficient oil supply.	(1) Check for low oil level or low oil pressure.
	(2) Bearing clearance excessive or bearing missing.	(2) Check clearance, repair as necessary.
	(3) Crankshaft connecting rod journal out-of-round.	(3) Check journal measurements, repair or replace as necessary.
	(4) Misaligned connecting rod or cap.	(4) Repair as necessary.
	(5) Connecting rod bolts tightened improperly.	(5) Tighten bolts to specified torque.
PISTON NOISE	(1) Piston-to-cylinder wall clearance excessive.	(1) Check clearance, repair as necessary.
	(2) Cylinder walls excessively tapered or out-of-round.	(2) Check cylinder wall measurements, rebore cylinder.
	(3) Piston ring broken.	(3) Replace all rings on that piston.
	(4) Loose or seized piston pin.	(4) Check piston-to-pin clearance, repair as necessary.
	(5) Connecting rods misaligned.	(5) Check rod alignment, straighten or replace.
	(6) Piston ring side clearance excessively loose or tight.	(6) Check ring side clearance, repair as necessary.
	(7) Carbon build-up on piston is excessive.	(7) Clean carbon from piston.
VALVE TRAIN NOISE	(1) Insufficient oil supply.	(1) Check for: (a) Low oil level. (b) Low oil pressure. (c) Plugged pushrods. (d) Wrong hydraulic tappets. (e) Plugged oil gallery in block. (f) Excessive tappet to bore clearance
	(2) Push rods worn or bent.	(2) Replace worn or bent push rods.
	(3) Rocker arms or pivots worn.	(3) Replace worn rocker arms or pivots.
	(4) Dirt or chips in hydraulic tappets.	(4) Clean tappets.
	(5) Excessive tappet leak-down.	(5) Replace valve tappet.
	(6) Tappet face worn.	(6) Replace tappet; check corresponding cam lobe for wear.
	(7) Broken or cocked valve springs.	(7) Properly seat cocked springs; replace broken springs.
	(8) Stem-to-guide clearance excessive.	(8) Check stem-to-guide clearance, ream guide, install oversize valve.
	(9) Valve bent.	(9) Replace valve.
	(10) Loose rocker arms.	(10) Tighten bolts to specified torque.
	(11) Valve seat runout excessive.	(11) Regrind valve seat/valves.
	(12) Missing valve lock.	(12) Install valve lock.
	(13) Push rod rubbing or contacting cylinder head.	(13) Remove cylinder head and remove obstruction in head.

Service Diagnosis—Performance

Condition	Possible Cause	Correction
HARD STARTING (ENGINE CRANKS NORMALLY)	(1) Binding linkage, choke valve or choke piston.	(1) Repair as necessary.
	(2) Restricted choke vacuum and hot air passages.	(2) Clean passages.
	(3) Improper fuel level.	(3) Adjust float level.
	(4) Dirty, worn or faulty needle valve and seat.	(4) Repair as necessary.
	(5) Float sticking.	(5) Repair as necessary.
	(6) Exhaust manifold heat valve stuck (eight-cylinder engine only).	(6) Lubricate or replace.
	(7) Faulty fuel pump.	(7) Replace fuel pump.
	(8) Incorrect choke cover adjustment.	(8) Adjust choke cover.
	(9) Inadequate unloader adjustment.	(9) Adjust unloader.
	(10) Faulty ignition coil.	(10) Test and replace as necessary.
	(11) Improper spark plug gap.	(11) Adjust gap.
	(12) Incorrect initial timing.	(12) Adjust timing.
	(13) Incorrect valve timing.	(13) Check valve timing; repair as necessary.
ROUGH IDLE OR STALLING	(1) Incorrect curb or fast idle speed.	(1) Adjust curb or fast idle speed.
	(2) Incorrect initial timing.	(2) Adjust timing to specifications.
	(3) Improper idle mixture adjustment.	(3) Adjust idle mixture.
	(4) Damaged tip on idle mixture screw(s).	(4) Replace mixture screw(s).
	(5) Improper fast idle cam adjustment.	(5) Adjust fast idle speed.
	(6) Faulty EGR valve operation.	(6) Test EGR system and replace as necessary.
	(7) Faulty PCV valve air flow.	(7) Test PCV valve and replace as necessary.
	(8) Exhaust manifold heat valve inoperative (eight-cylinder engine only).	(8) Lubricate or replace heat valve as necessary.
	(9) Choke binding.	(9) Locate and eliminate binding condition.
	(10) Improper choke setting.	(10) Adjust choke.
	(11) Faulty TAC unit.	(11) Repair as necessary.

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Service Diagnosis—Performance (Continued)

Condition	Possible Cause	Correction
ROUGH IDLE OR STALLING (Continued)	(12) Air leak into manifold vacuum.	(12) Check manifold vacuum and repair as necessary.
	(13) Improper fuel level.	(13) Adjust fuel level.
	(14) Faulty distributor rotor or cap.	(14) Replace rotor or cap.
	(15) Leaking engine valves.	(15) Perform cylinder combustion or compression test, repair as necessary.
	(16) Incorrect ignition wiring.	(16) Check wiring and correct as necessary.
	(17) Faulty coil.	(17) Test coil and replace as necessary.
	(18) Clogged air bleed or idle passages.	(18) Clean passages.
	(19) Restricted air cleaner.	(19) Clean or replace air cleaner.
FAULTY LOW-SPEED OPERATION	(1) Clogged idle transfer slots.	(1) Clean transfer slots.
	(2) Restricted idle air bleeds and passages.	(2) Clean air bleeds and passages.
	(3) Restricted air cleaner.	(3) Clean or replace air cleaner.
	(4) Improper fuel level.	(4) Adjust fuel level.
	(5) Faulty spark plugs.	(5) Clean or replace spark plugs.
	(6) Dirty, corroded, or loose secondary circuit connections.	(6) Clean or tighten secondary circuit connections.
	(7) Faulty coil wire (six- and eight-cylinder engines only).	(7) Replace coil wire.
	(8) Faulty distributor cap.	(8) Replace cap.
FAULTY ACCELERATION	(1) Improper pump stroke.	(1) Adjust pump stroke.
	(2) Incorrect ignition timing.	(2) Adjust timing.
	(3) Inoperative pump discharge check ball or needle.	(3) Clean or replace as necessary.
	(4) Faulty elastomer valve. (Eight-cylinder engine only.)	(4) Replace valve.
	(5) Worn or damaged pump diaphragm or piston.	(5) Replace diaphragm or piston.
	(6) Leaking main body cover gasket.	(6) Replace gasket.
	(7) Engine cold and choke too lean.	(7) Adjust choke.
	(8) Improper metering rod adjustment (BBD Model carburetor)	(8) Adjust metering rod.

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Service Diagnosis—Performance (Continued)

Condition	Possible Cause	Correction
FAULTY ACCELERATION (Continued)	(9) Faulty spark plug(s).	(9) Clean or replace spark plug(s).
	(10) Leaking engine valves.	(10) Check cylinder leakdown rate or compression, repair as necessary.
	(11) Faulty coil.	(11) Test coil and replace as necessary.
FAULTY HIGH SPEED OPERATION	(1) Incorrect ignition timing.	(1) Adjust timing.
	(2) Faulty distributor centrifugal advance.	(2) Check centrifugal advance and repair as necessary.
	(3) Faulty distributor vacuum advance.	(3) Check vacuum advance and repair as necessary.
	(4) Low fuel pump volume.	(4) Replace fuel pump.
	(5) Wrong spark plug gap; wrong plug.	(5) Adjust gap; install correct plug.
	(6) Faulty choke operation.	(6) Adjust choke.
	(7) Partially restricted exhaust manifold, exhaust pipe, muffler or tailpipe.	(7) Eliminate restriction.
	(8) Clogged vacuum passages.	(8) Clean passages.
	(9) Improper size or obstructed main jet.	(9) Clean or replace as necessary.
	(10) Restricted air cleaner.	(10) Clean or replace as necessary.
	(11) Faulty distributor rotor or cap.	(11) Replace rotor or cap.
	(12) Faulty coil.	(12) Test coil and replace as necessary.
	(13) Leaking engine valve(s).	(13) Perform cylinder combustion or compression test, repair as necessary.
	(14) Faulty valve spring(s).	(14) Inspect and test valve spring tension and replace as necessary.
	(15) Incorrect valve timing.	(15) Check valve timing and repair as necessary.
	(16) Intake manifold restricted.	(16) Remove restriction or replace manifold.
	(17) Worn distributor shaft.	(17) Replace shaft.

Service Diagnosis—Performance (Continued)

Condition	Possible Cause	Correction
MISFIRE AT ALL SPEEDS	(1) Faulty spark plug(s).	(1) Clean or replace spark plug(s).
	(2) Faulty spark plug wire(s).	(2) Replace as necessary.
	(3) Faulty distributor cap or rotor.	(3) Replace cap or rotor.
	(4) Faulty coil.	(4) Test coil and replace as necessary.
	(5) Trigger wheel too high.	(5) Set to specifications.
	(6) Primary circuit shorted or open intermittently.	(6) Trace primary circuit and repair as necessary.
	(7) Leaking engine valve(s).	(7) Perform cylinder combustion or compression test, repair as necessary.
	(8) Faulty hydraulic tappet(s).	(8) Clean or replace tappet(s).
	(9) Faulty valve spring(s).	(9) Inspect and test valve spring tension, repair as necessary.
	(10) Worn lobes on camshaft.	(10) Replace camshaft.
	(11) Air leak into manifold vacuum.	(11) Check manifold vacuum and repair as necessary.
	(12) Improper carburetor settings.	(12) Adjust carburetor.
	(13) Fuel pump volume or pressure low.	(13) Replace fuel pump.
	(14) Blown cylinder head gasket.	(14) Replace gasket.
	(15) Intake or exhaust manifold passage(s) restricted.	(15) Pass chain through passages.
	(16) Wrong trigger wheel.	(16) Install correct wheel.
POWER NOT UP TO NORMAL	(1) Incorrect ignition timing.	(1) Adjust timing.
	(2) Faulty distributor rotor.	(2) Replace rotor.
	(3) Trigger wheel positioned too high or loose on shaft.	(3) Reposition or replace trigger wheel.
	(4) Incorrect spark plug gap.	(4) Adjust gap.
	(5) Faulty fuel pump.	(5) Replace fuel pump.
	(6) Incorrect valve timing.	(6) Check valve timing and repair as necessary.
	(7) Faulty coil.	(7) Test coil and replace as necessary.
	(8) Faulty ignition.	(8) Test wires and replace as necessary.
	(9) Leaking engine valves.	(9) Perform cylinder combustion or compression test, and repair as necessary.
	(10) Blown cylinder head gasket.	(10) Replace gasket.

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Service Diagnosis—Performance (Continued)

Condition	Possible Cause	Correction
POWER NOT UP TO NORMAL (Continued)	(11) Leaking piston rings.	(11) Check compression and repair as necessary.
	(12) Worn distributor shaft.	(12) Replace shaft.
INTAKE BACKFIRE	(1) Improper ignition timing.	(1) Adjust timing.
	(2) Faulty accelerator pump discharge.	(2) Repair as necessary.
	(3) Improper choke operation.	(3) Repair as necessary.
	(4) Defective EGR CTO valve.	(4) Replace EGR CTO valve.
	(5) Defective TAC unit.	(5) Repair as necessary.
	(6) Lean fuel mixture.	(6) Check float level or manifold vacuum for air leak. Remove sediment from bowl.
EXHAUST BACKFIRE	(1) Air leak into manifold vacuum.	(1) Check manifold vacuum and repair as necessary.
	(2) Faulty diverter valve.	(2) Test diverter valve and replace as necessary.
	(3) Faulty choke operation.	(3) Repair as necessary.
	(4) Exhaust leak.	(4) Locate and eliminate leak.
PING OR SPARK KNOCK	(1) Incorrect ignition timing.	(1) Adjust timing.
	(2) Distributor centrifugal or vacuum advance malfunction.	(2) Check advance and repair as necessary.
	(3) Excessive combustion chamber deposits.	(3) Use combustion chamber cleaner.
	(4) Carburetor set too lean.	(4) Adjust carburetor.
	(5) Air leak into manifold vacuum.	(5) Check manifold vacuum and repair as necessary.
	(6) Excessively high compression.	(6) Check compression and repair as necessary.
	(7) Fuel octane rating excessively low.	(7) Try alternate fuel source.
	(8) Heat riser stuck in heat ON position (eight-cylinder engine only).	(8) Free-up or replace heat riser.
	(9) Sharp edges in combustion chamber.	(9) Grind smooth.
SURGING (CRUISING SPEEDS TO TOP SPEEDS)	(1) Low fuel level.	(1) Adjust fuel level.
	(2) Low fuel pump pressure or volume.	(2) Replace fuel pump.
	(3) Metering rod(s) not adjusted properly (BBD Model Carburetor).	(3) Adjust metering rod.

Service Diagnosis—Performance (Continued)

Condition	Possible Cause	Correction
SURGING (CRUISING SPEEDS TO TOP SPEEDS) (Continued)	(4) Improper PCV valve air flow.	(4) Test PCV valve and replace as necessary.
	(5) Air leak into manifold vacuum.	(5) Check manifold vacuum and repair as necessary.
	(6) Clogged main jet(s).	(6) Clean main jet(s).
	(7) Undersize main jet(s).	(7) Replace main jet(s).
	(8) Blocked air bleeds.	(8) Clean air bleeds.
	(9) Clogged fuel filter screen.	(9) Replace fuel filter.
	(10) Restricted air cleaner.	(10) Clean or replace air cleaner.

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DIAGNOSIS WITH SCOPE ANALYZER

The scope analyzer is an ignition system tester that provides a quick and accurate means for diagnosis of ignition system performance problems. All phases of the ignition cycle are displayed graphically on an oscilloscope (cathode ray tube) as they occur during engine operation.

The manufacturers of scope analyzer equipment provide descriptions of the test procedures possible with their equipment. This section is not intended to describe all uses of scope analyzer equipment, but to indicate differences in scope pattern between the HEI (High Energy Ignition) and SSI (Solid State Ignition) systems used on Jeep engines (fig. 1A-1).

The upper display illustrates a typical scope pattern for the HEI system from firing line to firing line and areas of the pattern significant for diagnosis. The scope pattern displays the time duration horizontally and voltage amplitude vertically.

Compare the scope pattern of the HEI system with the typical pattern of the SSI system.

The SSI waveform pattern is below the zero voltage line (i.e., negative) during oscilation dampening but otherwise is similar to that of the HEI system in this area.

Other than the differences noted, scope analyzer ignition system diagnosis for HEI and SSI systems is essentially the same.

CYLINDER COMPRESSION PRESSURE TEST

A cylinder compression pressure test is useful for identifying the cylinder(s) with an abnormal compression pressure. With this information available, additional testing/inspection will provide the exact cause of the pressure loss.

(1) Clean spark plug recesses with compressed air.

(2) Remove spark plugs.

(3) Remove coil wire from distributor caps and connect to ground (six- and eight-cylinder engines). Disconnect distributor wire harness connector for four-cylinder engines.

(4) Secure throttle in wide open position.

NOTE: *Ensure battery and starter motor are in good operating condition before starting test.*

(5) Insert compression pressure gauge, engage starter motor and turn engine for three revolutions. Record compression pressure on third revolution.

(6) Test remaining cylinders and record compression pressures.

(7) Refer to Compression Pressure chart.

Compression Pressure

Engine	Pressure—PSI (kPa)	Max. Cyl. Deviation—PSI (kPa)
Four-Cylinder	140 (965)	30 (207)
Six-Cylinder	120-140 (827-965)	30 (207)
Eight-Cylinder	120-140 (827-965)	30 (207)

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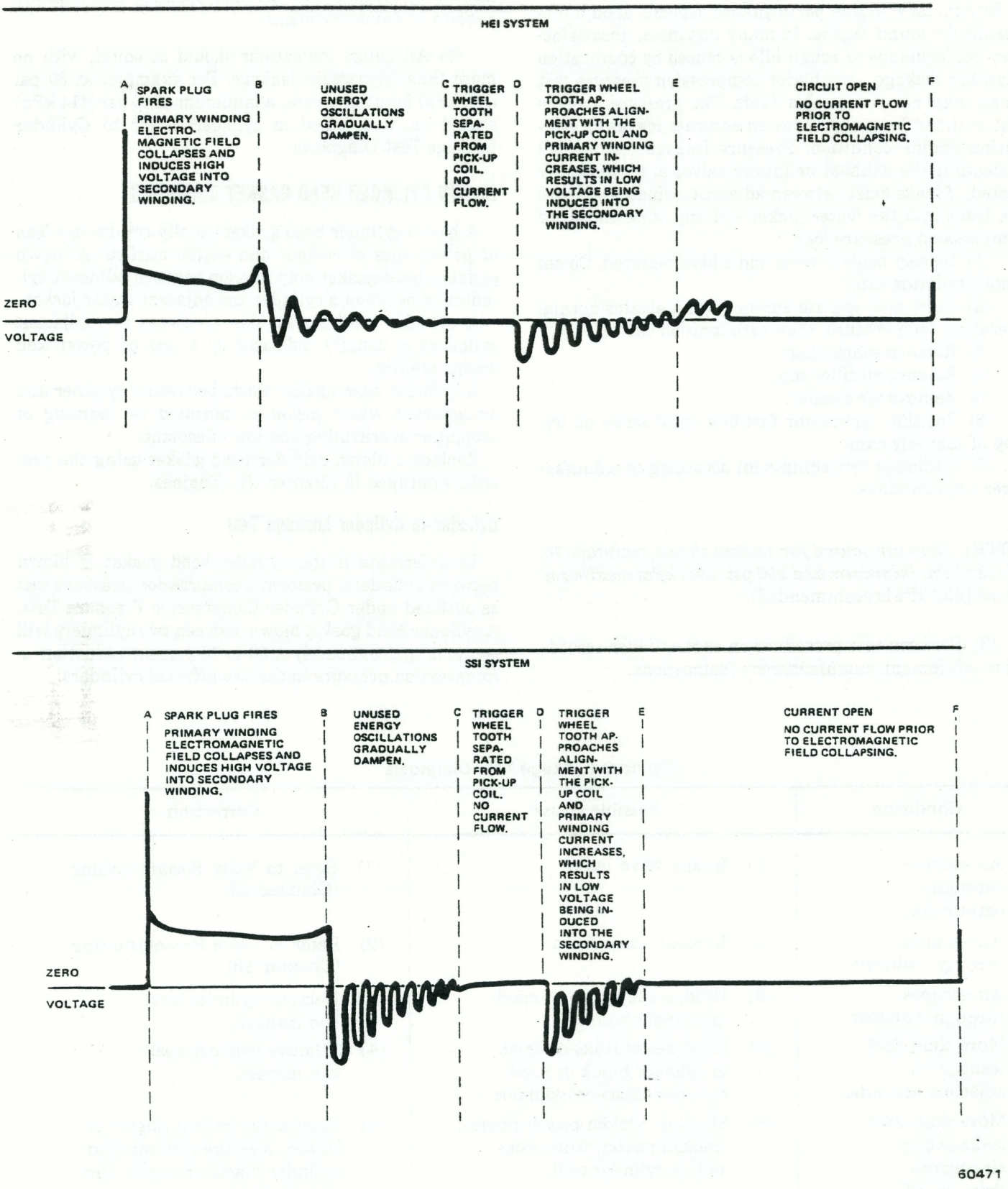

Fig. 1A-1 Scope Diagnosis Patterns

CYLINDER (COMBUSTION CHAMBER) LEAKAGE TEST

Satisfactory engine performance depends upon a mechanically sound engine. In many instances, unsatisfactory performance or rough idle is caused by combustion chamber leakage. A cylinder compression pressure test alone may not reveal this fault. The pressure leakage test outlined below provides an accurate means of evaluating engine condition. Pressure leakage testing will indicate if the exhaust or intake valves are improperly seated, if leaks exist between adjacent cylinders, if there are leaks into the water jacket and any other causes of compression pressure loss.

(1) Inspect coolant level and add as required. Do not install radiator cap.

(2) Start and operate engine until it attains normal operating temperature, then turn ignition Off.

(3) Remove spark plugs.

(4) Remove oil filler cap.

(5) Remove air cleaner.

(6) Position carburetor fast idle speed screw on top step of fast idle cam.

(7) Calibrate test equipment according to manufacturer's instructions.

NOTE: *Shop air source for testing should maintain 70 psi (483 kPa) minimum and 200 psi (1380 kPa) maximum (80 psi* [552 kPa] recommended).

(8) Perform test procedure on each cylinder according to equipment manufacturer's instructions.

NOTE: *While testing, listen for air escaping through carburetor, tailpipe and oil filler opening, and look for bubbles in radiator coolant.*

(9) All gauge indications should be equal, with no more than 25 percent leakage. For example, at 80 psi (552 kPa) input pressure, a minimum of 60 psi (414 kPa) should be maintained in cylinder. Refer to Cylinder Leakage Test Diagnosis.

BLOWN CYLINDER HEAD GASKET DIAGNOSIS

A blown cylinder head gasket usually results in a loss of power, loss of coolant and engine misfire. A blown cylinder head gasket may develop between adjacent cylinders or between a cylinder and adjacent water jacket.

A cylinder head gasket blown between two adjacent cylinders is usually indicated by a loss of power and engine misfire.

A cylinder head gasket blown between a cylinder and an adjacent water jacket is indicated by foaming of coolant or overheating and loss of coolant.

Replace a blown cylinder head gasket using the procedure outlined in Chapter 1B—Engines.

Cylinder-to-Cylinder Leakage Test

To determine if the cylinder head gasket is blown between cylinders, perform a compression pressure test as outlined under Cylinder Compression Pressure Test. A cylinder head gasket blown between two cylinders will result in approximately a 50 to 70 percent reduction in compression pressure in the two affected cylinders.

Cylinder Leakage Test Diagnosis

Condition	Possible Cause	Correction
(1) Air escapes through carburetor.	(1) Intake valve leaks.	(1) Refer to Valve Reconditioning (Chapter 1B).
(2) Air escapes through tailpipe.	(2) Exhaust valve leaks.	(2) Refer to Valve Reconditioning (Chapter 1B).
(3) Air escapes through radiator.	(3) Head gasket leaks or crack in cylinder block.	(3) Remove cylinder head and inspect.
(4) More than 25% leakage on adjacent cylinder.	(4) Head gasket leaks or crack in cylinder block or head between adjacent cylinders.	(4) Remove cylinder head and inspect.
(5) More than 25% leakage and air escapes through oil filler cap opening only.	(5) Stuck or broken piston ring(s); cracked piston; worn rings and/or cylinder wall.	(5) Inspect for broken ring(s) or piston. Measure ring gap and cylinder diameter, taper, and out-of-round.

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Cylinder-to-Water Jacket Leakage Test

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(1) Remove radiator cap and start engine. Allow engine to warm up until thermostat opens.

(2) If large compression/combustion pressure leak exists, bubbles will be visible in coolant.

(3) If bubbles are not visible, install radiator pressure tester and pressurize system. If cylinder compression and combustion pressure is leaking into water jacket, pointer will pulsate with every combustion stroke of piston.

INTAKE MANIFOLD LEAKAGE DIAGNOSIS

An intake manifold air leak is characterized by lower than normal manifold vacuum. One or more cylinders may be "dead."

Exterior Leak

Two tests are possible, one with engine oil and one with acetylene.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(1) Start engine.

(2) Apply oil to gasket edge areas between intake manifold and cylinder head. If oil is forced into manifold, or if smoke is evident in exhaust, manifold has air leak.

(3) Open acetylene valve of oxyacetylene torch. **Do not ignite.** Pass torch tip over gasket edge areas. If engine speed increases, manifold has leak.

Interior Leak—Eight-Cylinder Engine Only

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(1) Start engine. Remove PCV valve hose from intake manifold.

(2) Plug PCV valve hose fitting in manifold. Allow PCV valve to hang free.

(3) Remove oil filler cap. Cover filler tube with palm of hand. If vacuum is felt, crankcase is exposed to intake manifold or cylinder head vacuum.

(4) Remove intake manifold. Inspect for casting flaws.

(5) Inspect cylinder head for casting flaws. Thoroughly inspect area around intake valves and intake valve ports.

(6) With valve closed, fill port with gasoline and inspect for leaks. Alternate method: wrap shop cloth around air nozzle and apply air pressure to port. Listen for leaks.

ENGINE TUNE-UP

	Page		Page
Engine Assemblies	1A-16	General	1A-15
Exhaust Systems	1A-23	Ignition Systems	1A-16
Fuel Systems	1A-20	Specifications	1A-23

GENERAL

A complete, precision tune-up is required at the interval outlined in the Engine Maintenance Schedule. A tune-up will accomplish several things. First, it will assure that the engine is operating as efficiently and as economically as it was designed to operate. Second, it will assure that the undesirable exhaust and fuel vapor emissions are within the limits defined by Federal regulations.

A complete, precision tune-up includes all of the tasks listed in the Engine Maintenance Schedule. Some tasks involve highly-precision emission control devices. These devices are explained within the applicable systems in their respective chapters of this manual. They are included in this chapter for reference only.

For convenience, when performing a precision tune-up, the necessary services are grouped together by systems.

ENGINE ASSEMBLIES

Oil Filler Cap

On eight-cylinder engines, a polyurethane foam filter in the oil filler cap filters air coming into the PCV system. To clean the filter, apply light air pressure in the direction opposite normal air flow (through the filler tube opening). If the filter is deteriorated, replace the filler cap.

Drive Belts

Inspect belts for defects such as fraying or cracking. Test belt tension. Belt adjustment, arrangement and tension specifications are described in Chapter 1C—Cooling Systems.

Vacuum Fittings and Hoses

Inspect vacuum fittings for looseness and corrosion. Inspect rubber hoses for brittleness and cracking. Thoroughly inspect the hose ends that are slipped onto nipples. Engine performance may be adversely affected by air leaks in such unlikely places as the heater and air conditioner control hoses, Cruise Command hoses or the power brake booster hose.

IGNITION SYSTEMS

Spark Plugs

Remove and examine spark plugs for burned electrodes and fouled, cracked or broken porcelain insulators. Keep plugs arranged in the order removed from the engine. An isolated plug displaying an abnormal condition indicates that a problem exists in the cylinder from where it was removed. Replace plugs at the mileage interval recommended in the Engine Maintenance Schedule. Plugs that have less engine mileage may be cleaned and reused if not otherwise defective. Refer to Spark Plug Condition. After cleaning, file the center electrode flat with a point file. Adjust the gap clearance 0.033-0.038 inch (0.84-0.97 mm) for six- and eight-cylinder engines, and 0.060 inch (1.52 mm) for four-cylinder engines (fig. 1A-2).

Always use a torque wrench when installing spark plugs. Distortion from overtightening will change the gap clearance of the plug. For four- and six-cylinder engines, tighten plugs with 7 to 15 foot-pounds (9.5 to 23 N•m) torque. For eight-cylinder engines, tighten plugs with 25 to 30 foot-pounds (34 to 41 N•m) torque.

Spark Plug Condition

Refer to figure 1A-3. Compare the spark plugs with the illustrations and the following descriptions.

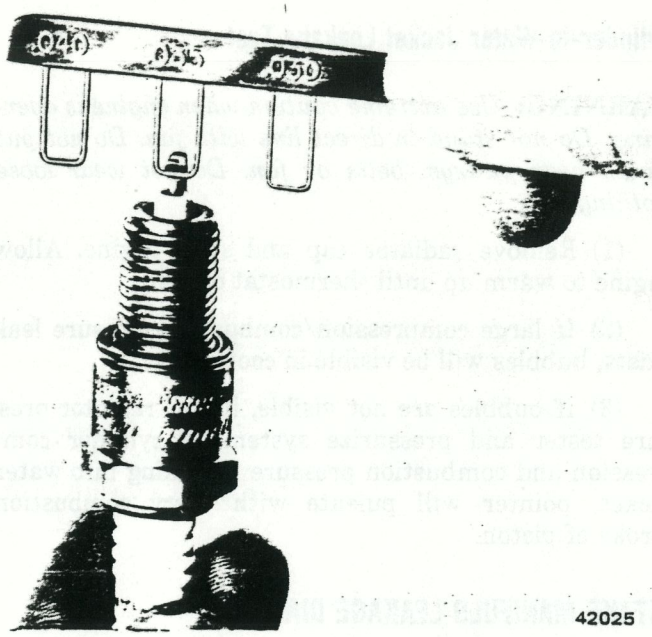


Fig. 1A-2 Spark Plug Gap Adjustment

A—Gap Bridging

Gap bridging may be traced to loose deposits in the combustion chamber. These deposits accumulate on the plugs during continuous stop-and-go driving. When the engine is suddenly subjected to a heavy load, the deposits partially liquefy and bridge the gap.

B—Scavenger Deposits

Fuel scavenger deposits may be either white or yellow. They may appear to be harmful but this is a normal condition caused by additives in certain fuels. Such additives are designed to change the chemical nature of deposits and lessen misfire tendencies. Notice that accumulation on the ground electrode and shell areas may be heavy, but the deposits are easily removed. Plugs with scavenger deposits can be considered as being in normal condition and can be cleaned using standard procedures.

C—Chipped Insulator

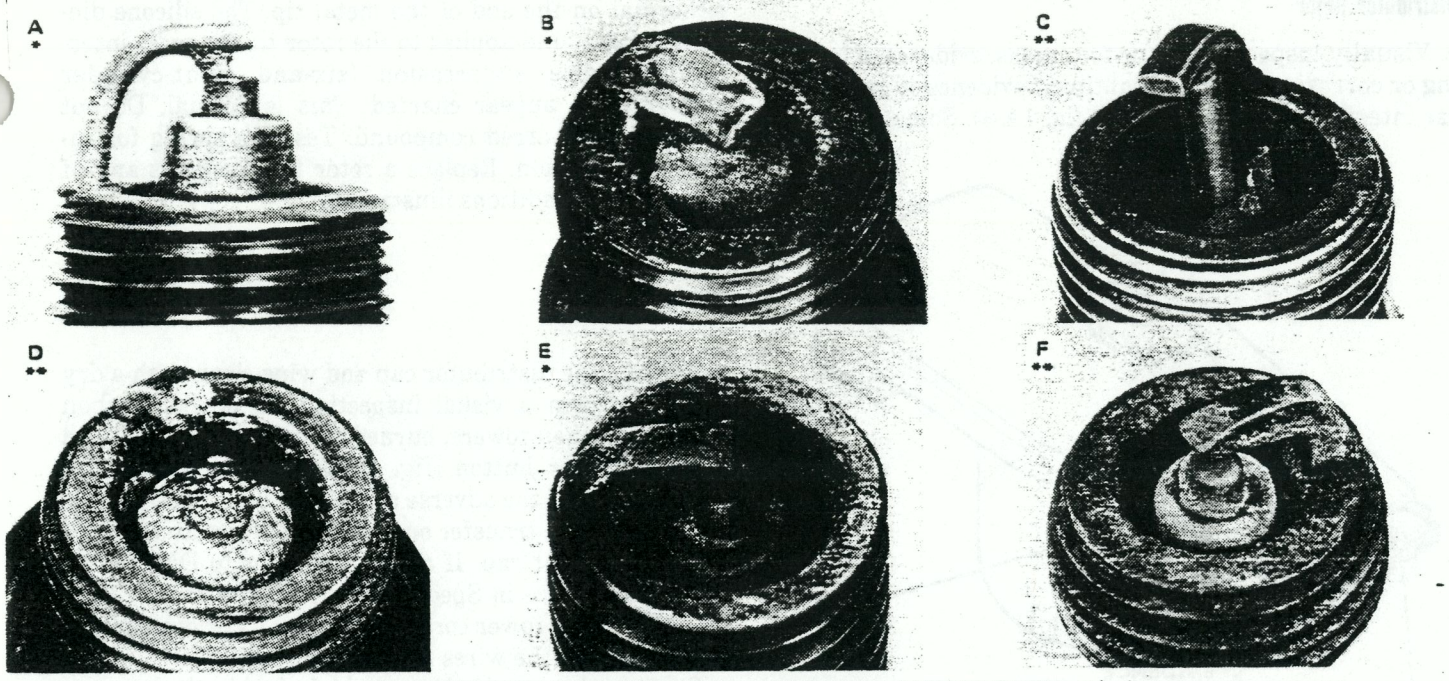
Chipped insulators usually result from bending the center electrode while adjusting the plug gap. Under certain conditions, severe detonation can also split insulators.

D—Pre-ignition Damage

Pre-ignition damage is caused by excessive combustion chamber temperature. First, the center electrode dissolves and, somewhat later, the ground electrode. Insulators appear relatively deposit free. Determine if plug has correct heat range and if ignition timing is overadvanced or if other similar conditions exist for overheating.

E—Cold Fouling (or Carbon Fouling)

Cold fouling is basically a carbon deposit. A dry, black deposit on one or two plugs in a set may be caused by sticking valves or defective spark plug wires. Fouling of the entire set may be caused by a clogged air cleaner, a sticking exhaust manifold heat valve (eight-cylinder engine only) or a faulty choke.



* LOW MILEAGE PLUGS WITH THIS CONDITION MAY BE CLEANED
** PLUGS WITH THIS CONDITION MUST BE REPLACED

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Fig. 1A-3 Spark Plug Conditions

F—Overheating

Overheating is indicated by a drab white or gray insulator that appears blistered. Electrode gap wear rate will be considerably in excess of 0.001 inch (0.025 mm) per 1000 miles. This may suggest that a cooler heat range plug should be used. Overadvanced ignition timing, detonation and cooling system malfunctions can also cause plug overheating.

NOTE: *Some fuel refiners are using a manganese additive (MMT) in unleaded fuel. During combustion, MMT fuel covers the entire tip of the spark plug with a rust-colored deposit. This rust color may be misdiagnosed as being caused by coolant in the combustion chamber. Spark plug performance is not affected by MMT deposits.*

Spark Plug Wires

To remove wires from spark plugs, twist the rubber protector boot approximately 1/2-turn to break the seal. Grasp the boot and pull it from the plug with steady, even force. Do not pull on the wire itself because this will damage the wire.

To remove wires from the distributor cap or coil tower, loosen the boot first, then grasp the upper part of the boot and the wire and gently pull straight up.

Wire Test

Do not puncture spark plug wires with a probe to perform any test. This may cause a separation in the conductor. Remove the suspected wire and use an ohmmeter to test for correct resistance according to the length of the particular wire.

Wire Resistance Values

Inches	Ohms
0 to 15	3,000 to 10,000
15 to 25	4,000 to 15,000
25 to 35	6,000 to 20,000
Over 35	8,000 to 25,000

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When installing spark plug wires and the coil high voltage wire, ensure there is a good, tight connection at the spark plug, distributor cap tower and coil tower (six- and eight-cylinder engines only). The protector boots on the spark plugs and distributor cap must fit tightly. A partially seated wire creates an additional gap (resistance) in the circuit and the resulting arc will cause terminal corrosion, wire damage and decrease the voltage at the spark plugs.

Ignition Coil

Always test a suspected defective ignition coil on the engine. Because a coil may break down after the engine has heated it to operating temperature, it is important that the coil be at operating temperature when tests are performed. Perform the tests following the instructions furnished by the test equipment manufacturer.

Distributor

The distributor used on all engines is a solid state, electronically controlled type (i.e., no contact points). Other than the cap and rotor inspection listed in the Engine Maintenance Schedule, there is no scheduled maintenance for distributors. Refer to Chapter 1G—Ignition Systems for distributor service procedures.

Distributor Rotor

Visually inspect the rotor for cracks, evidence of burning or corrosion on the metal tip, or evidence of mechanical interference with the cap (fig. 1A-4). Some charring is normal on the end of the metal tip. The silicone dielectric compound applied to the rotor tip for radio interference noise suppression (six-and eight-cylinder engines) will appear charred. This is normal. Do not remove the charred compound. Test the spring for insufficient tension. Replace a rotor that displays any of the adverse conditions illustrated.

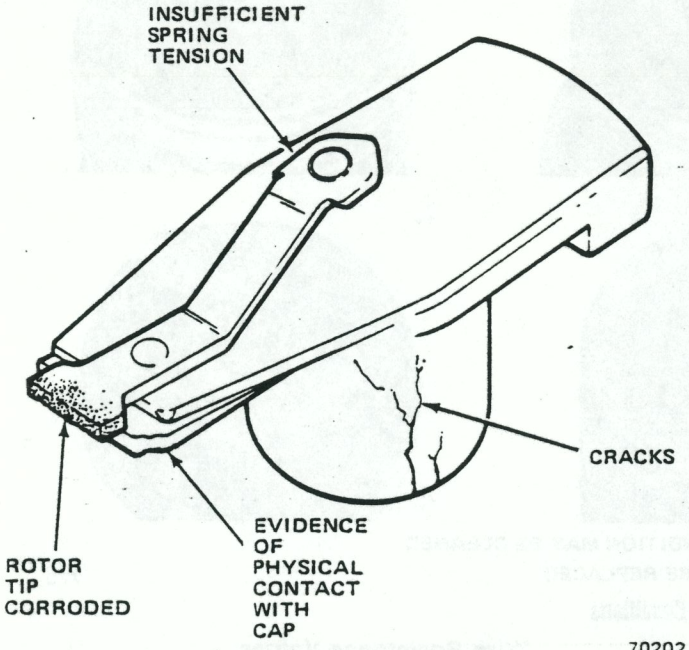

Fig. 1A-4 Rotor Inspection

Distributor Cap

Remove the distributor cap and wipe clean with a dry cloth. Perform a visual inspection for cracks, carbon runners, broken towers, burned or eroded terminals and damaged rotor button (fig. 1A-5). Replace a cap that displays any of the adverse conditions illustrated. When replacing a cap, transfer one spark plug wire at a time to the replacement cap. If necessary, refer to Distributor Wiring Sequence in Specifications. Ensure each wire is installed in the tower corresponding to its original tower position. Push the wires firmly into place.

Replace the cap if the terminals inside the cap are excessively burned. The vertical face of a terminal will indicate some evidence of burning through normal operation. Examine the terminals for evidence of mechanical interference with the rotor tip.

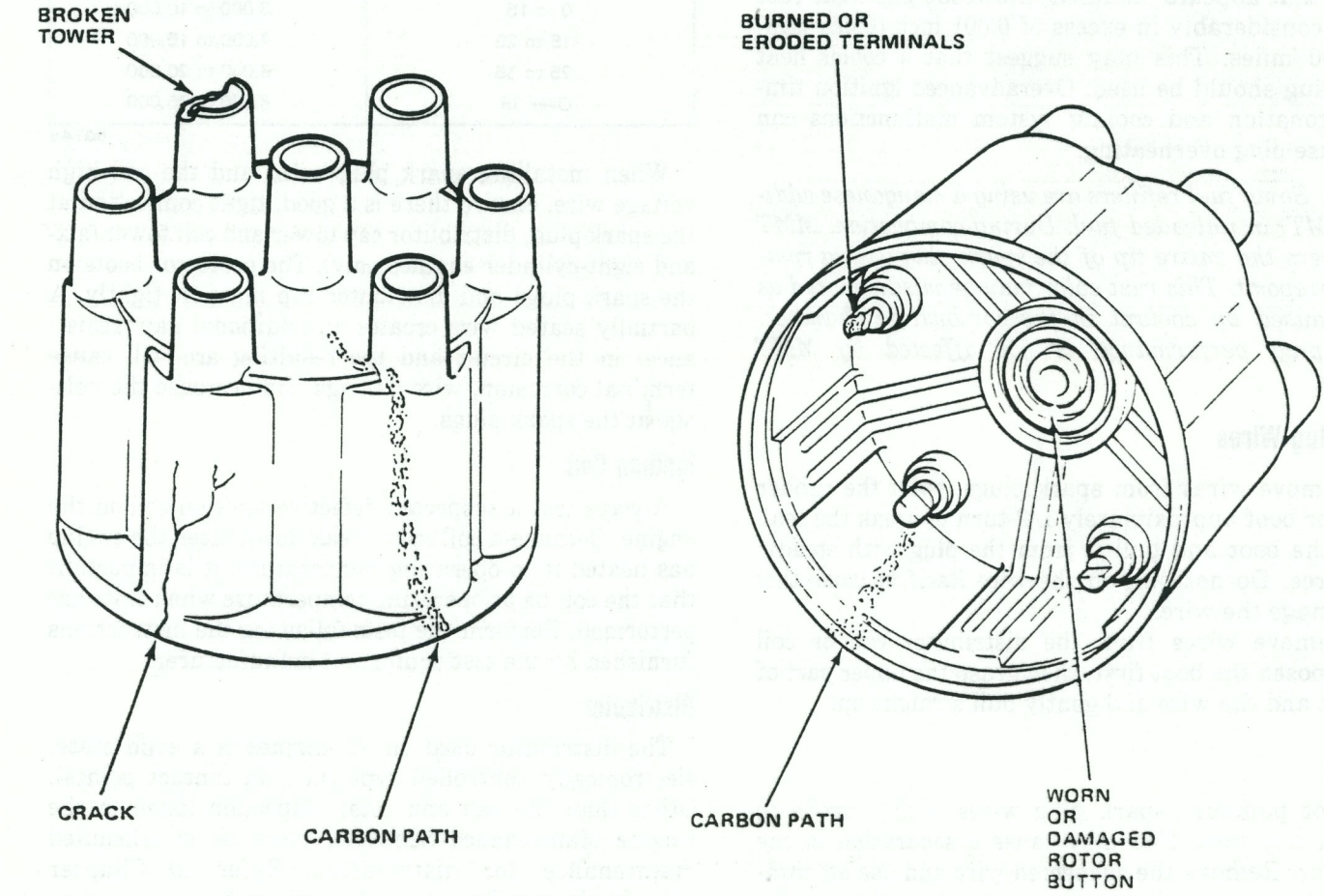

Fig. 1A-5 Distributor Cap Inspection—Typical

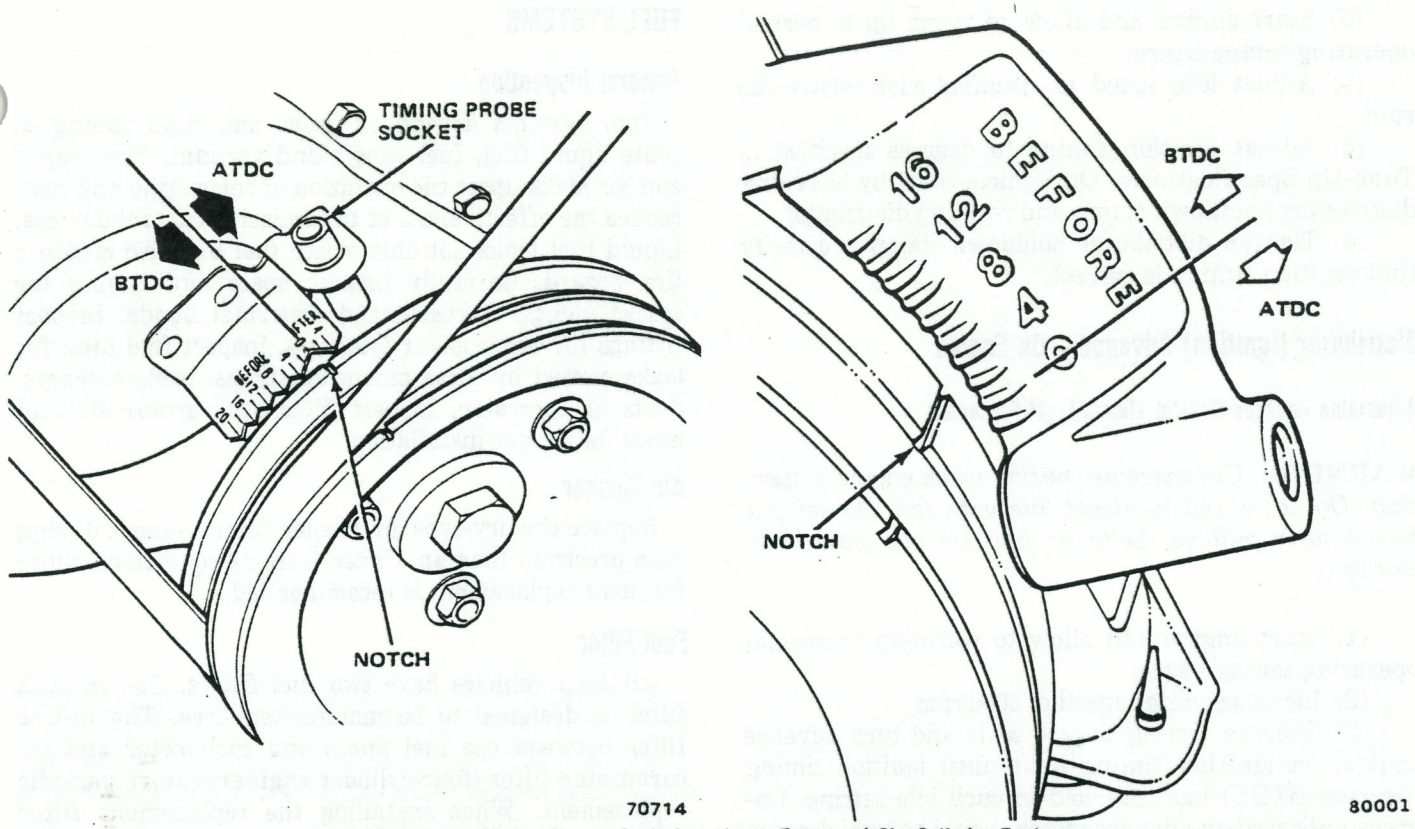

Fig. 1A-6 Timing Degree Scale Location—Four- and Six-Cylinder Engines

Ignition Timing

A graduated timing degree scale located on the timing case cover is used for timing each ignition system. A notch milled into the vibration damper is used to reference the No. 1 cylinder crankshaft firing position with the correct timing mark on the scale (figs. 1A-6 and 1A-7).

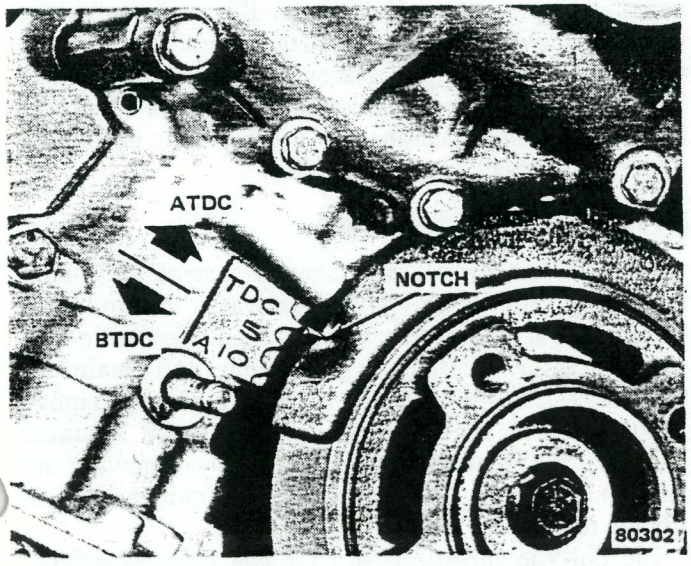

Fig. 1A-7 Timing Degree Scale Location—Eight-Cylinder Engine

Magnetic Timing Probe

A socket integral with the timing degree scale on the timing case cover is provided for use with a special magnetic timing probe that detects the milled notch in the vibration damper. The probe is inserted through the socket until it touches the vibration damper and is automatically spaced away from the damper by damper eccentricity. Ignition timing is indicated on a meter or computer printout, depending on the manufacturer's equipment.

The socket is located at 9.5° ATDC, and the equipment is calibrated to compensate for the degree difference. **Do not use the socket location when timing an ignition system with a conventional timing light.**

Timing Procedure

(1) Disconnect and plug distributor vacuum advance hose.

(2) Connect ignition timing light and properly calibrated tachometer.

NOTE: *If the timing light has an adjustable advance control feature, turn the control to the OFF position.*

WARNING: *Use extreme caution when engine is operting. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(3) Start engine and allow to warm up to normal operating temperature.

(4) Adjust idle speed to specified curb (slow) idle rpm.

(5) Adjust ignition timing to degrees specified in Tune-Up Specifications—On Vehicle chart by loosening distributor holddown clamp and rotating distributor.

(6) Tighten distributor holddown clamp and verify that ignition timing is correct.

Distributor (Ignition) Advance—On Engine

Adjustable Advance Control Timing Light Procedure

WARNING: *Use extreme caution when engine is operting. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(1) Start engine and allow to warm-up to normal operating temperature.

(2) Increase engine speed to 2000 rpm.

(3) Observe timing degree scale and turn advance control on ignition timing light until ignition timing (degrees BTDC) has returned to curb idle setting. Degrees indicated on advance meter should be total degrees advance as specified in Tune-Up Specifications—On Vehicle chart.

(4) If total degrees advance at 2000 rpm is less than specified, disconnect and plug vacuum advance hose at distributor.

(5) Repeat steps (2) and (3) above to determine maximum centrifugal advance degrees at 2000 rpm. Refer to Distributor Curves in Specifications.

If the centrifugal advance degrees are as specified, replace the vacuum advance mechanism.

Distributor (Ignition) Advance—On Tester

Total distributor advance degrees also may be determined with the distributor removed from the engine. Follow the distributor test equipment manufacturer's instructions.

Information provided in the Distributor Curves is for on-engine testing. If the distributor advance mechanisms are tested with a distributor tester, convert the information in the Distributor Curves from engine rpm to distributor rpm and from engine degrees advance to distributor degrees advance. Divide engine rpm by 2 to obtain distributor rpm. Divide engine degrees advance by 2 to obtain distributor degrees advance. For instance, if the Distributor Curve indicates 8 to 12 degrees advance at 2000 rpm, the corresponding on-tester specifications would be 4 to 6 degrees advance at 1000 rpm.

NOTE: *The vacuum inches of mercury (or kPa) is the same, regardless if test is on-engine or off-engine.*

FUEL SYSTEMS

General Inspection

Fuel systems depend on hoses and rigid tubing to route liquid fuel, fuel vapors and vacuum. Fuel vapor and air leaks upset the operation of the engine and may reduce the effectiveness of the emission control devices. Liquid fuel leaks not only waste fuel but also create a fire hazard. Carefully inspect hoses and tubing for cracks, dents, corrosion and abnormal bends. Inspect fittings for corrosion or looseness. Inspect fuel tank for leaks caused by loose mounting straps, broken seams, dents or corrosion. Inspect filler neck grommets and hoses for proper installation.

Air Cleaner

Replace the dry-type air cleaner filter element during each precision tune-up. Under extreme conditions, more frequent replacement is recommended.

Fuel Filter

All Jeep vehicles have two fuel filters. The in-tank filter is designed to be maintenance-free. The in-line filter between the fuel pump and carburetor and in-carburetor filter (four-cylinder engine) require periodic replacement. When installing the replacement filter (six- and eight-cylinder engines), ensure the fuel return nipple is positioned at the top of the filter.

Engine Idle Speed Adjustment

General

The engine and related systems must be operating properly before performing idle speed adjustments.

The idle mixture should not require adjustment as part of a precision tune-up. The idle mixture adjustment screws are sealed on all carburetors (fig. 1J-8, 1J-9 and 1J-10). The plugs or dowel pins must be removed before the idle mixture can be adjusted. This effectively prevents indiscriminate adjustments. Do not remove the plug(s) or dowel pins and readjust the mixture screw(s) unless involved in a major carburetor overhaul, throttle body replacement or the emission of excessive CO at idle speed has been determined by a competent authority. Refer to Chapter 1J—Fuel Systems.

Idle Speed Control (Six-Cylinder Engines)

The Sol-Vac throttle positioner is part of the model BBD carburetor assembly. It is activated in two ways: by an electric holding solenoid and by a pneumatic vacuum actuator. The holding solenoid will maintain throttle position, but it does not have the ability to move the throttle to a new position. The vacuum actuator portion of the Sol-Vac, however, is capable of moving the throttle to a new position when manifold vacuum is applied to it.

The Sol-Vac throttle positioner has three positions. One is the off, or deactivated, position (curb idle); the

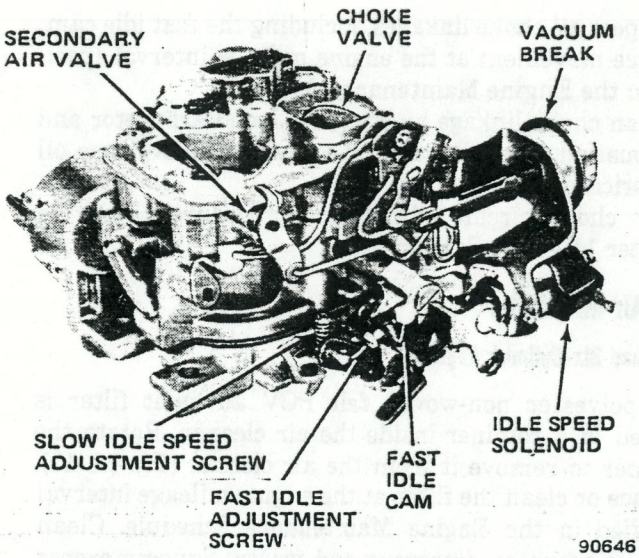

Fig. 1A-8 Rochester Model 2SE and E2SE Carburetors

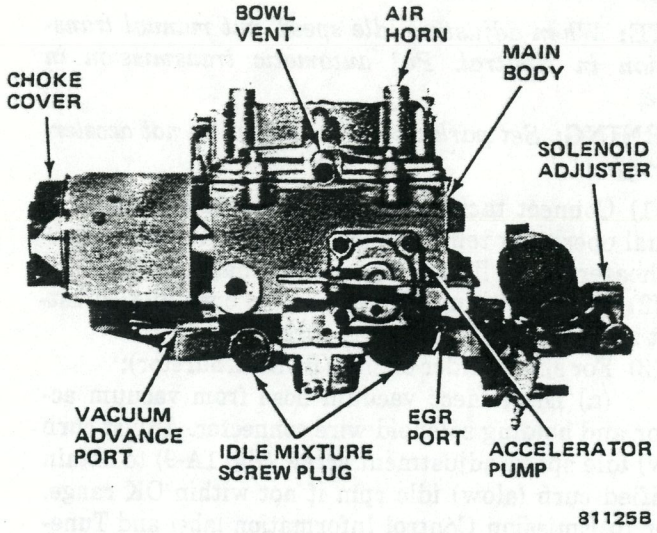

Fig. 1A-10 Motorcraft Model 2150 Carburetor

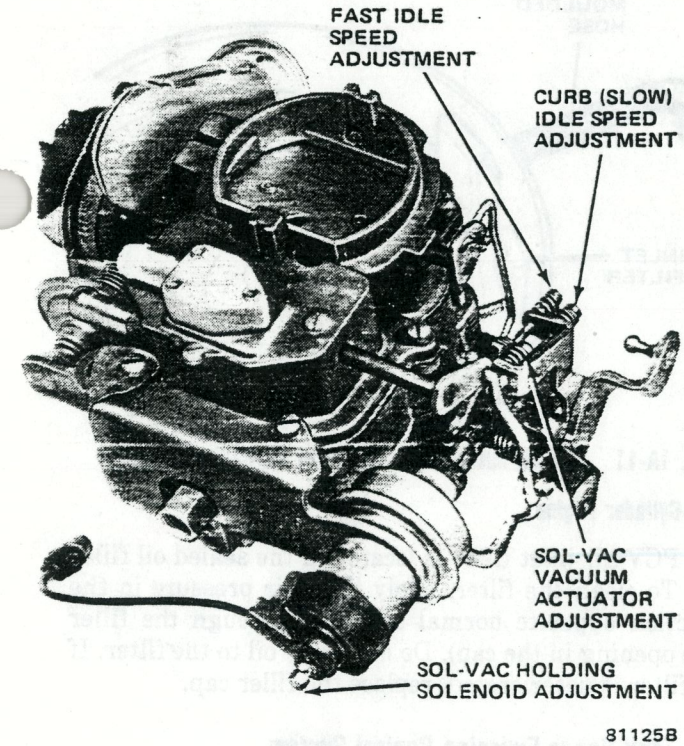

Fig. 1A-9 Carter Model BBD Carburetor

second is the holding solenoid position; and the third is the vacuum actuator position. An electric vacuum switching solenoid allows manifold vacuum stored in a reservoir to reach the vacuum actuator and engage it. The electric vacuum switching solenoid is energized by the idle speed controller.

The idle speed controller energizes the holding solenoid if either the intake manifold heater, air conditioner or rear window defroster are in use. The vacuum actuator is engaged via the thermal electric switch (TES) if the air cleaner air temperature is below 60°F or 16°C (approximately). When the air cleaner air temperature is above the switching temperature, the idle speed controller energizes the vacuum switching solenoid to engage the vacuum actuator every time the idle speed decreases to the calibrated minimum rpm. When engine rpm increases to the calibrated maximum, the vacuum actuator is disengaged by the idle speed controller and the throttle returns to either the holding solenoid position (if energized) or to the curb idle speed position.

NOTE: *The calibrated minimum and maximum rpm's for vehicles equipped with automatic transmissions are 435 ± 10 rpm and 1050 ± 100 rpm. For vehicles equipped with manual transmissions, the calibrated minimum and maximum rpm's are 463 ± 10 rpm and 1175 ± 150 rpm.*

Adjustment Precautions and General Information

- Because vehicles with automatic transmissions are adjusted in Drive, set the parking brake firmly and do not accelerate the engine.
- Bring the engine up to normal operating temperature before adjusting the idle speed.
- Perform the adjustment with the air cleaner installed.
- Do not idle the engine more than three minutes at a time.
- Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.

Idle Speed Adjustment Procedure

NOTE: *When adjusting idle speed, put manual transmission in Neutral. Put automatic transmission in Drive.*

WARNING: *Set parking brake firmly. Do not accelerate engine.*

(1) Connect tachometer, start engine and warm to normal operating temperature. Choke and intake manifold heater (six-cylinder engine only) must be off.

(2) If not within OK range, turn curb idle adjustment screw to obtain specified curb idle rpm.

(3) For six-cylinder engine (BBD carburetor):

(a) Disconnect vacuum hose from vacuum actuator and holding solenoid wire connector. Adjust curb (slow) idle speed adjustment screw (fig. 1A-9) to obtain specified curb (slow) idle rpm if not within OK range. Refer to Emission Control Information label and Tune-Up Specifications.

(b) Apply direct source of vacuum to vacuum actuator.

(c) Turn vacuum actuator adjustment screw on throttle lever until specified rpm is obtained (900 rpm for manual transmissions, and 800 rpm for automatic transmissions).

(d) Disconnect manifold vacuum source from vacuum actuator.

(e) With jumper wire apply battery voltage (12V) to energize holding solenoid. Turn A/C on, if equipped.

NOTE: *Throttle must be opened manually to allow Sol-Vac throttle positioner to be extended.*

(f) With Sol-Vac throttle positioner extended, idle speed should be 650 ± 70 rpm for automatic transmission equipped vehicles and 750 ± 70 rpm for manual transmission equipped vehicles.

(g) If idle speed is not within tolerance, adjust Sol-Vac (hex-head adjustment screw) to obtain specified rpm.

(h) Remove jumper wire from Sol-Vac holding solenoid wire connector.

(i) Connect Sol-Vac holding solenoid wire connector.

(j) Connect original hose to vacuum actuator.

(4) For four- and eight-cylinder engines (2SE, E2SE or 2150 carburetor, turn nut on solenoid plunger or hex screw on solenoid carriage to obtain specified idle rpm.

(a) Tighten locknut, if equipped.

(b) Disconnect solenoid wire connector and adjust curb idle screw to obtain 500 rpm idle speed.

(c) Connect solenoid wire connector.

(d) If model 2150 carburetor (eight-cylinder engine, is equipped with dashpot. With throttle at curb idle position, fully depress dashpot stem and measure clearance between stem and throttle lever. Clearance should be 0.032 inch (0.813 mm). Adjust by loosening locknut and turning dashpot.

Choke Linkage

Inspect all choke linkages, including the fast idle cam, for free movement at the engine mileage interval specified in the Engine Maintenance Schedule.

Clean choke linkage by applying Jeep Carburetor and Combustion Area Cleaner, or equivalent. Never use oil to lubricate choke linkage.

For choke circuit adjustment procedures, refer to Chapter 1J—Fuel Systems.

PCV Air Inlet Filter

Four- and Six-Cylinder Engines

A polyester non-woven felt PCV air inlet filter is located in a retainer inside the air cleaner. Rotate the retainer to remove it from the air cleaner (fig. 1A-11). Replace or clean the filter at the engine mileage interval specified in the Engine Maintenance Schedule. Clean with kerosene or detergent and water. Squeeze excess liquid from filter. Do not wring or twist. After cleaning, lightly oil the filter with clean engine lube oil.

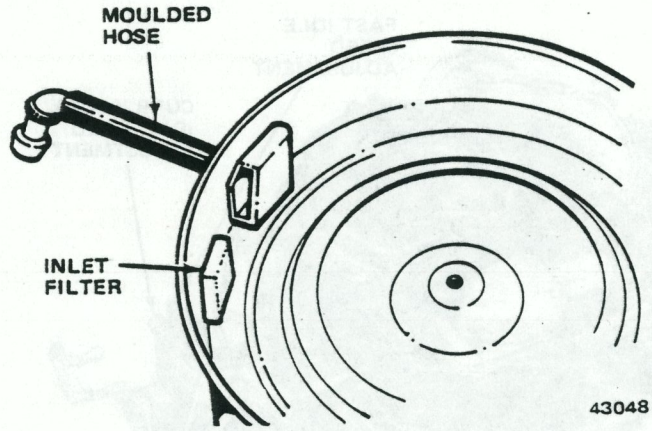

Fig. 1A-11 PCV Air Inlet Filter—Four- and Six-Cylinder Engines

Eight-Cylinder Engine

A PCV air inlet filter is located in the sealed oil filler cap. To clean the filter, apply light air pressure in the direction opposite normal air flow (through the filler tube opening in the cap). Do not apply oil to the filter. If the filter is deteriorated, replace the filler cap.

Fuel Tank Vapor Emission Control System

The fuel tank, filler cap, fuel lines and vent lines must be maintained in good condition to prevent raw fuel vapor (hydrocarbons) from entering the atmosphere.

Inspect the filler cap for evidence of fuel leakage stains at the filler neck opening. Remove the cap and examine the condition of the sealing gasket. Replace the filler cap if the gasket is damaged or deteriorated.

Inspect the fuel tank for evidence of fuel leakage stains. Trace stain to its origin and repair or replace the tank as required.

Inspect the fuel and vent lines for leakage or damage. Repair or replace as required. Ensure all connections are tight.

If liquid fuel is present in the fuel vapor storage canister, inspect the liquid check valve and replace if necessary.

Fuel Vapor Storage Canister Filter

The filter pad located at the bottom of the canister is the only serviceable part of the canister assembly. Replace at the interval specified in the Engine Maintenance Schedule.

Thermostatically Controlled Air Cleaner (TAC) System

Inspect the air valve in the air cleaner snorkel for proper operation. If necessary, refer to Chapter 1J—Fuel Systems for functional test procedure.

Inspect hoses for cracks and brittleness. Replace as necessary.

EXHAUST SYSTEMS

Air Injection Systems

Inspect hoses and hose connections for defects. Replace as necessary. Refer to Chapter 1K—Exhaust Systems for system functional test procedures.

Exhaust Manifold Heat Valve—Eight-Cylinder Engine

The exhaust manifold heat valve is an often overlooked, but highly important, emission control related device. This valve can affect the fuel economy, engine performance and driveability, and cause excessive emission of undesirable exhaust gases.

Inspect the valve (located in front exhaust pipe) for correct operation and lubricate with Jeep Heat Valve Lubricant, or equivalent. Refer to Chapter 1K—Exhaust Systems for additional service procedures.

SPECIFICATIONS

Tune-Up Specifications—On-Vehicle

CID and Venturi	Vehicle	Transmission	Slow Idle RPM		Initial Timing at Curb Idle		Distributor Model Number	Vacuum Mechanism Number	Tot. Degrees Advance at 2000 RPM	Centrifugal Advance	Spark Plug
			Set To	OK Range	Set To	OK Range					
151 2V	CJ	Manual (49-S)	900	800-1000	10°	±1°	1110560	8131940	33°-42°	Refer To Distributor	Type AC R44TSX 0.060 Inch (1.52 mm) Gap
		Automatic (49-S)	700	600-800	12°	±1°	1110561	8132515	30°-38°		
		Manual (Calif.)	900	800-1000	10°	±1°	1110560	8131940	33°-42°		
		Automatic (Calif.)	700	600-800	10°	±1°	1110560	8131940	33°-42°		
304 2V	CJ	Manual (49-S)	600	500-700	8°	±1°	3237198	8131969	34°-43°	Curves	N12Y (Alt. RN12Y) Gap 0.033 (0.84 mm) to 0.038 (0.97 mm)
		Manual (Hilly Terrain)	700	600-800	12°	±1°	3237198	8131969	38°-47°		
		Automatic (49-S)	600	550-650	10°	±1°	3237199	8131970	43°-52°		
360 2V	Cherokee Wagoneer Truck	Manual (49-S)	600	550-650	10°	±1°	3233174	8129470	36°-43°		
		Automatic (49-S)	600	550-650	10°	±1°	3233174	8129470	36°-43°		

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CID and Venturi	Vehicle	Trans.	Curb Idle Speed — RPM		Sol-Vac Speed RPM	Initial Timing BTDC at Curb Idle Speed With Vacuum Advance Hose Disconnected	Distributor Model Number	Vacuum Advance Mechanism	Total Degrees Advance At 2000 RPM	Centrifugal Advance	Spark Plug Type And Gap
			Set To	Holding Solenoid Energized	Vacuum Actuator Energized	Set To					
258 2V	CJ	Manual (49-S)	650 ±70	750 ±50	900 ±50	8° ±1°	3235141	8131971	35-43	Refer To Distributor Curves	Champion RFN14LY (Alternate FN14LY) 0.035 (0.033 to 0.038) Inch (0.84 to 0.97 mm) Gap
		Manual (Calif.)	650 ±70	750 ±50	900 ±50	4° ±1°	3235141	8131971	33-41		
		Automatic (49-S)	550 ±70	650 ±50	800 ±50	8° ±1°	3235141	8131971	37-45		
		Automatic (Calif.)	550 ±70	650 ±50	800 ±50	6° ±1°	3235141	8131971	35-43		
	Cherokee Wagoneer Truck	Manual (49-S)	650 ±70	750 ±50	900 ±50	8° ±1°	3235141	8131971	35-43		
		Manual (Calif.)	650 ±70	750 ±50	900 ±50	4° ±1°					
		Automatic (49-S)	550 ±70	650 ±50	800 ±50	8° ±1°					
		Automatic (Calif.)	550 ±70	650 ±50	800 ±50	6° ±1°					

NOTE: Automatic Adjusted in Drive; Manual in Neutral Sol-Vac de-energized.

NOTE: Automatic Adjusted in Drive; Manual Adjusted in Neutral. Idle Speed is 500 rpm with solenoid de-energized.

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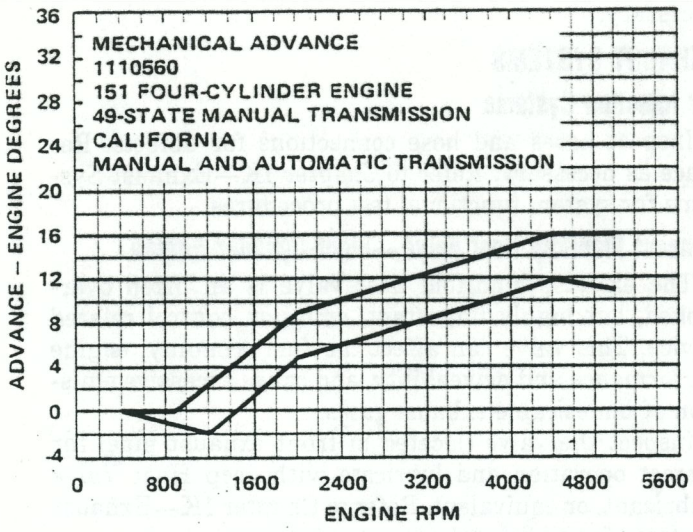
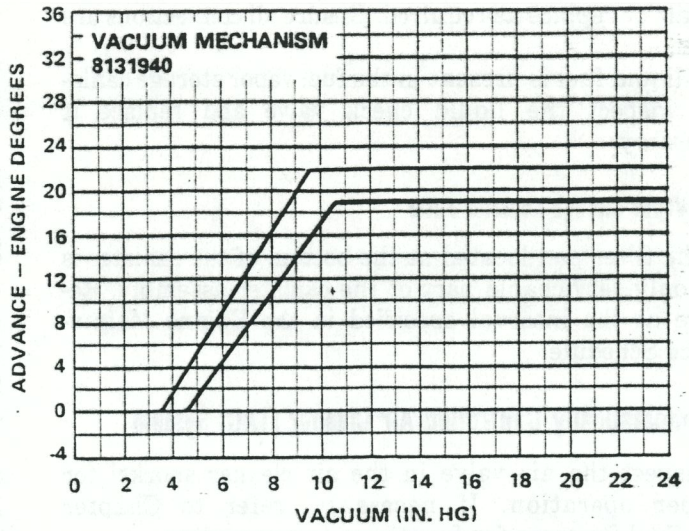
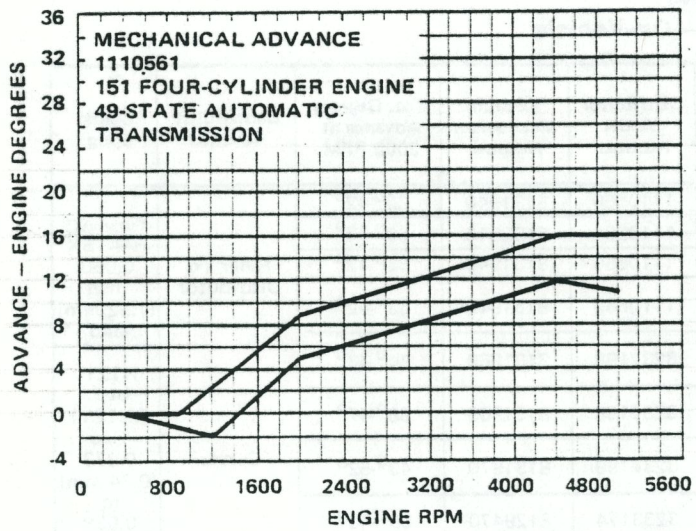
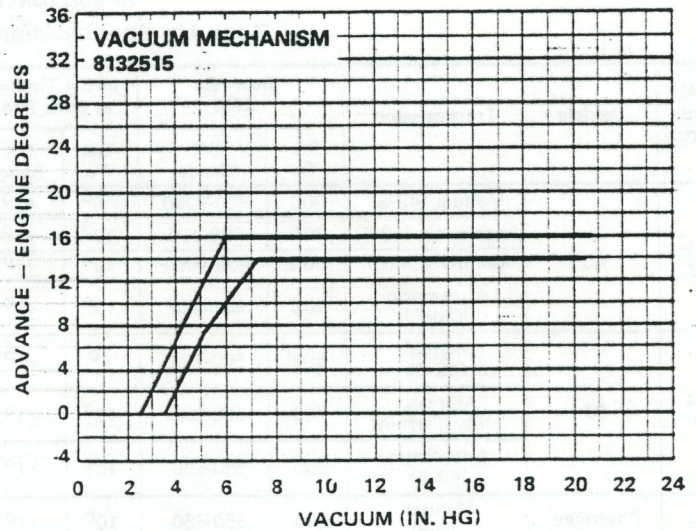
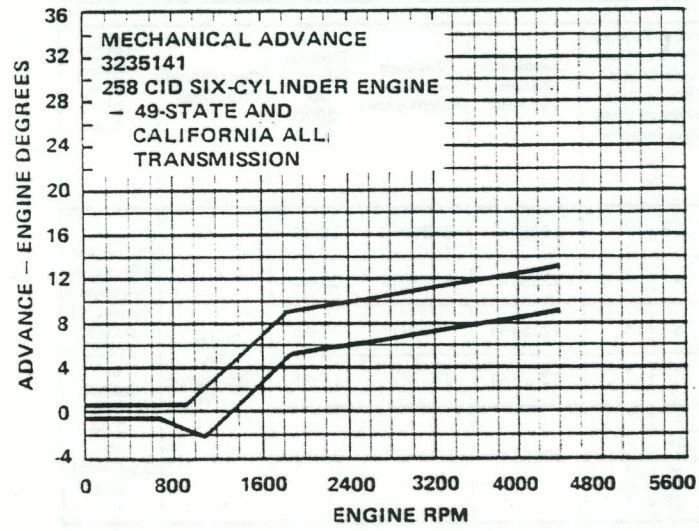
Distributor Curves—On-Vehicle

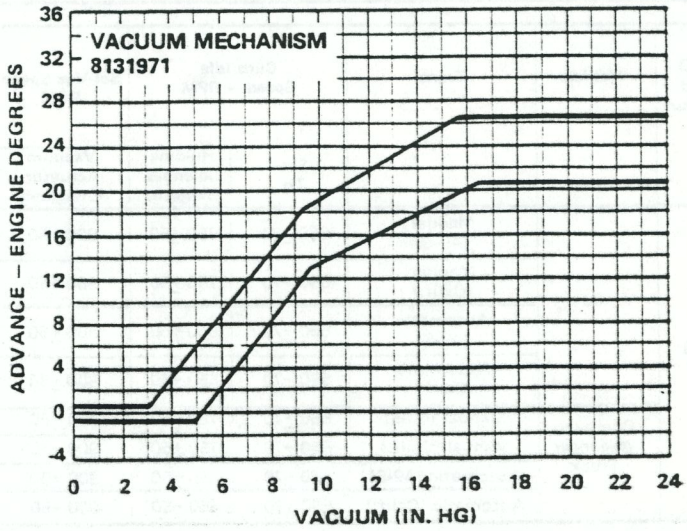












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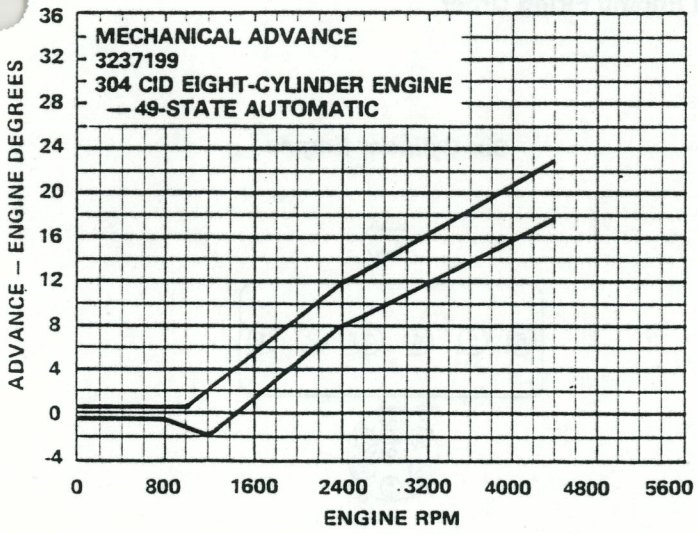
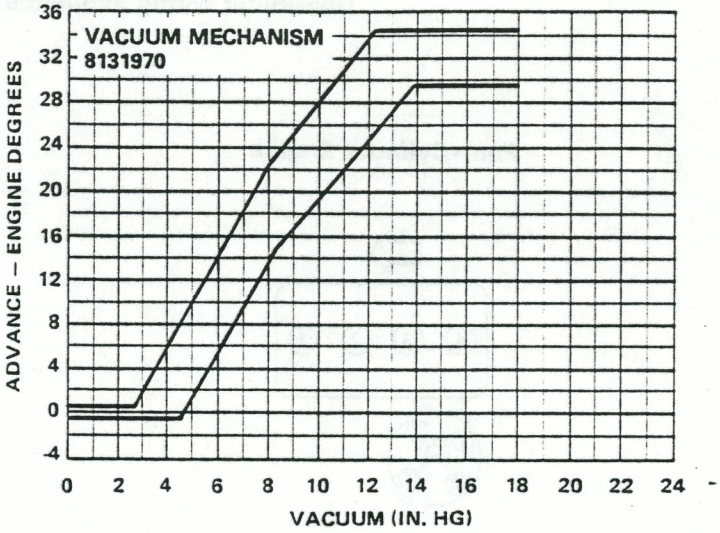
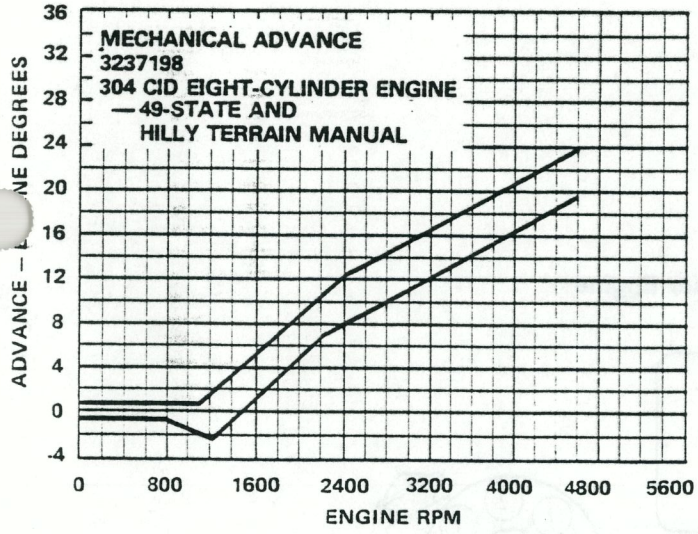
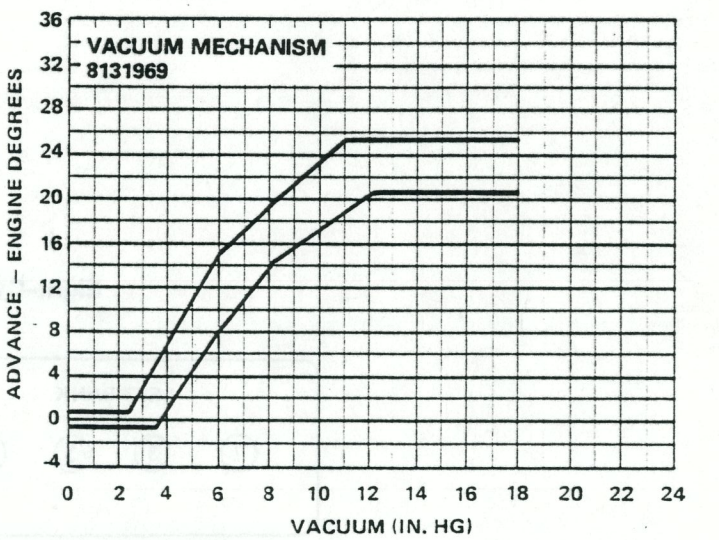
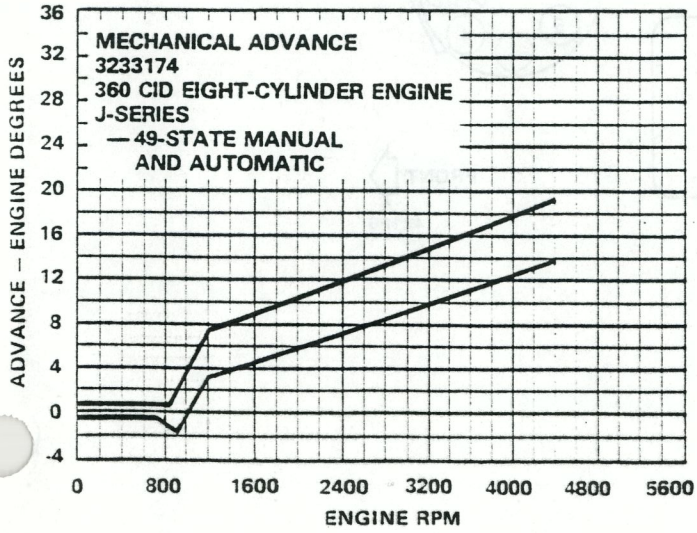
Distributor Curves—On-Vehicle

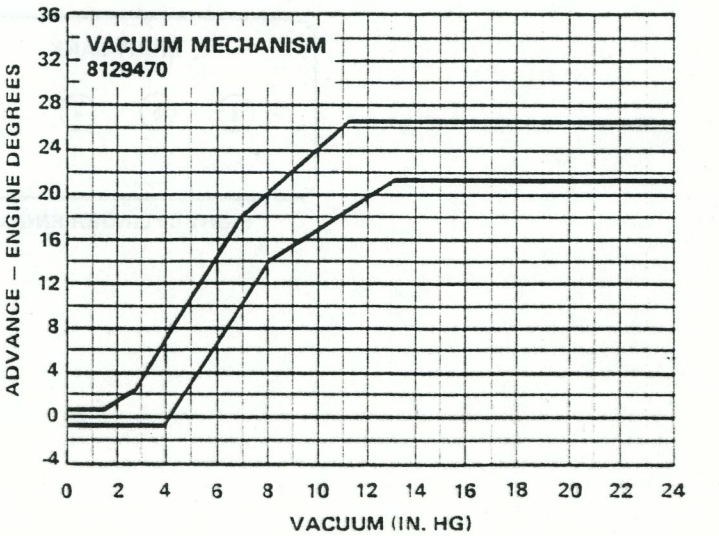












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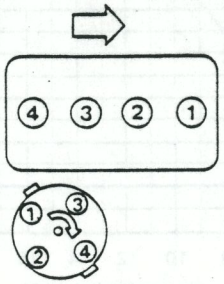
Distributor Wiring Sequence and Engine Firing Order

Four-Cylinder Engine



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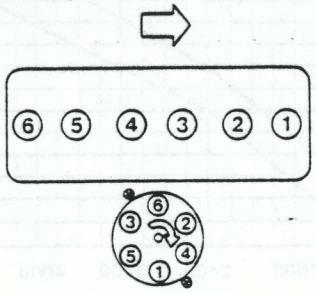
Six-Cylinder Engine



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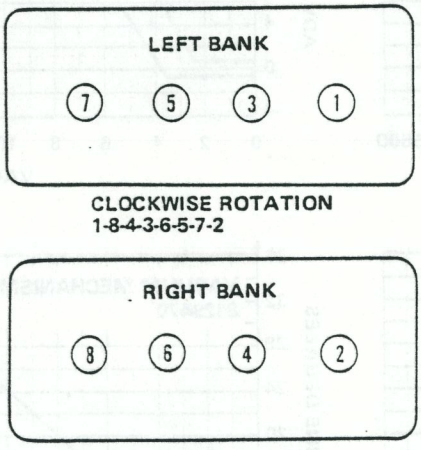
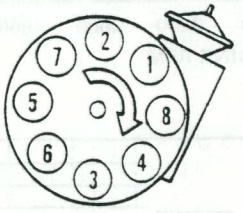
Eight-Cylinder Engine





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ENGINES 1B

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FOUR-CYLINDER ENGINE

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GENERAL

The 151 CID (2.5 liter) four-cylinder engine (fig. 1B-1, 2 and 3) installed in CJ vehicles has a cross-flow cylinder head, five main crankshaft bearings, hydraulic valve tappets, conventional ball socket valve rocker arms, a camshaft that is gear driven directly from the crankshaft and a coolant heated aluminum intake manifold.

Identification

The three-character engine identification code is stamped into the left hand rear top corner of the block (fig. 1B-4).

In addition, engines built for sale in Georgia and Tennessee have a nonrepeating number stamped into the left rear block flange (fig. 1B-4).

Three-Character Engine Code

The following three-character engine ID codes represent the data listed adjacent to each code.

- WCP—49S, Manual Trans, WO/AC
- WCT—49S, Auto Trans, WO/AC
- WCU—Calif. Manual Trans, WO/AC
- WCW—Calif., Auto Trans, WO/AC

Engine Mounting

Resilient rubber cushions support the engine (fig. 1B-5) and transmission at three points: at each side on the centerline of the engine and at the rear between the transmission extension housing and the rear support crossmember. Replacement of a cushion may be accomplished by supporting the weight of the engine or transmission at the area of the cushion.

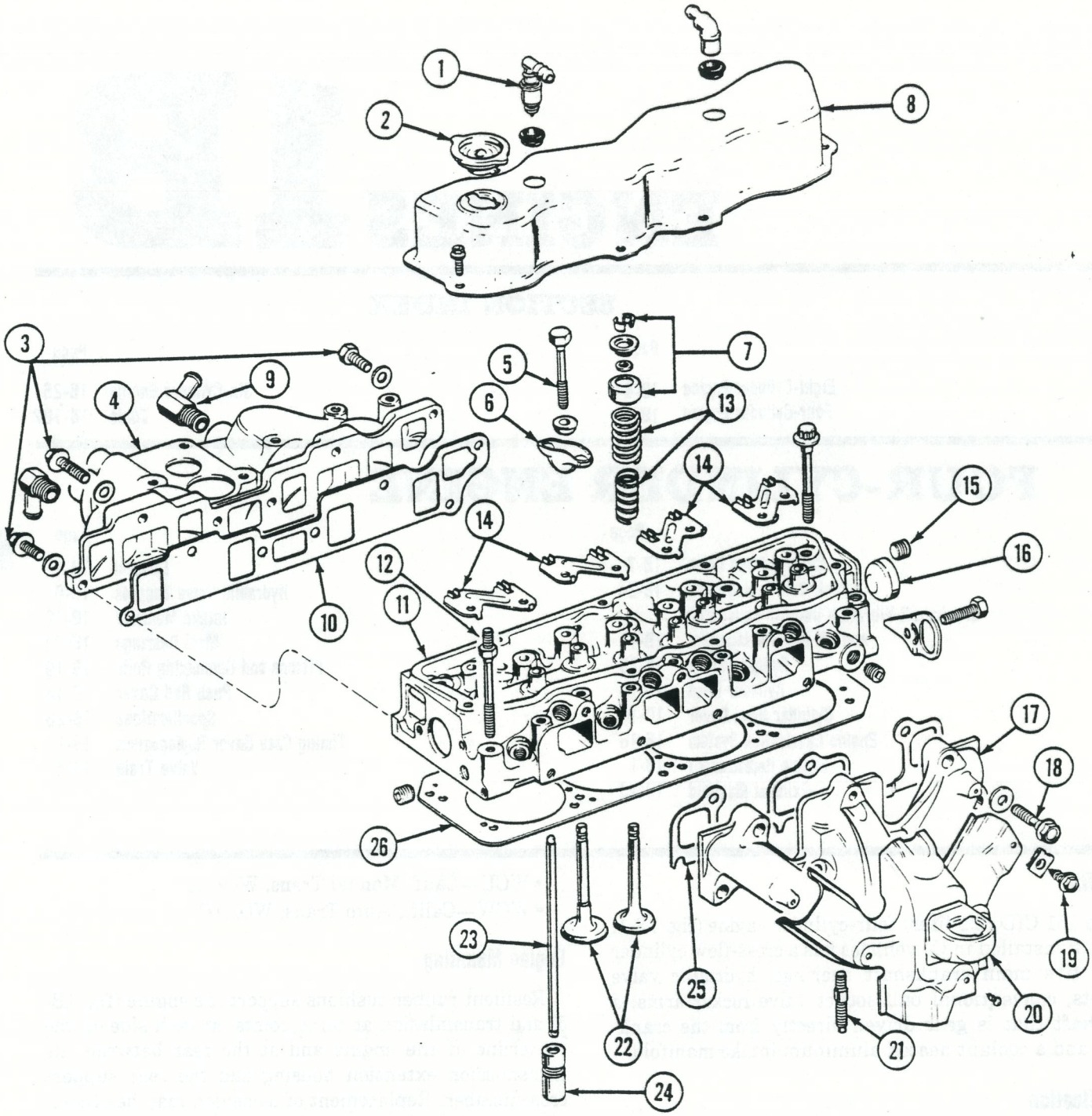
NOTE: *Remove the screws that attach the shroud to the radiator to prevent damage to the shroud by the fan.*

ENGINE REPLACEMENT

Removal

(1) Open hood.

(2) Remove battery negative cable from battery. Remove body ground wire from dash panel.



1. PCV VALVE
2. OIL FILLER CAP
3. INTAKE MANIFOLD ATTACHING BOLTS
4. INTAKE MANIFOLD
5. ROCKER ARM CAPSCREW
6. ROCKER ARM
7. VALVE SPRING RETAINER ASSEMBLY
8. CYLINDER HEAD COVER (ROCKER COVER)
9. COOLANT HOSE FITTING
10. INTAKE MANIFOLD GASKET
11. CYLINDER HEAD
12. CYLINDER HEAD STUD
13. VALVE SPRING
14. PUSH ROD GUIDE
15. CYLINDER HEAD PLUG
16. CYLINDER HEAD CORE PLUG
17. EXHAUST MANIFOLD
18. EXHAUST MANIFOLD BOLT
19. OIL LEVEL INDICATOR TUBE ATTACHING SCREW
20. EXHAUST MANIFOLD HEAT SHROUD (HEAT SHIELD)
21. EXHAUST MANIFOLD TO EXHAUST PIPE STUD
22. VALVES
23. PUSH ROD
24. TAPPET
25. EXHAUST MANIFOLD GASKET
26. CYLINDER HEAD GASKET

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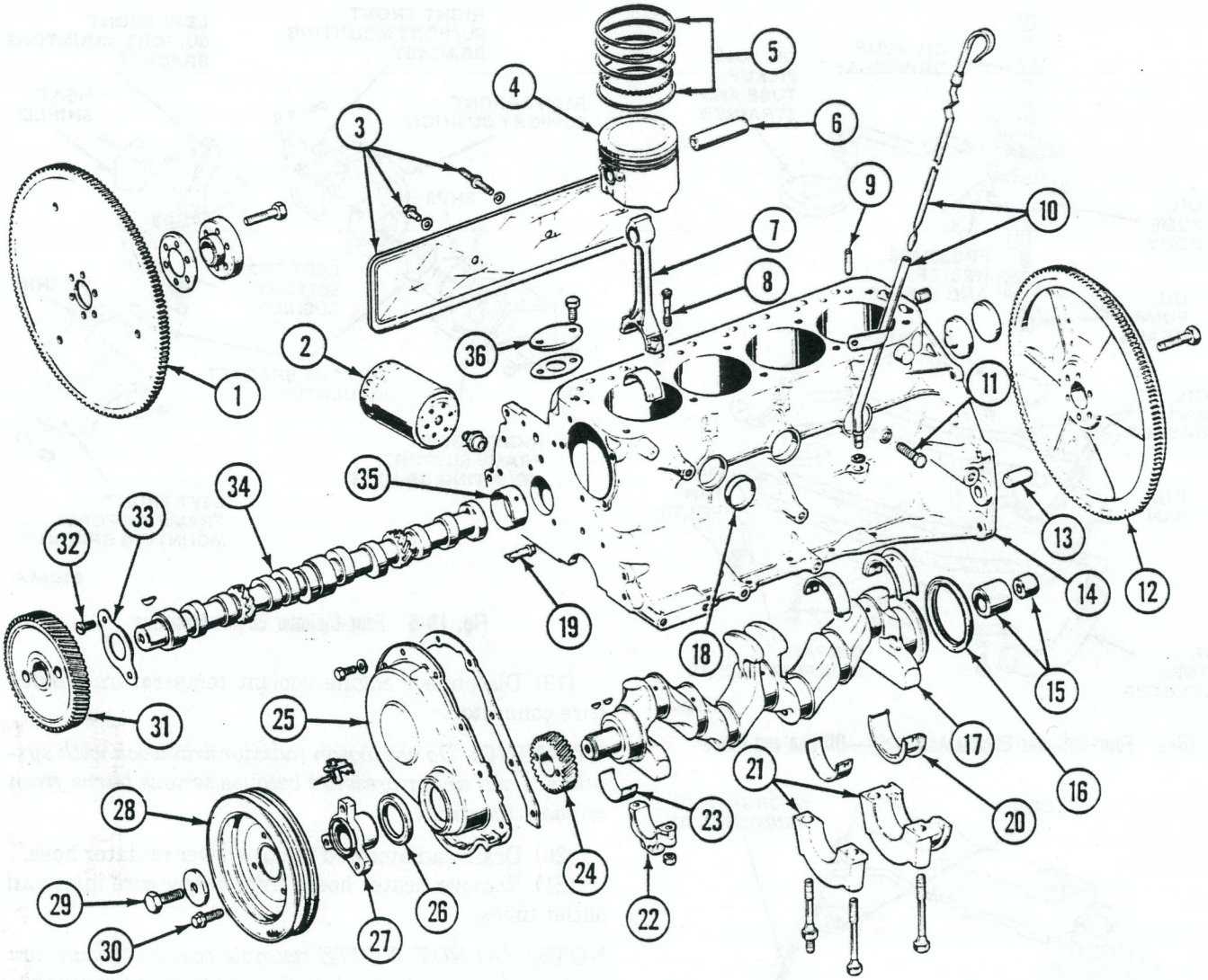
Fig. 1B-1 Four-Cylinder Engine Assembly—Head



1. DRIVE PLATE AND RING GEAR (AUTOMATIC TRANS)
2. OIL FILTER
3. PUSH ROD COVER AND BOLTS
4. PISTON
5. PISTON RING
6. PISTON PIN
7. CONNECTING ROD
8. CONNECTING ROD BOLT
9. DOWEL
10. OIL LEVEL INDICATOR AND TUBE
11. BLOCK DRAIN
12. FLYWHEEL AND RING GEAR (MANUAL TRANS)
13. DOWEL
14. CYLINDER BLOCK
15. PILOT AND/OR CONVERTER BUSHING
16. REAR OIL SEAL
17. CRANKSHAFT
18. BLOCK CORE PLUG
19. TIMING GEAR OIL NOZZLE
20. MAIN BEARINGS
21. MAIN BEARING CAPS
22. CONNECTING ROD BEARING CAP
23. CONNECTING ROD BEARING
24. CRANKSHAFT GEAR
25. TIMING GEAR COVER (FRONT)
26. TIMING GEAR COVER OIL SEAL
27. CRANKSHAFT PULLEY HUB
28. CRANKSHAFT PULLEY
29. CRANKSHAFT PULLEY HUB BOLT
30. CRANKSHAFT PULLEY BOLT
31. CRANKSHAFT TIMING GEAR
32. CAMSHAFT THRUST PLATE SCREW
33. CAMSHAFT THRUST PLATE
34. CAMSHAFT
35. CAMSHAFT BEARING
36. OIL PUMP DRIVESHAFT RETAINER PLATE, GASKET AND BOLT

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Fig. 1B-2 Four-Cylinder Engine Assembly—Block

(3) Remove air cleaner assembly.

(4) Raise vehicle and support with safety stands.

(5) Remove exhaust pipe from exhaust manifold. Disconnect oxygen sensor connector, if equipped.

(6) Disconnect battery cable and solenoid wire from starter motor solenoid.

(7) Remove starter motor bolts and rear bracket nut. Remove starter motor.

(8) Disconnect wire connector from distributor and from oil pressure sending unit.

(9) Remove engine mounting nuts.

(10) Remove hydraulic clutch slave cylinder and flywheel inspection plate (manual transmission only).

(11) Remove transmission clutch/converter housing-to-engine bolts. Automatic transmission, disconnect converter from drive plate.

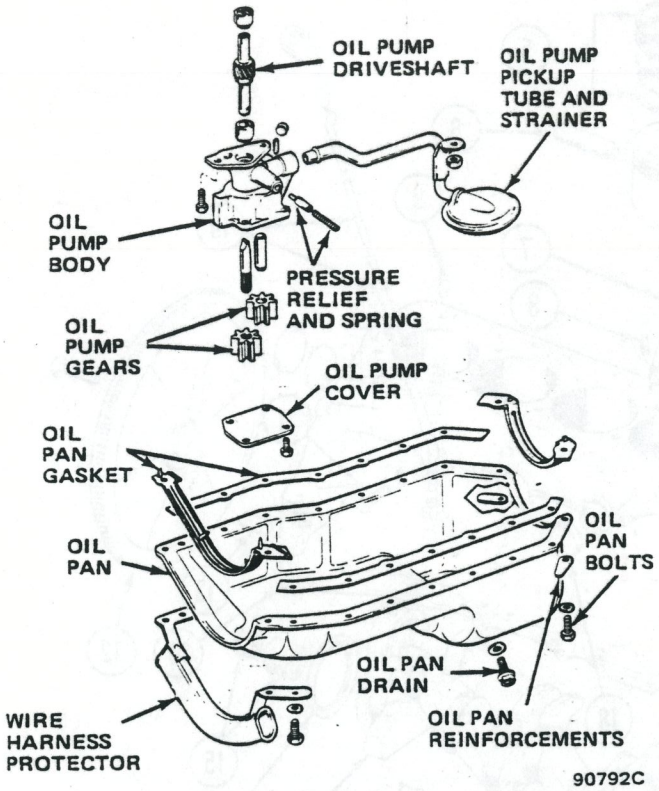


Fig. 1B-3 Four-Cylinder Engine Assembly—Oil Pan and Pump

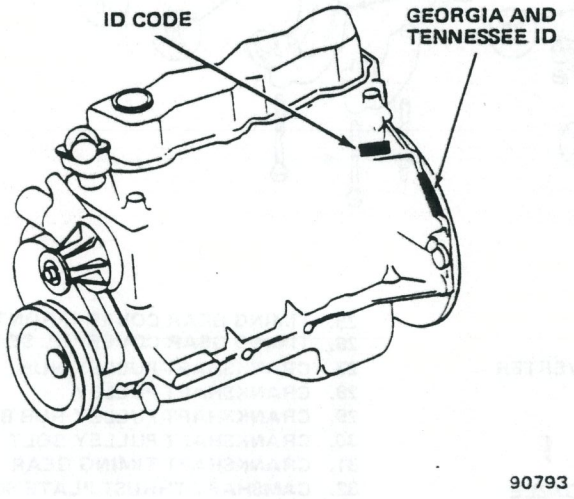


Fig. 1B-4 Engine ID Code Locations

(12) Lower vehicle.

(13) Support transmission with floor jack.

(14) Identify, tag and remove vacuum hoses from canister and carburetor.

(15) Remove bowl vent hose from carburetor. Disconnect mixture control solenoid wire connector from carburetor, if equipped.

(16) Remove wires from alternator.

(17) Disconnect throttle cable from bracket and from carburetor.

(18) Disconnect choke and solenoid wires at carburetor.

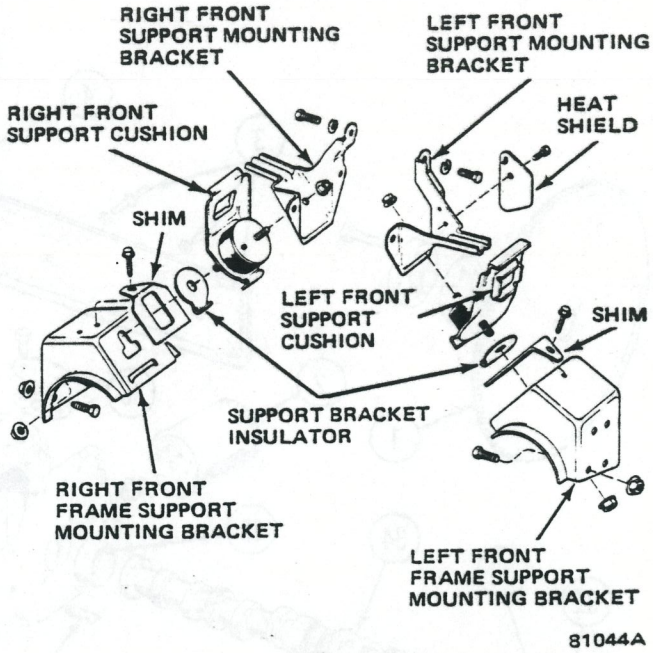


Fig. 1B-5 Four-Cylinder Engine Mounting

(19) Disconnect engine coolant temperature sender wire connector.

WARNING: *Do not loosen radiator draincock with system hot and under pressure because serious burns from coolant can occur.*

(20) Drain radiator and remove lower radiator hose.

(21) Remove heater hoses from heater core inlet and outlet tubes.

NOTE: *DO NOT WASTE reusable coolant. If solution is clean, drain coolant into a clean container for reuse.*

NOTE: *It may be necessary to attach a flexible hose to draincock to route coolant to container.*

(22) Remove fan shroud bolts. Remove upper radiator hose, radiator and shroud.

(23) Remove power steering hoses at pump.

CAUTION: *Manual transmission may have to be raised to provide a smooth engine/transmission separation.*

(24) Attach engine hoisting sling and remove engine.

Installation

(1) Lower engine into engine compartment. If manual transmission, ensure that transmission shaft mates correctly with clutch disc and pilot bushing.

(2) Connect power steering hoses.

(3) Connect and secure heater hoses to heater core with clamps.

(4) Connect following wire connectors:

(a) Coolant Temperature sender

(b) Oil pressure sender

(c) Choke and solenoid
(d) Mixture control solenoid, if equipped.

(5) Connect vacuum hoses to canister and carburetor. Ensure hoses are connected correctly according to identifying tags that were attached prior to removal.

(6) Connect bowl vent hose to carburetor.

(7) Connect alternator wires.

(8) Attach throttle cable to carburetor. Secure cable in position with bracket.

(9) Position fan shroud over fan. Install radiator and connect upper and lower radiator hoses. Attach shroud to radiator. Fill system with coolant.

NOTE: *Refer to Chapter 1C—Cooling Systems for additional information.*

(10) Raise vehicle.

(11) Automatic transmission, connect converter to drive plate.

(12) Install transmission clutch/converter housing-to-engine bolts. Tighten bolts with 35 foot-pounds (47 N•m) torque.

(13) Install flywheel inspection plate and hydraulic clutch slave cylinder (manual transmission only). Tighten bolts with 225 inch-pounds (25 N•m) torque.

(14) Install engine mounting nuts. Tighten with 34 foot-pounds (46 N•m) torque.

(15) Install starter motor. Tighten bolts with 27 foot-pounds (37 N•m) torque and bracket nut with 40 inch-pounds (4.5 N•m) torque.

(16) Connect battery cable and solenoid wire to starter motor solenoid.

(17) Connect distributor wire connector.

(18) Connect exhaust pipe to exhaust manifold. Tighten securing nuts with 35 foot-pounds (50 N•m) torque. Connect oxygen sensor wire connector, if equipped.

(19) Connect battery negative cable and body ground wire.

(20) Install air cleaner.

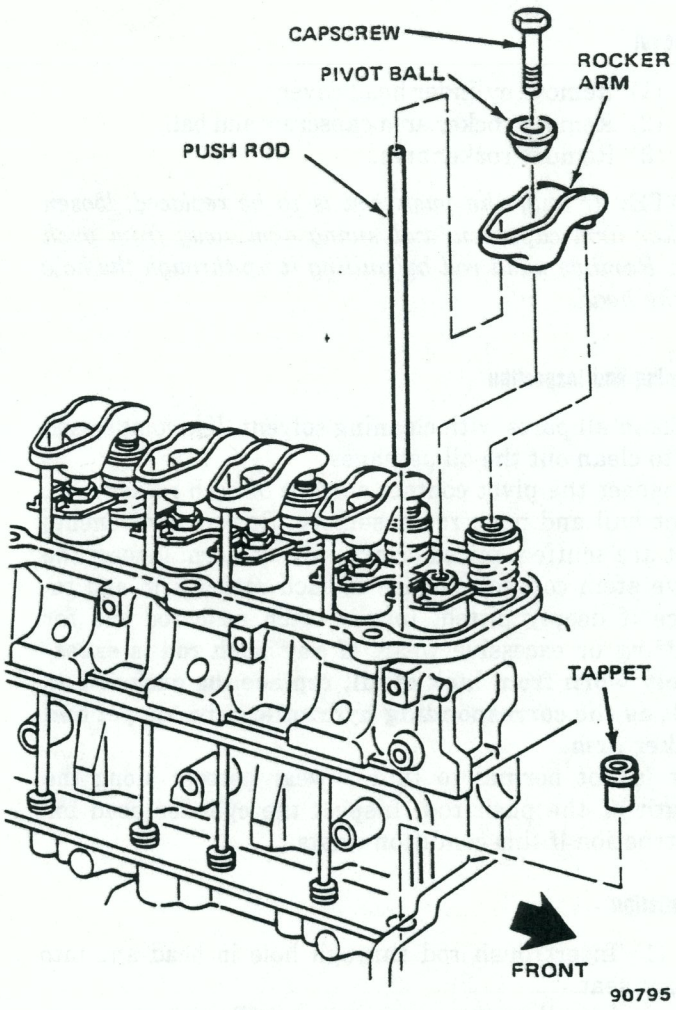
WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

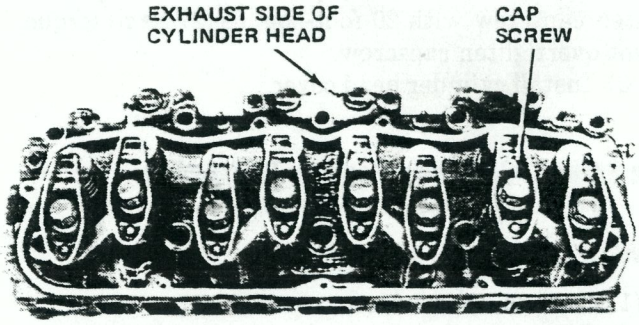
(21) Start engine and inspect for leaks. Refill fluids as necessary.

VALVE TRAIN

General

Motion is transmitted from the camshaft through the hydraulic tappet and push rod to the rocker arm. Each rocker arm moves on its pivot ball and transmits the camshaft motion to the valve. The rocker arm and pivot ball are retained by a capscrew (fig. 1B-6).





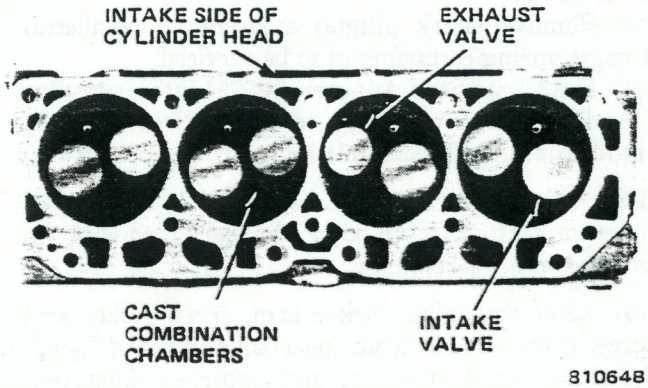


Fig. 1B-6 Valve Train

Rocker Arm and Push Rod

Removal

(1) Remove cylinder head cover.
(2) Remove rocker arm capscrew and ball.
(3) Remove rocker arm.

NOTE: *If only the push rod is to be replaced, loosen rocker arm capscrew and swing arm away from push rod. Remove push rod by pulling it up through the hole in the head.*

Cleaning and Inspection

Clean all parts with cleaning solvent. Use compressed air to clean out the oil passages.

Inspect the pivot contact surface of each rocker arm, pivot ball and push rod assembly. Replace components that are scuffed, pitted or excessively worn. Inspect the valve stem contact surface of each rocker arm and replace if deeply pitted. Inspect each push rod end for scuffing or excessive wear. **If any push rod is excessively worn from lack of oil, replace the push rod as well as the corresponding hydraulic valve tappet and rocker arm.**

It is not normal to find a wear pattern along the length of the push rod. Inspect the cylinder head for obstruction if this condition exists.

Installation

(1) Insert push rod through hole in head and into tappet seat.
(2) Install rocker arm, pivot ball and capscrew. Tighten capscrew with 20 foot-pounds (27 N•m) torque. Do not overtighten capscrew.
(3) Install cylinder head cover.

Valve Springs, Shields and/or Seal Replacement

Removal

(1) Remove cylinder head cover.
(2) Remove rocker arms of valve spring components to be serviced.
(3) Remove spark plug(s) adjacent to cylinder(s) with valve spring components to be serviced.
(4) Install air hose Adapter J-22794 into spark plug hole and apply air pressure to hold valves in place. Apply minimum of 90 psi (621 kPa) air pressure.

NOTE: *An adapter can be constructed by welding an air hose connection to the body of a spark plug with the porcelain insulator removed.*

(5) After removing rocker arm, screw rocker arm capscrew into cylinder head. Insert slotted end of Tool J-5892-1 under head of rocker arm capscrew. Compress valve spring (fig. 1B-7) and hold to allow removal of valve spring retainer cap locks. Remove tool, retainer locks, cap, shield, spring, and valve stem oil seal (fig. 1B-8).

NOTE: *Retain components in same order removed to facilitate installation in original position.*

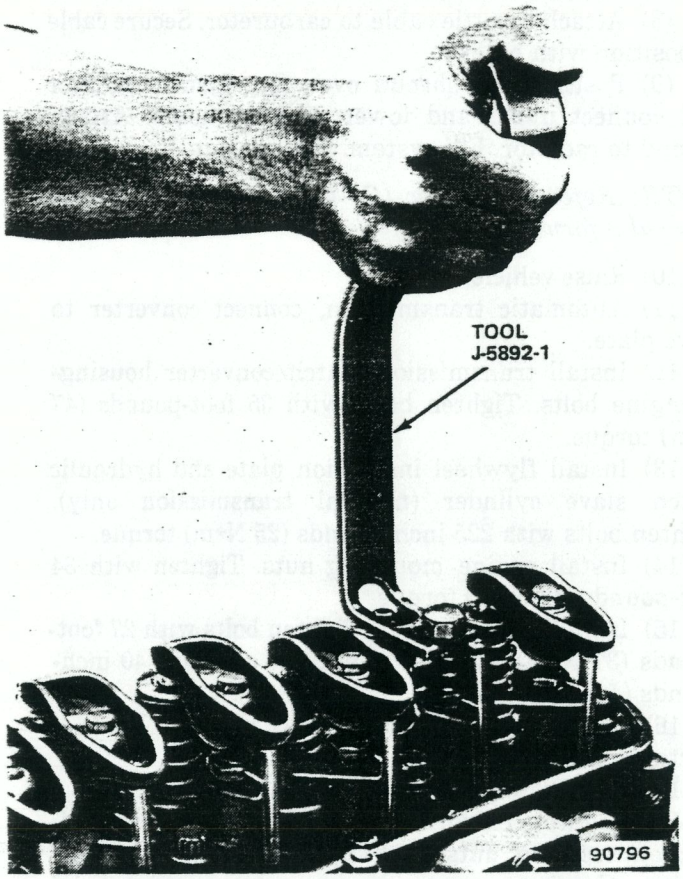


Fig. 1B-7 Compressing Valve Springs

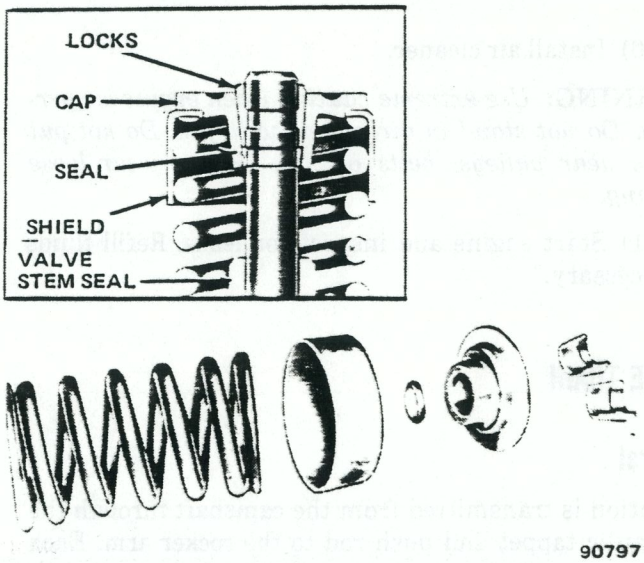


Fig. 1B-8 Upper Valve Train Components

Valve Spring Tension Test

Use Valve Spring Tester J-8056, or equivalent, to test each valve spring for the specified tension values (fig. 1B-9). Replace springs that are not within specification and that bind because of warpage.

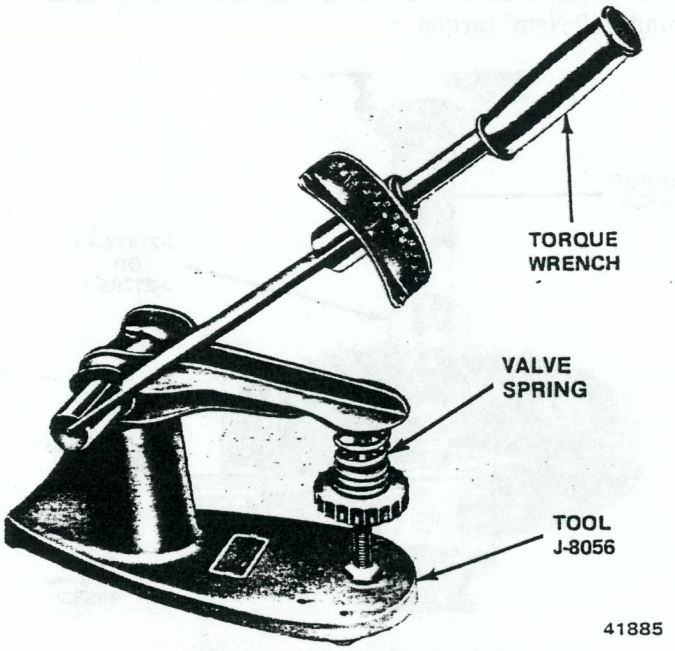


Fig. 1B-9 Testing Valve Spring—Typical

Installation

Always install a new valve stem oil seal whenever valve spring retainer cap locks have been disturbed.

(1) Position oil seal, spring, shield and cap over valve stem.

(2) With Tool J-5892-1, compress valve spring and install retainer cap locks. Remove tool.

(3) Install rocker arm, pivot ball and capscrew over stud. Tighten capscrew with 20 foot-pounds (27 N•m) torque. Do not overtighten.

(4) Install cylinder head cover.

(5) Remove air hose adapter and install spark plug.

CAMSHAFT AND DRIVE

The cast iron camshaft is supported by three bearings and is gear driven. An iron crankshaft gear drives the camshaft through a plastic composition timing gear with a steel hub (fig. 1B-10).

The cam lobes are ground, hardened and tapered with the high side toward the rear. This, coupled with the spherical face on the tappet, causes the tappets to rotate.

The camshaft bearings are lubricated through oil holes that intersect the main oil gallery.

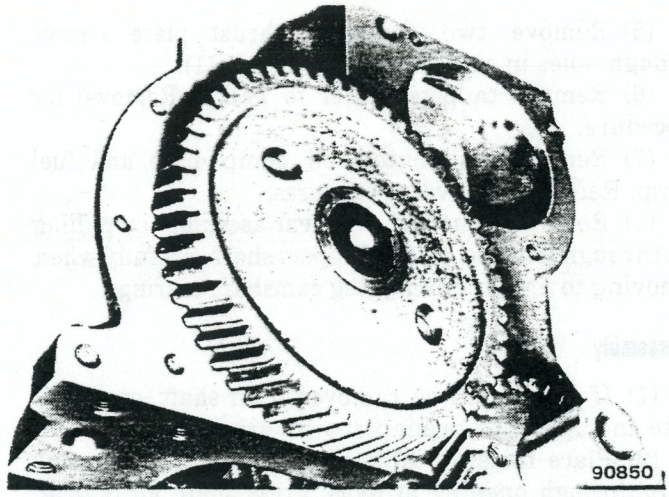


Fig. 1B-10 Camshaft and Crankshaft Gears

Camshaft Replacement

Removal

(1) Remove air cleaner.

WARNING: *DO NOT remove block drain plugs or loosen radiator draincock with system hot and under pressure because serious burns from coolant can occur.*

(2) Drain cooling system.

NOTE: *Do not waste reusable coolant. If solution is clean, drain coolant into a clean container for reuse.*

NOTE: *It may be necessary to attach a flexible hose to the drains to route the coolant to the container.*

(3) Remove timing gear cover. Refer to Timing Gear Cover Removal for procedure.

(4) Disconnect radiator hoses at radiator. Remove radiator. Refer to Radiator Removal in Chapter 1C—Cooling Systems.

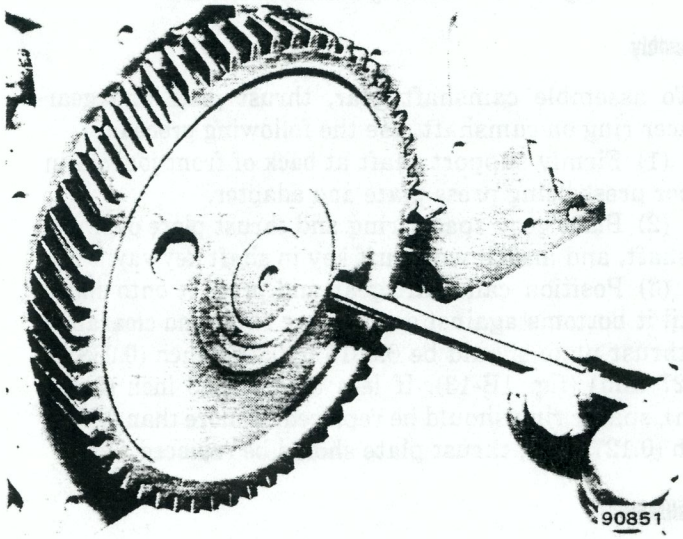


Fig. 1B-11 Removing Camshaft Thrust Plate Screws

(5) Remove two camshaft thrust plate screws through holes in camshaft gear (fig. 1B-11).

(6) Remove tappets. Refer to Tappet Removal for procedure.

(7) Remove distributor, oil pump drive and fuel pump. Refer to removal procedures.

(8) Remove camshaft and gear assembly by pulling out through front of block. Support shaft carefully when removing to prevent damaging camshaft bearings.

Disassembly

(1) If gear must be removed from shaft, use press plate and appropriate adapter with arbor press.

(2) Place tools on table of arbor press. Place camshaft through opening in tools. Press shaft out of gear using socket wrench or other suitable tool (fig. 1B-12).

NOTE: *Thrust plate must be properly aligned to ensure woodruff key in shaft does not damage it when the shaft is pressed out of gear.*

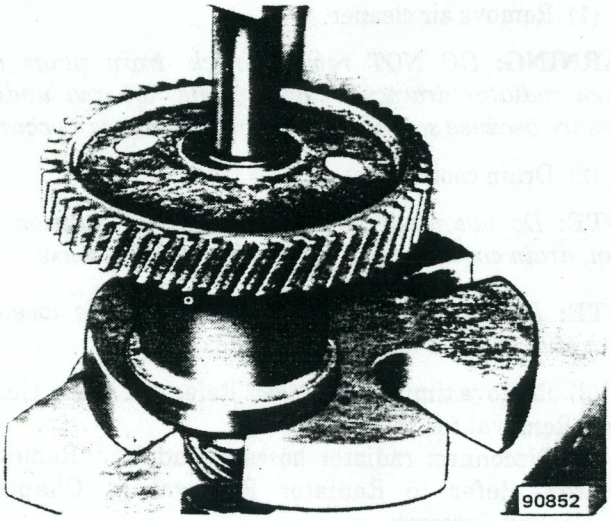


Fig. 1B-12 Removing Camshaft Timing Gear

Assembly

To assemble camshaft gear, thrust plate and gear spacer ring on camshaft, use the following procedure.

(1) Firmly support shaft at back of front journal in arbor press using press plate and adapter.

(2) Place gear spacer ring and thrust plate over end of shaft, and install woodruff key in shaft keyway.

(3) Position camshaft gear and press it onto shaft until it bottoms against gear spacer ring. End clearance of thrust plate should be 0.0015 to 0.0050 inch (0.038 to 0.127 mm) (fig. 1B-13). If less than 0.0015 inch (0.038 mm), spacer ring should be replaced. If more than 0.0050 inch (0.127 mm), thrust plate should be replaced.

Installation

(1) Thoroughly coat camshaft journals with high quality engine oil supplement (EOS).

(2) Install camshaft assembly in engine block. Use care to prevent damaging bearings or camshaft.

(3) Turn crankshaft and camshaft so that valve timing marks on gear teeth are aligned. Engine is now in number four cylinder firing position. Install camshaft thrust plate-to-block screws and tighten with 75 inch-pounds (10 N•m) torque.

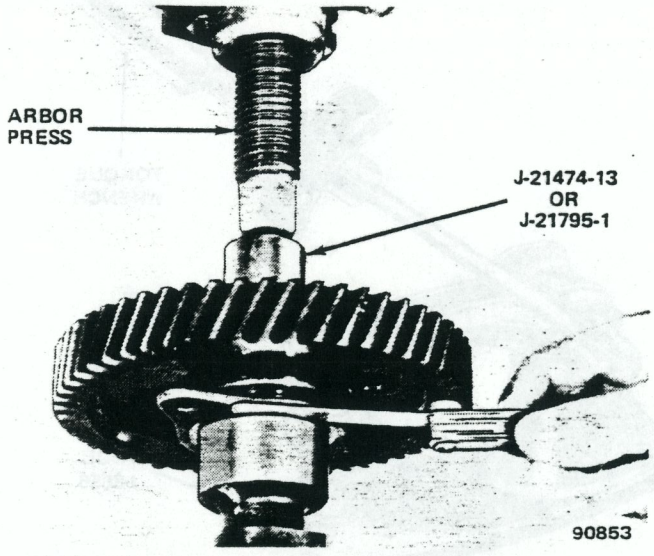


Fig. 1B-13 Installing Camshaft Timing Gear and Measuring Thrust Plate End Clearance

(4) Install timing gear cover and gasket.

(5) Line up keyway in hub with key on crankshaft and slide hub onto shaft. Install center bolt and tighten with 160 foot-pounds (212 N•m) torque.

(6) Install valve tappets, push rods, push rod cover, oil pump shaft and gear assembly and fuel pump. Install distributor according to following procedure.

(a) Turn crankshaft 360 degrees to firing position of number one cylinder (number one exhaust and intake valve tappets both on base circle (heel) of camshaft and timing notch on vibration damper indexed with top dead center mark [TDC] on timing degree scale).

(b) Install distributor and align shaft so that rotor arm points toward number one cylinder spark plug contact.

(7) Install rocker arms and pivot balls over push rods. With tappets on base circle (heel) of camshaft, tighten rocker arm capscrews with 20 foot-pounds (27 N•m) torque. Do not overtighten.

(8) Install cylinder head cover. Refer to Cylinder Head Cover Installation for procedure.

(9) Install intake manifold. Refer to Intake Manifold Installation for procedure.

(10) Install radiator and lower radiator hose.

(11) Install belt, fan and shroud. Tighten fan bolts with 18 foot-pounds (34 N•m) torque. Install upper radiator hose. Tighten belts.

NOTE: *The fan assembly and pulley must be installed with the drive belt(s) in position on pulleys.*

(12) Install engine coolant.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(13) Start engine. Inspect for oil and coolant leaks. Adjust ignition timing.

(14) Install air cleaner.

Camshaft Bearings

NOTE: *Engine must be removed for camshaft bearing service.*

Replacement

(1) With camshaft and flywheel/drive plate removed, drive out expansion plug from rear cam bearing from inside block.

(2) Using Bearing Remover J-21473-1, drive front bearing toward rear and rear bearing toward front.

(3) Install extension J-21054-1 and drive center bearing out toward rear (fig. 1B-14).

(4) Position replacement bearing on tool and install.

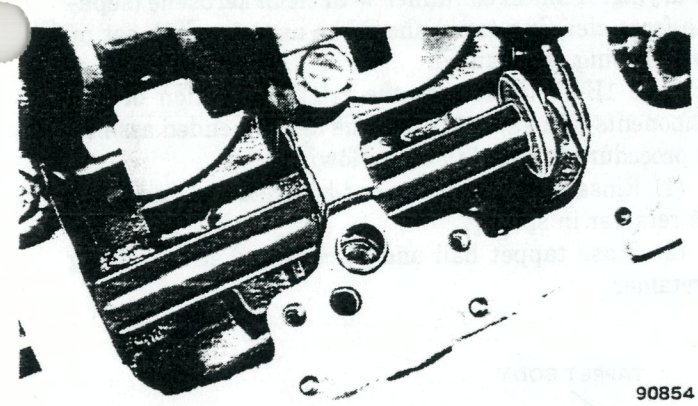


Fig. 1B-14 Removing Center Camshaft Bearing—Typical

NOTE: *Install bearings by reversing procedure listed above. Ensure oil holes are aligned.*

NOTE: *The front bearing must be driven approximately 1/8 inch (3.2 mm) behind front of cylinder block to expose oil hole for timing gear oil nozzle.*

HYDRAULIC VALVE TAPPETS

Hydraulic valve tappets are used to keep all parts of the valve train in constant contact. Each tappet automatically adjusts to maintain zero lash under all conditions.

The hydraulic tappet assembly (fig. 1B-15) consists of a steel body, plunger, push rod seat, metering valve, plunger spring, ball check valve and spring, ball check valve retainer, and retainer ring.

The tappet operates in a guide bore that intersects with the main oil gallery.

The operating cycle of the hydraulic tappet begins when the tappet is on the heel of the cam lobe (engine valve closed). A groove in the tappet body aligns with the tappet oil gallery, admitting pressurized oil into the tappet. A hole and groove arrangement admits the oil to the inside of the plunger. Oil is forced past the plunger check valve and fills the chamber between the plunger and tappet body. When the chamber is full, pressurized oil flows around the metering disc, which controls the amount of oil that flows up the push rod to lubricate the rocker arm assembly. These events all take place while the tappet is on the heel of the cam lobe. As the cam turns, the lobe begins exerting force on the tappet body. This force is transmitted by the trapped oil in the tappet chamber to the plunger and finally to the pushrod and rocker arm assembly. The engine valve opens. While the valve is open, the trapped oil is subjected to considerable pressure and some of it escapes between the plunger and the tappet body (leak-down). The cycle is completed as the cam lobe rotates back to the starting position and another charging cycle begins. In this way, zero valve lash is maintained.

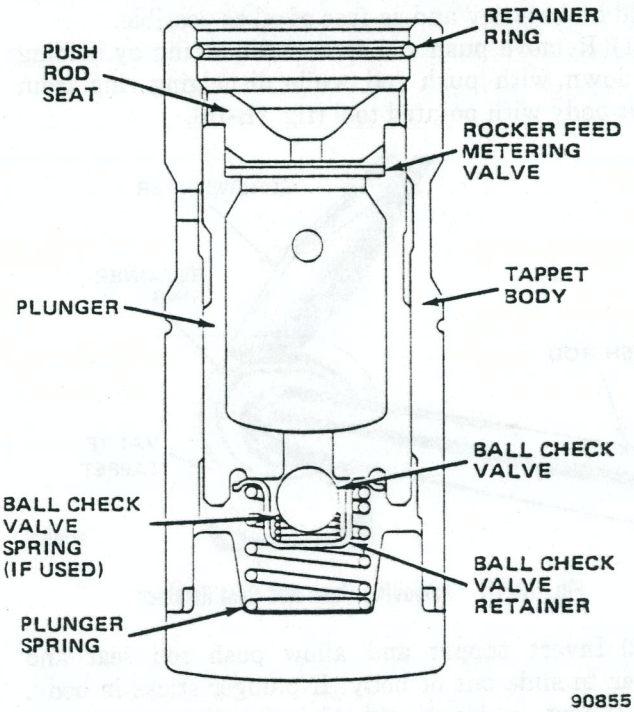


Fig. 1B-15 Hydraulic Valve Tappet

Replacement

(1) Remove cylinder head cover, intake manifold and push rod cover. Refer to removal procedures.

(2) Loosen rocker arm and rotate for access clearance to push rod.

(3) Remove push rod and valve tappet. Hydraulic Valve Tappet Remover J-3049 will facilitate removal of tappet.

NOTE: *If a replacement tappet is to be installed, ensure that all sealer coating is removed from inside of replacement tappet and test for correct leak-down rate.*

Disassembly

Because of the important function that hydraulic valve tappets have in the operation of an engine and the close manufacturing tolerances, proper handling, and above all, cleanliness, cannot be overstressed when servicing the components.

New tappets are serviced as individual units packaged with a plastic coating. Do not remove coating until ready to test the leak-down rate. It is not necessary to remove the oil from replacement tappets prior to testing the leak-down rate because it is special leak-down test oil.

Valve Tappet Cleaning Tank J-5821 is recommended for cleaning valve tappets. The tank should only be used for cleaning valve tappets and should be kept covered when not in use. All servicing should be done in an area isolated from grinders and other sources of dust and foreign material.

Tappets should at all times be stored in a covered box that will maintain them in a clean condition. The box should be kept dry and as free of oil as possible.

(1) Remove push rod seat retainer ring by holding seat down with push rod while dislodging ring from tappet body with pointed tool (fig. 1B-16).

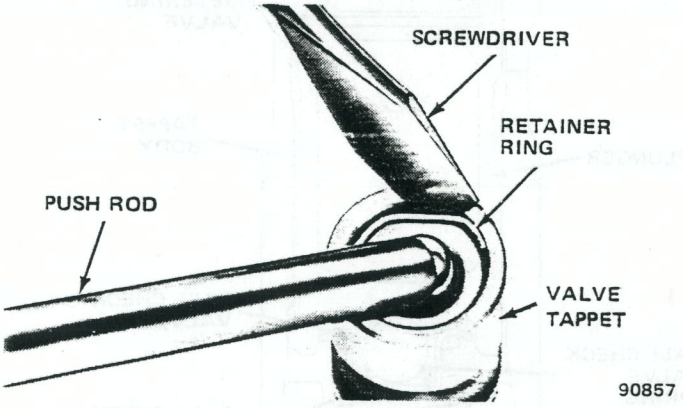


Fig. 1B-16 Removing Push Rod Seat Retainer

(2) Invert tappet and allow push rod seat and plunger to slide out of body. If plunger sticks in body, place tappet in large end of hydraulic valve tappet plunger remover Tool (J-4160) with push rod end of tappet downward. Hold tool firmly in hand with thumb over tappet body and sharply strike tool against block of wood until plunger falls out.

NOTE: *It may be necessary to soak a tappet that has a stuck plunger in cleaning solvent for several minutes before plunger can be removed.*

(3) With oil drained from tappet bodies, place all components of each tappet assembly in separate compartment of tray.

NOTE: *The valve tappet body and plunger are selectively fitted and must not be interchanged with other tappets. Also, keeping all components of each tappet separate will aid in trouble diagnosis.*

Cleaning and Inspection

Thoroughly clean and inspect tappet surfaces for nicks, scratches and scores. Inspection of the check ball and seat should be done with a magnifying glass. The tappet base should also be inspected for wear. If heavy wear is indicated on the cam mating surface, the same lobe of the cam should also be examined. Always clean tappets using only approved solvent and a soft brush. Never use a wire brush or sand paper.

Assembly

All components must be absolutely clean when assembling a hydraulic valve tappet. Because lint and dust may adhere to the components, they should not be dried with compressed air or wiped with a cloth. All parts should be rinsed in clean kerosene and assembled without drying. A small container with clean kerosene (separate from cleaning tank) should be used for each set of tappets being overhauled.

Figure 1B-17 illustrates the relative position of the components of a valve tappet. The recommended assembly procedure is listed in the following steps.

(1) Rinse plunger spring and ball retainer and position retainer in spring.

(2) Rinse tappet ball and place it and small spring in retainer.

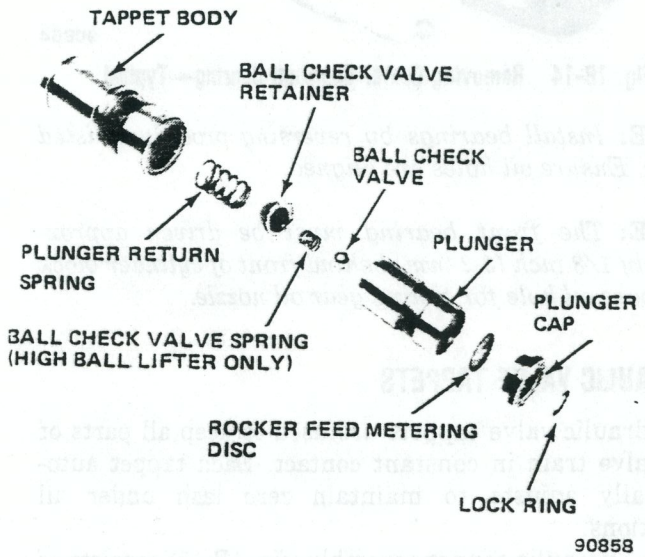


Fig. 1B-17 Hydraulic Valve Tappet—Exploded View

(3) Rinse plunger and place on retainer so that seat on plunger mates with ball.

(4) Invert plunger with parts assembled thus far and, after rinsing tappet body, position body over spring and plunger.

(5) Place tappet body on clean paper, rinse and install push rod seat and retainer ring.

(6) After tappet has been assembled, place in tappet box and close lid to preserve cleanliness.

Leak-Down Test

After all tappets have been assembled, the leak-down rate must be tested before they are installed in the engine. Hydraulic Valve Tappet Leak-Down Tester J-5790 (fig. 1B-18) is designed for testing the leak-down rate of tappets to determine whether or not they are within the specified limits. As with previous service operations involving tappets, cleanliness is paramount. The tester cup and ram should be thoroughly cleaned and testing should be done in an area free of dust and dirt. The testing procedure is described in the following steps:

(1) Fill tester cup to approximately one inch from top with special fluid (J-5268 or equivalent) that is available from tester manufacturer.

(2) Swing weight arm up out of way, raise ram, and position tappet into boss in center of tester cup.

(3) Adjust ram (with weight arm clear of ram) so that pointer is positioned at set line (marked "S"). Tighten jamnut to maintain set position.

(4) Operate tappet through full travel of plunger by pumping weight arm to fill tappet with test fluid and force out air (tappet must be completely submerged at all times). Continue pumping for several strokes after definite resistance is detected.

(5) Raise weight arm to allow plunger spring to expand fully; lower arm onto ram and turn handle slowly (1 revolution every 2 seconds).

Time indicator travel from lower line (first line above set line) to line marked 0.094 or 3/32 inch (2.39 mm), while still rotating cup with handle (fig. 1B-18). Tappet is satisfactory if leak-down interval is between 12 and 90 seconds.

Installation

(1) Place each tappet in original tappet boss.

(2) Replace push rods.

(3) Position rocker arms and pivot balls on push rods.

(4) With tappet on base circle (heel) of camshaft, tighten each rocker arm capscrew with 20 foot-pounds (27 N•m) torque. Do not over tighten.

(5) Replace push rod cover.

(6) Install intake manifold.

(7) Install cylinder head cover.

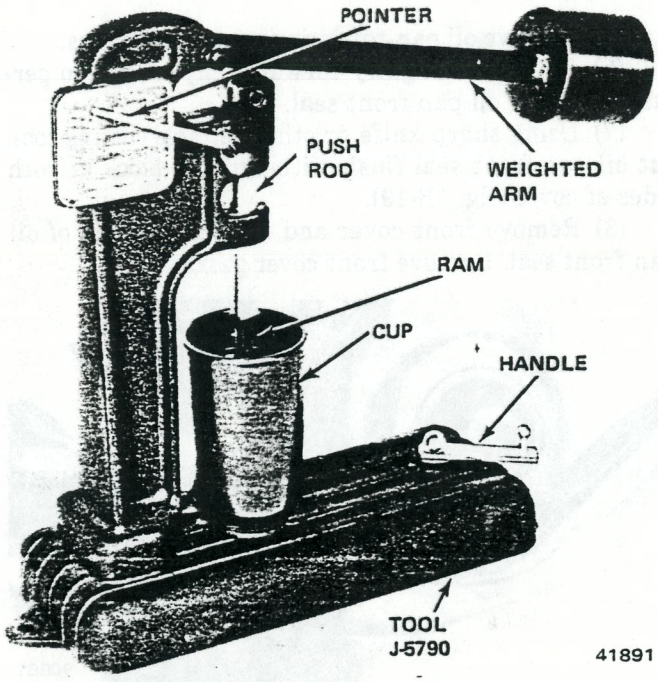


Fig. 1B-18 Testing Leak-Down Rate

CRANKSHAFT VIBRATION DAMPER PULLEY HUB AND OIL SEAL REPLACEMENT

(1) Remove drive belts.

(2) Remove center bolt and slide damper and hub from shaft.

(3) Carefully pry oil seal from front cover with a large screwdriver. Do not bend or distort sheet metal cover.

(4) Install new seal with helical lip toward rear of engine. Drive seal carefully into place using Tool J-23042.

(5) Coat oil seal contact area of vibration damper with engine oil.

(6) Position hub on crankshaft and slide into position until it contacts crankshaft gear.

(7) Install center bolt and tighten with 160 foot-pounds (212 N•m) torque.

(8) Install belts and adjust tensions. Refer to Chapter 1C—Cooling Systems for procedures.

NOTE: *Damper-to-hub bolts should have a locking agent applied to their threads. Coat threads with Drylock 299, or equivalent, before installing.*

TIMING CASE COVER REPLACEMENT

(1) Remove battery negative cable.

(2) Remove crankshaft vibration damper pulley hub. Refer to Crankshaft Vibration Damper Pulley Hub Replacement.

(3) Remove alternator bracket.

(4) Remove fan and shroud nuts. Loosen belts. Remove fan and shroud.

(5) Remove oil pan-to-timing case cover screws.

(6) Pull cover slightly forward only enough to permit cutting of oil pan front seal.

(7) Using sharp knife or other suitable cutting tool, cut oil pan front seal flush with cylinder block at both sides of cover (fig. 1B-19).

(8) Remove front cover and attached portion of oil pan front seal. Remove front cover gasket.

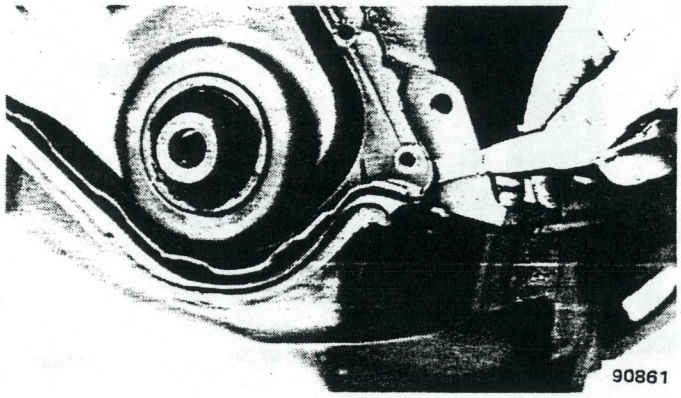


Fig. 1B-19 Cutting Pan Gasket

(9) Clean gasket surfaces on block and timing case cover.

(10) Cut tabs from replacement oil pan front seal (fig. 1B-20). Use sharp instrument to ensure clean cut.

(11) Install seal on timing gear cover. Press tips into holes provided in cover.

(12) Coat gasket with gasket sealer and place in position on cover.

(13) Apply 1/8-inch (3 mm) bead of RTV sealant to joint formed at oil pan and cylinder block (fig. 1B-21).

(14) Install Alignment Tool J-23042 in timing case cover seal (fig. 1B-22).

NOTE: *It is important that an alignment tool be used to align the timing case cover so that vibration damper hub installation will not damage seal and to ensure that seal is positioned evenly around hub.*

(15) Position timing case cover on block. Insert and partially tighten two oil pan-to-timing case cover screws.

(16) Install timing case cover-to-block attaching screws.

(17) Tighten all cover attaching screws to specifications and remove centering Tool J-23042.

(18) Install alternator bracket.

(19) Install pulley hub. Refer to Crankshaft Vibration Damper Pulley Hub Replacement.

(20) Install fan and shroud.

NOTE: *The fan assembly and pulleys must be installed with the drive belts in position on pulleys. Tighten attaching nuts with 18 foot-pounds (34 N•m) torque.*

(21) Tighten belts.

(22) Connect battery negative cable.

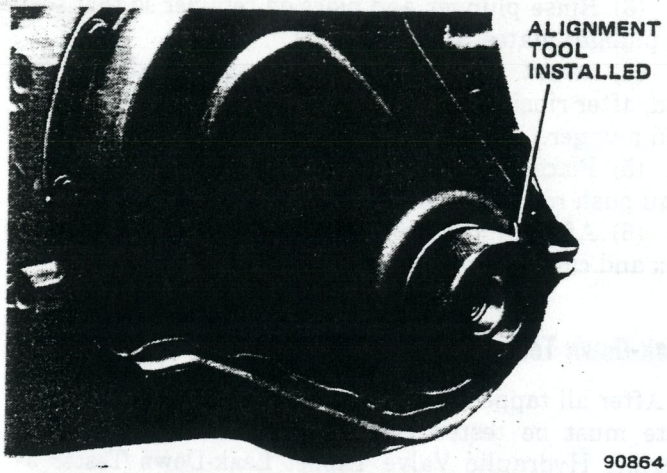


Fig. 1B-20 Oil Pan Seal Modification

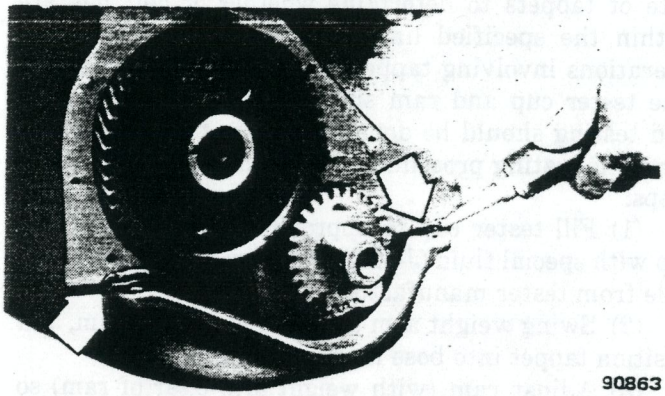


Fig. 1B-21 Applying RTV Sealant

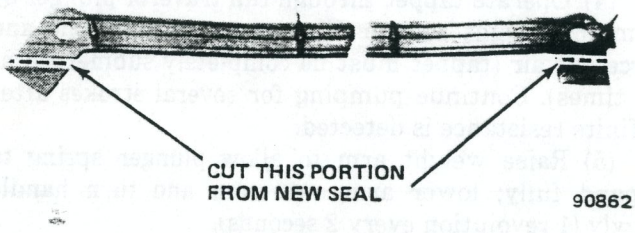


Fig. 1B-22 Timing Case Cover Alignment Tool Installed

INTAKE MANIFOLD

The intake manifold is cast aluminum and has a single level design. A cast passage in the manifold allows engine coolant to pass through to utilize hot coolant heat to warm the manifold and carburetor. This results in better fuel vaporization. An EGR port is also cast in the manifold and receives exhaust gas from an internal exhaust passage through the cylinder head.

Intake Manifold Replacement

WARNING: *The battery negative cable must be removed to prevent a potential fire hazard when the fuel pipe is disconnected.*

(1) Remove battery negative cable.
(2) Remove air cleaner and PCV valve hose.

WARNING: *DO NOT remove block drain plugs or loosen radiator draincock with system hot and under pressure because serious burns from coolant can occur.*

(3) Drain cooling system.

NOTE: *DO NOT WASTE reusable coolant. If solution is clean, drain into a clean container for reuse.*

(4) Tag and remove vacuum hoses (ensure distributor vacuum advance hose is removed).
(5) Disconnect fuel pipe and electrical wire connections from carburetor.
(6) Disconnect carburetor throttle linkage. Remove carburetor and carburetor spacer.
(7) Remove bellcrank and throttle linkage brackets and move to one side for clearance.
(8) Remove heater hose at intake manifold.
(9) Remove alternator. Note position of spacers for installation.
(10) Remove manifold-to-cylinder head bolts and remove manifold.
(11) Position replacement gasket and install replacement manifold on cylinder head. Start all bolts.
(12) Tighten manifold-to-cylinder head bolts using sequence illustrated in figure 1B-23. Tighten all bolts with 37 foot-pounds (50 N•m) torque.

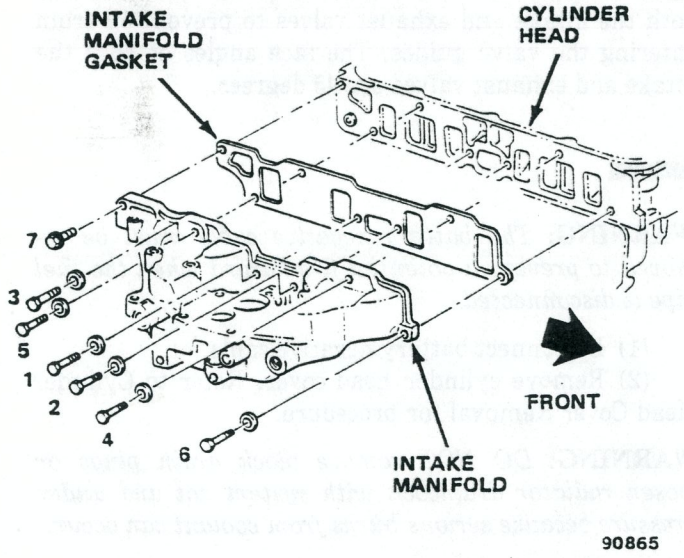


Fig. 1B-23 Intake Manifold Bolt Tightening Sequence

(13) Connect heater hose to intake manifold.
(14) Install bellcrank and throttle linkage brackets.
(15) Connect carburetor throttle linkage to brackets and bellcrank.
(16) Install carburetor spacer and tighten bolts with 15 foot-pounds (20 N•m) torque.
(17) Install carburetor and gasket. Tighten nuts with 15 foot-pounds (20 N•m) torque.
(18) Install fuel pipe and electrical wire connections. Install vacuum hoses.
(19) Install battery negative cable.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(20) Refill cooling system. Start engine and inspect for leaks.
(21) Install air cleaner and PCV valve hose.

EXHAUST MANIFOLD

The exhaust manifold is made of cast nodular iron. The manifold is equipped with a heat stove that is used to provide heated air for the carburetor air intake. This results in better fuel vaporization.

Exhaust Manifold Replacement

(1) Remove air cleaner and heated air tube.
(2) Remove engine oil dipstick tube attaching bolt.
(3) Remove oxygen sensor, if equipped.
(4) Raise vehicle and disconnect exhaust pipe from manifold. Lower vehicle.
(5) Remove exhaust manifold bolts and remove manifold and gasket.
(6) Install replacement gasket and exhaust manifold on cylinder head. Tighten all bolts with 39 foot-pounds (52 N•m) torque in the sequence illustrated in figure 1B-24.
(7) Install dipstick tube attaching bolt.

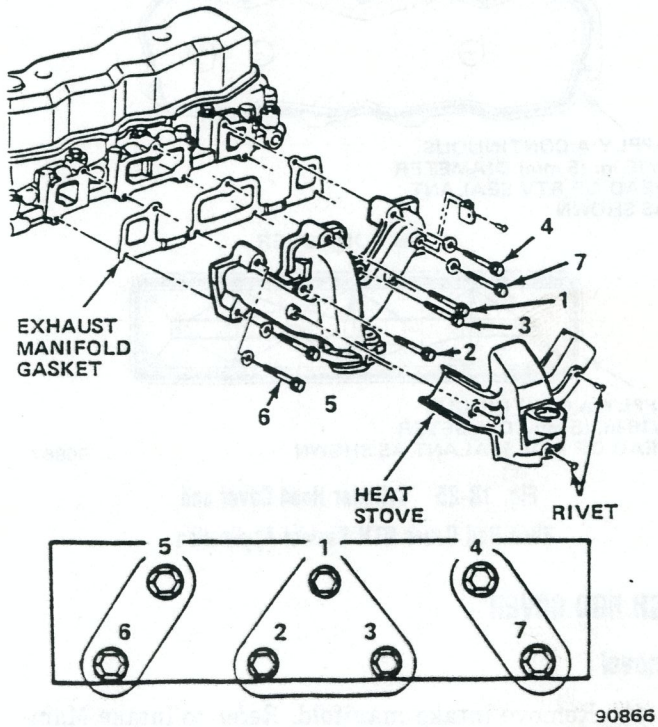


Fig. 1B-24 Exhaust Manifold Tightening Sequence

(8) Install heated air tube and air cleaner.
(9) Install oxygen sensor, if removed.
(10) Raise vehicle and connect exhaust pipe to manifold. Tighten bolts with 35 foot-pounds (50 N•m) torque. Lower vehicle.

CYLINDER HEAD COVER

Removal

(1) Remove air cleaner.
(2) Remove PCV valve (or hose).
(3) Remove cylinder head cover bolts.
(4) Remove spark plug wires from spark plugs and bracket clips.
(5) Remove cylinder head cover by tapping with a rubber hammer to loosen RTV gasket seal. Do not pry on cover.

Installation

(1) Thoroughly clean sealing surfaces on cylinder head cover and cylinder head.
(2) Apply continuous 3/16-inch (5 mm) diameter bead of RTV sealant on cylinder head cover as illustrated in figure 1B-25.
(3) Position cover on head, install retaining bolts and tighten with 7 foot-pounds (10 N•m) torque.
(4) Install spark plug wires, PCV valve (or hose) and air cleaner.

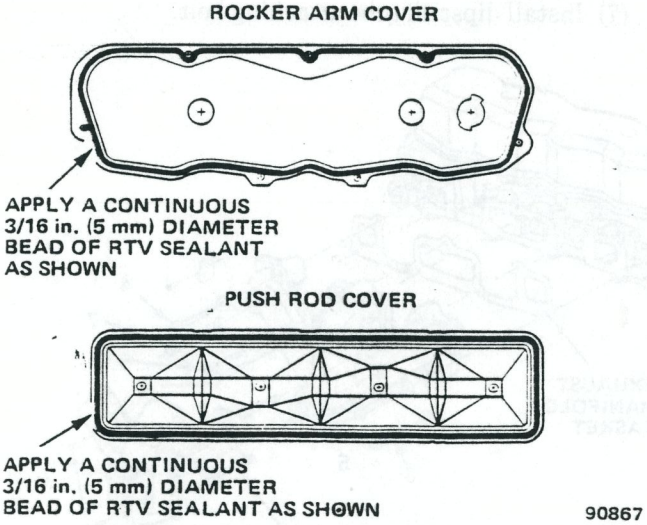


Fig. 1B-25 Cylinder Head Cover and Push Rod Cover RTV Sealant Application

PUSH ROD COVER

Removal

(1) Remove intake manifold. Refer to Intake Manifold for replacement procedure.
(2) Remove push rod cover bolts and remove cover.

Installation

(1) Thoroughly clean sealing surfaces on push rod cover and cylinder block.
(2) Apply continuous 3/16-inch (5 mm) bead of RTV sealant on push rod cover as illustrated in figure 1B-25.
(3) Install cover and cover-to-block bolts. Tighten bolts with 75 inch-pounds (9 N•m) torque.
(4) Install intake manifold. Refer to Intake Manifold for replacement procedure.

CYLINDER HEAD

The cast iron cylinder head is designed to provide a compression ratio of 8.3:1. It is cast with individual intake and exhaust ports for each cylinder. The valve guides are cast integral with the head and the rocker arms are retained on individual threaded studs. The combustion chambers are cast to ensure uniform shape for all cylinders. The spark plugs are located near the intake valves to provide maximum combustion efficiency. The intake valves have 46 degree seat angles and are large to provide sufficient air/fuel intake for high power requirements. The exhaust valve seat angle is also 46 degrees. The 46 degree seat angle assures valve-to-seat contact at the outer diameter of the seat.

External shields are used on both the intake and exhaust valves to reduce the amount of oil splashed against the stems. Valve stem seals are also used on both the intake and exhaust valves to prevent oil from entering the valve guides. The face angles of both the intake and exhaust valves are 45 degrees.

Removal

WARNING: *The battery negative cable must be removed to prevent a potential fire hazard when the fuel pipe is disconnected.*

(1) Disconnect battery negative cable.
(2) Remove cylinder head cover. Refer to Cylinder Head Cover Removal for procedure.

WARNING: *DO NOT remove block drain plugs or loosen radiator draincock with system hot and under pressure because serious burns from coolant can occur.*

(3) Drain block.

NOTE: *DO NOT WASTE reusable coolant. If solution is clean, drain coolant into a clean container for reuse.*

(4) Remove exhaust pipe.
(5) Tag and disconnect vacuum hoses.

NOTE: *Ensure vacuum advance hose is tagged and disconnected.*

(6) Remove alternator and put aside. Do not misplace spacers.

(7) Disconnect fuel pipe from carburetor. Move pipe over and align with opening in intake manifold to facilitate cylinder head removal.

(8) Remove rear heater hose and upper radiator hose.

(9) Remove power steering pump and bracket assembly.

NOTE: *Do not disconnect power steering hoses from pump or gear.*

(10) Remove dipstick.

(11) Remove rocker arm assemblies and push rods.

NOTE: *Note location of rocker arms to facilitate installation in their original locations.*

CAUTION: *To prevent slipping, use a 12 mm 12-point socket wrench to ensure a tight fit on the bolt heads.*

(12) Remove cylinder head bolts.

(13) Remove cylinder head by inserting pry bar into alternator bracket and prying upward.

Installation

The gasket mating surfaces on both the head and the block must be smooth and clean, i.e., no foreign matter, nicks or heavy scratches. The cylinder head bolt threads in the block and on the cylinder head bolts must also be clean, if not, bolt tightening torque will be inaccurate.

(1) Place replacement cylinder head gasket in position over dowel pins and flat on cylinder block.

(2) Carefully guide cylinder head into place over dowel pins and gasket.

(3) Coat underside of heads and threads of cylinder head bolts with sealing compound and install finger-tight.

CAUTION: *To prevent slipping, use a 12 mm 12-point socket wrench to ensure a tight fit on the bolt heads.*

(4) Tighten cylinder head bolts in steps following sequence depicted in figure 1B-26. The final torque is 92 foot-pounds (125 N•m).

(5) Install push rods, rocker arm assemblies and cylinder head cover. Tighten rocker arm capscrews with 20 foot-pounds (27 N•m) torque. Refer to Cylinder Head Cover for procedure.

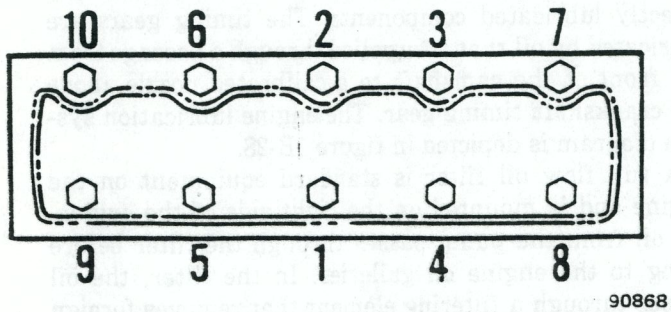


Fig. 1B-26 Cylinder Head Tightening Sequence

(6) Install power steering pump and bracket.

(7) Install alternator and tighten belt to specified tension. Refer to Chapter 1C—Cooling Systems for procedure.

(8) Connect fuel pipe to carburetor.

(9) Install heater hose and upper radiator hose, tighten clamps.

(10) Connect vacuum hoses.

(11) Install exhaust pipe. Tighten nuts with 18 foot-pounds (24 N•m) torque.

(12) Refill cooling system with coolant.

(13) Install dipstick.

(14) Connect battery negative cable.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(15) Start engine and inspect for leaks.

Valves and Seats

Reconditioning of valves and valve seats is very important because the seating of the valves must be precise for the engine to produce specified power and provide reliable performance.

Another important factor is the cooling of the valve heads. Close contact between each valve and its seat is imperative to ensure that the heat in the valve head will be properly transferred to the cylinder head.

Several different types of equipment are available for refacing valves and valve seats. The instructions provided by the manufacturer of the equipment being used should be carefully followed to attain proper results.

Regardless of the type of equipment used it is essential that valve bores be free from carbon and other foreign matter to ensure correct centering of the pilot in the guide.

Valve Guide Bores

Valves with oversize stems are available for both intake and exhaust valves. Guides should be reamed and replacement oversize valves installed whenever clearances exceed specifications.

Cylinder Head Disassembly

(1) With cylinder head removed, remove rocker arm capscrews, pivot balls and rocker arms. Install capscrews.

(2) Using Tool J-5892-1, compress each valve spring and remove locks. Release tool and remove spring cap, spring shield, spring, and oil seal. Wash all parts in cleaning solvent and dry thoroughly.

(3) Remove valves from cylinder head and place in rack in proper sequence to facilitate assembly in their original positions.

(4) Clean all carbon from combustion chambers and valve ports.

(5) Thoroughly clean valve guides using Tool J-8101.

(6) Clean all carbon and sludge from push rods and rocker arms.

(7) Clean valve stems and head on buffing wheel. Inspect valves for burned heads, cracked faces and damaged stems.

(8) Remove carbon and other deposits from head gasket mating surfaces.

(9) Inspect cylinder head for cracks in exhaust ports, combustion chambers, and external cracks in water jacket.

(10) Measure fit of valve stems in their respective guides.

NOTE: *Excessive valve stem-to-guide clearance will cause reduced power, rough idling and noisy valves, and may cause valve breakage. Insufficient clearance will result in noisy and sticky functioning of the valve and cause rough idling.*

(a) Using a micrometer, measure diameter of valve stem in three places; top, center and bottom. Exhaust valves have tapered stems and are approximately 0.001-inch (0.025 mm) larger at top of stem than at head end.

(b) Insert telescoping gauge in valve guide bore to measure valve-to-valve guide clearance (fig. 1B-27).

(c) If clearance is not within specified limits, use next oversize valve stem size and ream bore to fit using suitable reamer with Tool J-5830-02. Service valves are available with standard, 0.003-inch (0.076 mm) and 0.005-inch (0.127 mm) oversize stem diameters.

(11) Test valve spring tension with suitable tester. Refer to Valve Spring Tension Testing.

NOTE: *Springs should be tested by compressing to a specified height, and measuring force required to maintain that height. (See Specifications.) Weak springs should be replaced if not within 10 force-pounds (44 N) of the specified load (without dampers).*

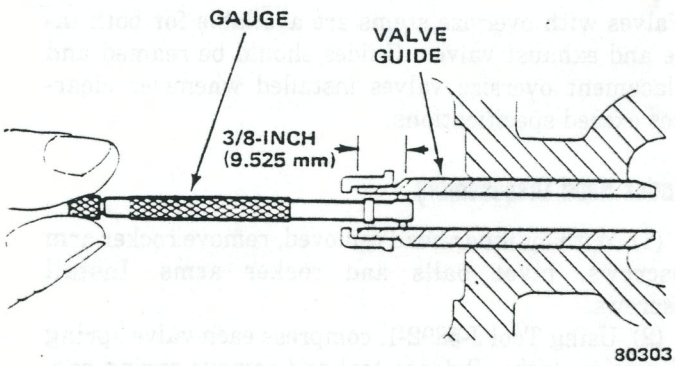


Fig. 1B-27 Measuring Valve Guide Bore with Telescoping Gauge

Cylinder Head Assembly

(1) Insert valve in original port.

(2) Assemble valve spring and related parts according to following procedure:

(a) Set valve spring, shield and cap in place.

(b) Compress spring with Tool J-5892-1.

(c) With Tool J-22330 install oil seal in lower groove of stem. Ensure seal is flat and not twisted.

(d) Install locks and release compressing tool. Ensure locks are seated properly in upper groove of valve stem.

(3) Install remaining valves according to procedure described above.

(4) Test each valve stem oil seal by placing Valve Seal Installer and Tester Tool J-22330 over end of valve stem and against cap.

(5) Measure installed height of valve springs using a narrow, thin scale. Use of a cutaway scale will help. Measure from top of spring seat to top of valve spring or oil shield. If spring exceeds specified height, install 1/16-inch (1.59 mm) valve spring seat shim.

CAUTION: *Never shim a spring excessively. Installed height should never be less than specified minimum height.*

ENGINE LUBRICATION SYSTEM

Engine lubrication is accomplished through a gear type pump that pumps engine oil from the oil pan sump, through the full flow oil filter and into an oil passage that runs along the right side of the block and intersects the hydraulic valve tappet bores. Oil from this passage is routed to the crankshaft main and camshaft bearings through smaller drilled passages. Oil is supplied to the rocker arms through holes in the hydraulic valve tappets, which force oil up through the tubular push rods to the rocker arms. The oil is metered by a disc located within each tappet body.

Two valves are incorporated into the lubrication system to ensure the proper flow of oil. A bypass valve is located within the oil filter mounting boss that will continue oil flow in the event that the filter becomes clogged or restricted. The pressure regulator valve located in the oil pump body maintains adequate pressure for the lubrication system and bypasses any excess oil back to the oil pan sump.

Many internal engine parts have no direct oil source and are either gravity or splash lubricated from other directly lubricated components. The timing gears are lubricated by oil that is supplied through a passage from the front of the camshaft to a calibrated nozzle above the crankshaft timing gear. The engine lubrication system diagram is depicted in figure 1B-28.

A full flow oil filter is standard equipment on the engine and is mounted on the right side of the engine. All oil from the pump passes through the filter before going to the engine oil galleries. In the filter, the oil passes through a filtering element that removes foreign particles.

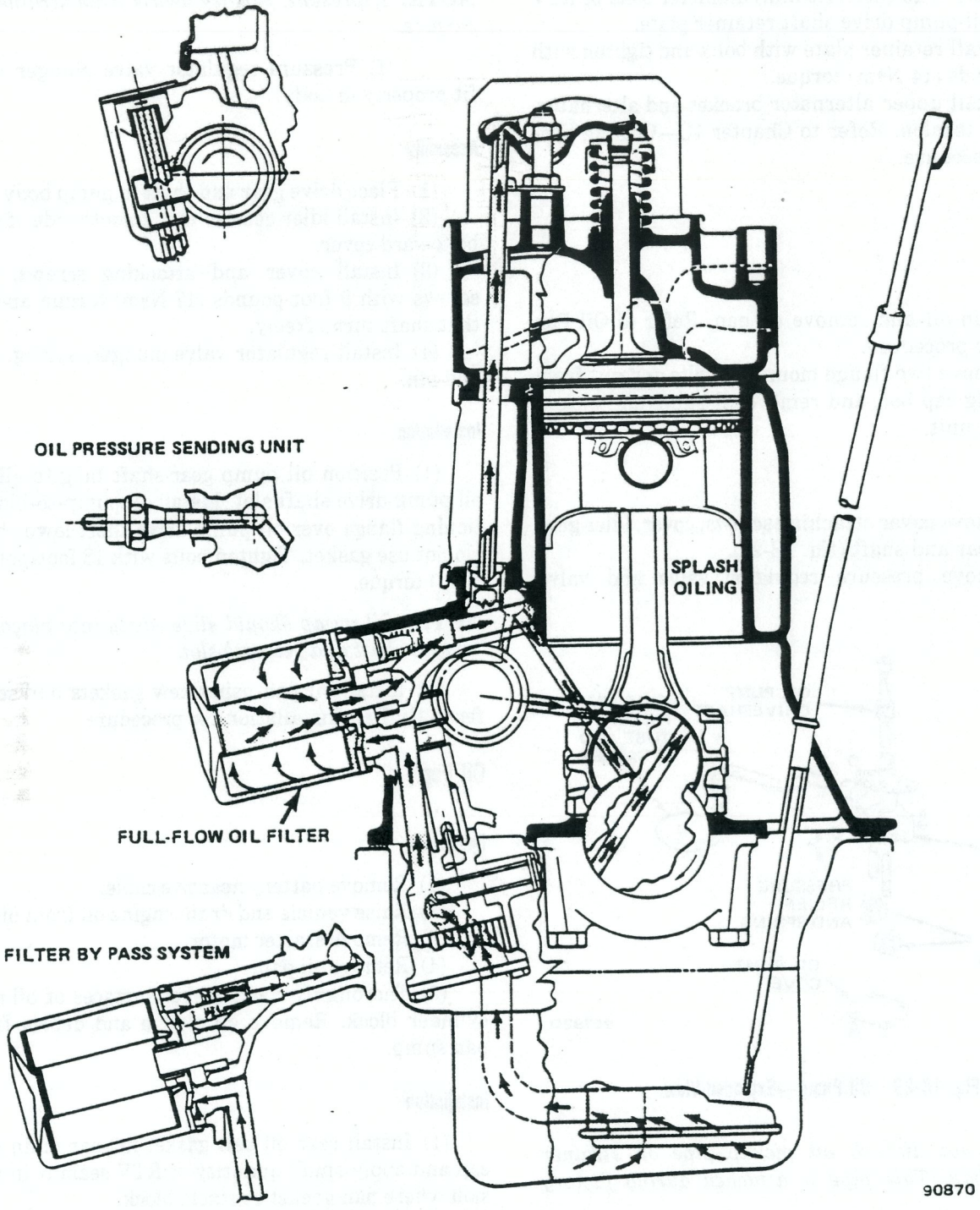


Fig. 1B-28 Engine Lubrication System Diagram

Oil Pump Drive Shaft

Removal

(1) Remove alternator and upper bracket.

(2) Remove oil pump drive shaft retainer plate bolts and remove bushing and shaft assembly.

Installation

(1) Install oil pump drive shaft assembly by turning shaft until it meshes with camshaft drive gear and inserts properly in oil pump body.

(2) Thoroughly clean sealing surfaces on cylinder block and retainer plate.

(3) Apply 1/16-inch (1.6 mm) diameter bead of RTV sealant to oil pump drive shaft retainer plate.

(4) Install retainer plate with bolts and tighten with 10 foot-pounds (14 N•m) torque.

(5) Install upper alternator bracket and alternator. Adjust belt tension. Refer to Chapter 1C—Cooling Systems for procedure.

Oil Pump

Removal

(1) Drain oil and remove oil pan. Refer to Oil Pan Removal for procedure.

(2) Remove two flange mounting bolts and nut from main bearing cap bolt and remove oil pump and pickup assembly as unit.

Disassembly

(1) Remove cover attaching screws, cover, idler gear and drive gear and shaft (fig. 1B-29).

(2) Remove pressure regulator valve and valve parts.

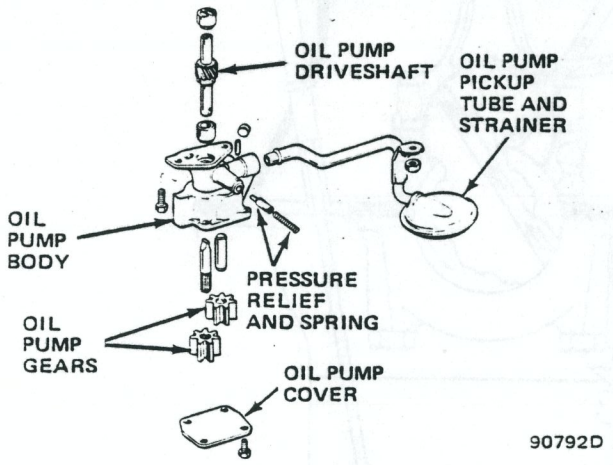


Fig. 1B-29 Oil Pump—Exploded View

NOTE: *Do not disturb oil pickup pipe on strainer screen or body. This pipe is attached during factory assembly.*

(3) If any of the following discrepancies are observed during inspection, complete pump assembly should be replaced.

(a) Pump body has cracks or excessive wear.

(b) Pump gears have cracks, excessive wear and damage.

(c) Shaft is loose in housing.

(d) Inside of cover has wear that would permit oil to leak past ends of gears.

(e) Oil pick-up assembly has damage to strainer screen or relief grommet.

NOTE: *If present, remove debris from strainer screen surface.*

(f) Pressure regulator valve plunger does not fit properly in body.

Assembly

(1) Place drive gear and shaft in pump body.

(2) Install idler gear so that smooth side of gear will be toward cover.

(3) Install cover and attaching screws. Tighten screws with 9 foot-pounds (17 N•m) torque and ensure that shaft turns freely.

(4) Install regulator valve plunger, spring, retainer and pin.

Installation

(1) Position oil pump gear shaft tang to align with oil pump drive shaft slot. Install oil pump-to-block positioning flange over oil pump drive shaft lower bushing. Do not use gasket. Tighten bolts with 18 foot-pounds (25 N•m) torque.

NOTE: *Oil pump should slide easily into place. If not, remove shaft and relocate slot.*

(2) Install oil pan using new gaskets and seals. Refer to Oil Pan Installation for procedure.

Oil Pan

Removal

(1) Remove battery negative cable.

(2) Raise vehicle and drain engine oil from oil pan.

(3) Remove starter motor.

(4) Remove oil pan.

(5) Thoroughly clean gasket surfaces of oil pan and cylinder block. Remove all sludge and debris from oil pan sump.

Installation

(1) Install rear oil pan gasket in rear main bearing cap and apply small quantity of RTV sealant in depression where pan gasket contacts block.

(2) Position gasket on oil pan. Apply 1/8 x 1/4-inch (3 x 6 mm) bead of RTV sealant at split lines of front and side gasket.

(3) Position oil pan. Insert and tighten screws with 45 inch-pounds (5 N•m) torque.

(4) Install starter motor. Tighten 3/8-inch bolts with 17 foot-pounds (24 N•m) torque. Tighten nut with 40 inch-pounds (4.5 N•m) torque. Connect battery cable and solenoid wire to starter motor solenoid.

(5) Lower vehicle.

(6) Connect battery negative cable. Refill crankcase with oil.

PISTONS AND CONNECTING RODS

The pistons are lightweight, cast aluminum with slipper skirt and cam ground so that the diameter across the thrust face is larger than the diameter fore and aft of the engine. Two compression rings and one oil control ring are used. All are located above the piston pin.

The piston pins are offset toward the thrust side (right-hand side) to provide a gradual change in thrust pressure against the cylinder wall as the piston travels within the cylinder. The piston pins are tempered steel and have a floating fit in the pistons. They are retained in the connecting rods by a press fit.

The connecting rods are made of Armasteel. Full pressure lubrication is directed to the connecting rods by drilled oil passages from the adjacent main bearing journal. Oil holes at the connecting rod journals are located so that oil is supplied to give maximum lubrication just prior to full bearing load.

Removal

(1) Remove cylinder head according to procedure described in Cylinder Head Removal.

(2) Remove oil pan according to procedure described in Oil Pan Removal.

(3) Remove ridge and/or deposits from upper end of cylinder bores with ridge reamer tool. Before ridge or deposits are removed, turn crankshaft until piston is at bottom of stroke and place a cloth on top of piston to collect cuttings. After ridge and/or deposits are removed, turn crankshaft until piston is at top of stroke and remove cloth and cuttings.

(4) Inspect connecting rod and piston for cylinder number identification and, if not identified, mark them.

(5) Remove bearing cap and install Connecting Rod Bolt Guide Set J-6305-11.

(6) Carefully remove connecting rod and piston assembly by pushing out with knurled handle of long guide.

Disassembly

CAUTION: *Use care at all times when handling and servicing connecting rods and pistons. To prevent possible damage to these units, do not clamp rod or piston in vise because they may become distorted. Do not allow pistons to strike against one another, against hard objects or bench surfaces because distortion of piston contour or nicks in the soft aluminum material may result.*

(1) Remove piston rings using suitable piston ring removal tool.

(2) Install guide bushing of Piston Pin Removal and Installation Tool J-24086.

(3) Position piston and connecting rod assembly on support and place assembly on arbor press (fig. 1B-30).

(4) Press pin out of connecting rod with Piston Pin Removal Tool J-24086.

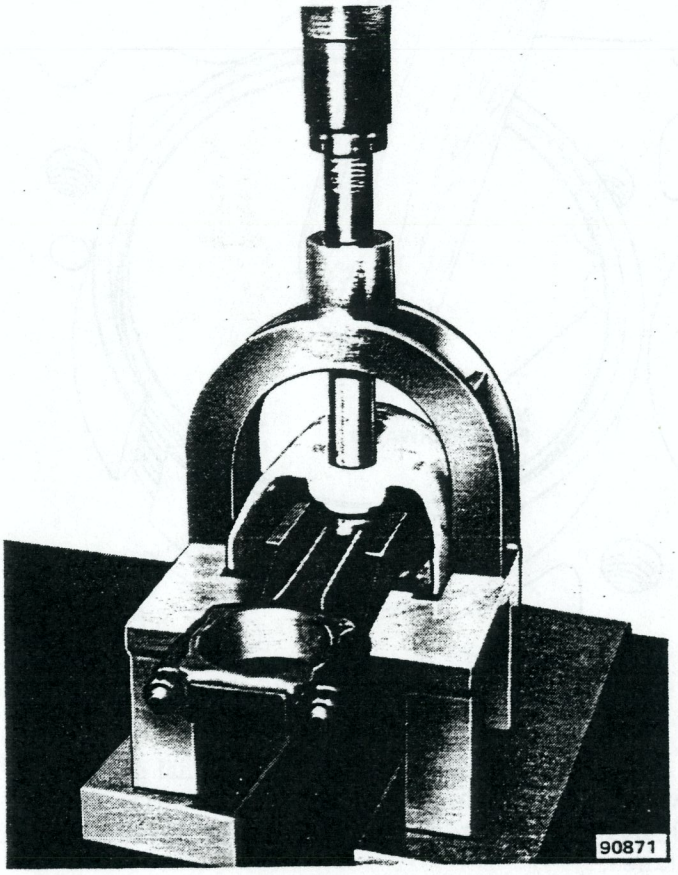


Fig. 1B-30 Removing Piston Pin

(5) Remove assembly from press, remove piston pin from support and remove tool from piston and rod.

(6) Clean carbon, varnish, and gum deposits from piston surfaces, including underside of piston head. Clean ring grooves and oil holes in oil ring groove with appropriate cleaning tools and solvent.

(7) Clean piston pin, rod, cap, bolts and nuts in appropriate solvent. Reinstall cap on connecting rod to prevent inadvertent mixing of caps and connecting rods.

(8) Carefully examine piston for rough or scored surfaces; cracks in skirt or head; cracked, broken, or worn ring lands; and scored, galled, or worn piston bosses. Damaged or defective pistons should be replaced.

(9) Inspect piston pin for scoring, roughness, or uneven wear and proper fit.

(10) Inspect rod bearing inserts to ensure they are not damaged. Fit of bearings should be determined when engine is being assembled.

Assembly

There are two notches cast in the top of all piston heads to facilitate proper installation. The pistons should always be installed with the notches toward the front of the engine (fig. 1B-31).

(1) Lubricate piston pin holes in piston and connecting rod lightly with graphite lubricant.

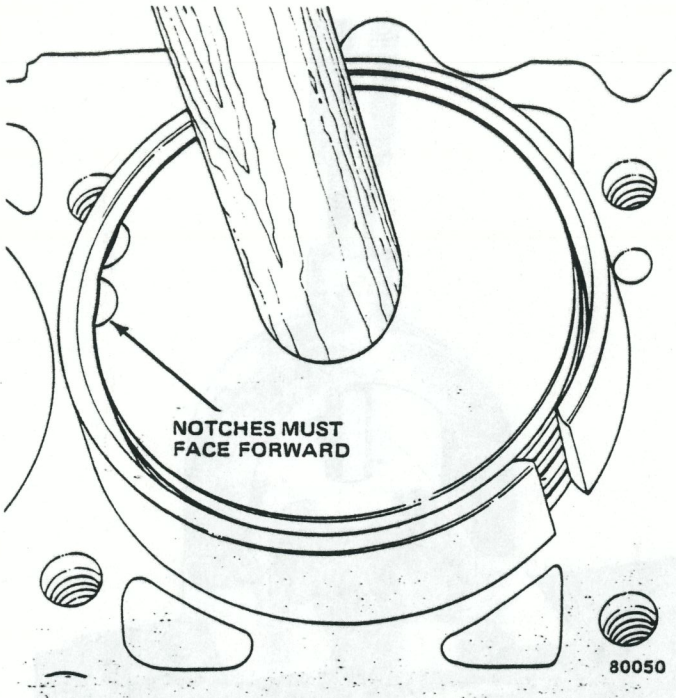


Fig. 1B-31 Installing Piston in Cylinder

(2) Position connecting rod in its original piston so that raised notch side of rod (fig. 1B-32) at bearing end is 180 degrees opposite notches in top of piston when installed.

(3) Position piston and rod on support, and insert pilot through piston and rod. Note positions of notches.

(4) Place support on arbor press, start pin into position and press on installation tool until guide bushing bottoms (fig. 1B-30).

(5) Remove installation tool and support assembly from piston and connecting rod assembly.

(6) Inspect piston pin for freedom of movement in piston bore.

(7) Install piston rings with appropriate installation tool. Refer to Piston Ring Installation for procedure.

Installation

(1) Install Connecting Rod Bolt Guide Set J-6305-11 on connecting rod bolts.

(2) Using appropriate piston ring compressor, insert rod and piston assembly into cylinder so that notches in top of piston is facing front of engine (fig. 1B-31).

(3) From beneath engine, position connecting rod with upper bearing insert in place against journal.

(4) Remove Guide Set J-6305-11 and install lower bearing insert and cap. Tighten capnuts with 30 foot-pounds (40 N•m) torque.

(5) Install oil pan.

(6) Install cylinder head, intake manifold and exhaust manifold.

(7) Connect fuel pipe and vacuum hoses to carburetor.

(8) Install push rods, place rocker arms in position and tighten rocker arm nuts. Do not over tighten nuts.

(9) Install cylinder head cover.

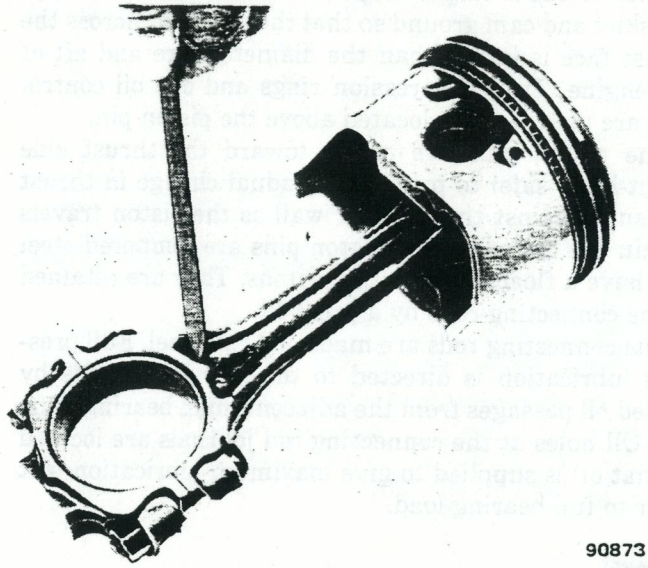


Fig. 1B-32 Raised Notch Location

Connecting Rod Bearings

The connecting rod bearings are the precision insert type and should be replaced if the clearances are excessive. Service bearings are available in standard size, 0.001-inch (0.025 mm), 0.002-inch (0.050 mm) and 0.010-inch (0.254 mm) undersize for use with replacement and remanufactured crankshafts.

Replacement and Inspection

Before removal of the connecting rod and cap, stamp the side of the connecting rod and cap with corresponding cylinder number to assure matched reassembly.

(1) With oil pan and oil pump removed, remove connecting rod cap and bearing.

(2) Inspect bearing inserts for evidence of wear or damage.

(3) Wipe bearings and journal clean of oil.

(4) Measure journal for out-of-round or taper with micrometer. If not within specification, replace or recondition crankshaft. If within specification and replacement bearing inserts are to be installed, measure maximum diameter of journal to determine required size of replacement bearing inserts.

(5) If within specification, measure replacement or original bearing clearances with Plastigage, or equivalent.

(6) If bearing is being fitted to out-of-round journal, allow for maximum diameter of journal. If bearing is fitted to minimum diameter and journal is out-of-round, interference between bearing and journal will result and rapid bearing failure will occur.

(a) Place strip of Plastigage on full width of journal on area that is contacted by bearing (parallel to crankshaft).

(b) Install bearing inserts in connecting rod and cap.

(c) Install rod and bearing cap and evenly tighten nuts with 30 foot-pounds (40 N•m) torque.

NOTE: *Do not turn the crankshaft with the Plastigage installed.*

(d) Remove bearing cap and, with scale on envelope, measure width of Plastigage strip at widest point (fig. 1B-33).

(e) If clearance exceeds specification, select correct replacement size bearing inserts and remeasure clearance.

NOTE: *Ensure that size of removed bearing is ascertained to determine correct size for replacement bearing inserts. If the clearance cannot be brought to specification, the journal must be ground undersize. If the journal is already at maximum undersize, the crankshaft must be replaced.*

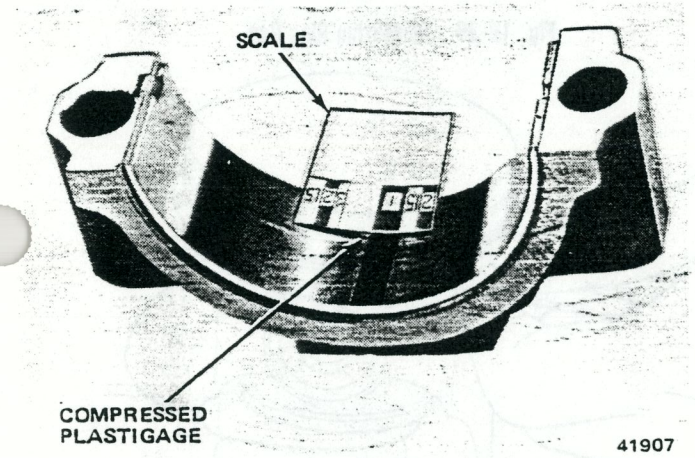


Fig. 1B-33 Connecting Rod Bearing Clearance Measurement with Plastigage

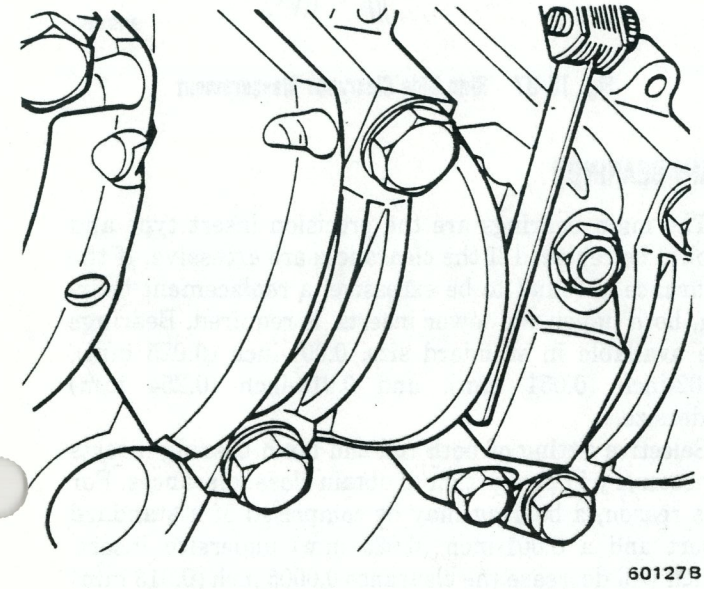


Fig. 1B-34 Measuring Connecting Rod Side Clearance

(7) Coat bearing surface with oil, install inserts, rod and bearing cap. Tighten nuts with 30 foot-pounds (40 N•m) torque.

(8) When all connecting rod bearings have been installed, tap each rod lightly (parallel with journal) to ensure they have correct clearance.

(9) Measure all connecting rod side clearances (refer to Specifications) between connecting rod caps (fig. 1B-34).

Piston Fit

Pistons should be fitted in the bores by actually measuring the fit (measure OD of piston at the measuring locations and ID of cylinder bore). Refer to engine specifications for correct clearances. If cylinder bores have been reconditioned, or if pistons are being replaced, reconditioning of bores and fitting of pistons should be closely coordinated.

If bore has been honed, it should be washed thoroughly with hot, soapy water and a stiff bristle brush. Thoroughly oil bores after washing.

Using a cylinder measurement gauge, measure the cylinder bore crosswise to the block to determine the smallest diameter. Record the smallest diameter of each bore.

NOTE: *When measuring cylinder bores and pistons, it is very important that the block and pistons be at room temperature. If any or all of the parts are warmer or cooler than normal room temperature, improper fitting will result.*

Measure the piston skirt perpendicular (90 degrees from) to the piston pin boss (piston pin removed) and at the measuring locations indicated in figure 1B-35.

NOTE: *Ensure the micrometer is in full contact.*

As the pistons are measured, they should be marked for size identification and the measurements recorded.

If there is excessive clearance between a cylinder bore and the piston that was originally installed, a replacement piston should be used. Replacement pistons are available in both standard size and oversize.

Because the sizes are nominal or basic sizes, it is important that replacement pistons be measured to ensure proper fit. All replacement pistons are equipped with selectively fitted piston pins.

After all measurements have been completed, match the replacement pistons with cylinders that will provide the correct clearance. Honing of the cylinder bore may be necessary to effect a proper fit. When properly mated, mark each piston with the matching cylinder number to ensure it will not become mis-matched.

Piston Pins

Piston pins normally do not become loose enough to cause a knock or tapping until after very high mileage accumulation on the engine and in such instances the piston and rod can be reamed and oversize pins installed.

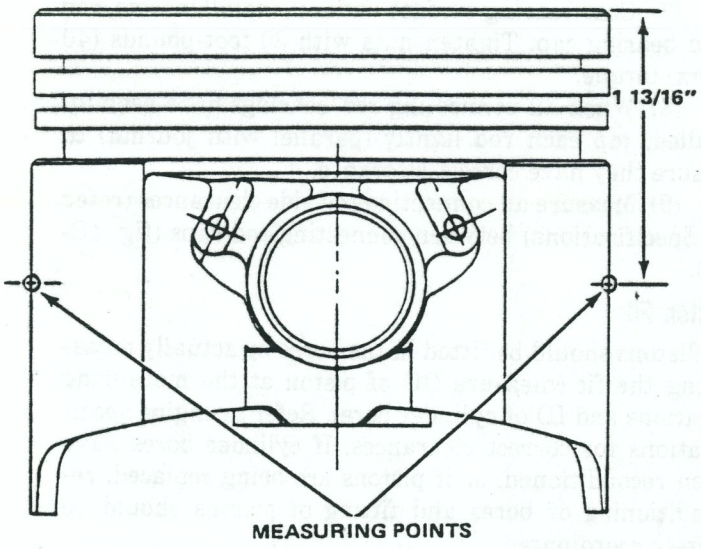


Fig. 1B-35 Piston Measurement Locations

The piston pin fit specification in the piston is 0.0002 to 0.0004 inch (0.005 to 0.010 mm) loose with pin and bosses clean and dry.

NOTE: *Piston and pin must be at room temperature when determining fit and pin must gravity-fall from the piston.*

Piston Rings

Installation

Replacement rings are available for standard size pistons and for 0.010-inch (0.254 mm) and 0.030-inch (0.762 mm) oversize pistons. When selecting rings, ensure they correspond to the size of the piston (i.e., standard rings for standard pistons, 0.010-inch oversize rings for 0.010-inch oversize pistons, etc.). Ring gap and side clearance should be measured when installing rings as follows:

(1) Inspect pistons to ensure that ring grooves and oil return holes have been properly cleaned.

(2) Place ring at lower end of ring travel area in cylinder bore. Level ring in bore by pushing it into position with inverted piston.

(3) Measure gap between ends of ring with feeler gauge (fig. 1B-36). Refer to Specifications.

NOTE: *An incorrect ring gap indicates that the wrong size rings are being used. If rings are selected according to the size of the bore, they should have the proper gap. It should not be necessary to alter ring gap by filing.*

(4) Install rings on piston with appropriate ring installation tool to prevent breakage or fracture of rings, or damage to pistons.

(5) Measure side clearance of rings in ring groove (fig. 1B-37). Refer to Specifications. If side clearance is excessive, piston must be replaced.

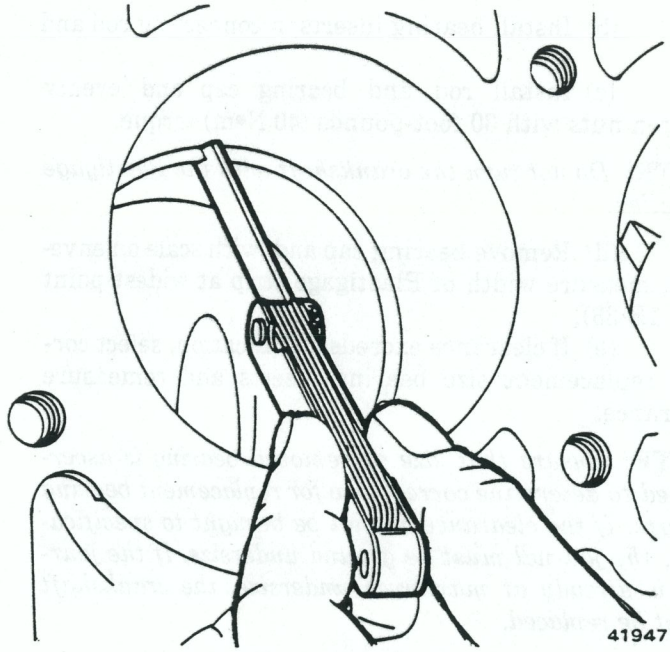


Fig. 1B-36 Measuring Ring Gap

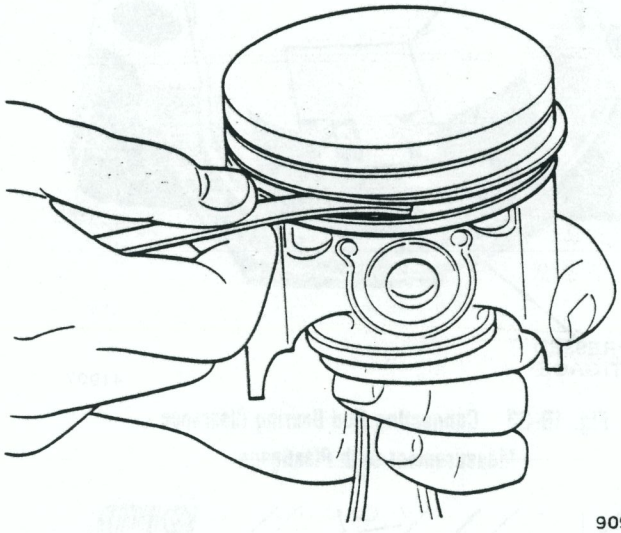


Fig. 1B-37 Ring Side Clearance Measurement

MAIN BEARINGS

The main bearings are the precision insert type and should be replaced if the clearances are excessive. If the clearance is found to be excessive, a replacement bearing, both upper and lower inserts, is required. Bearings are available in standard size, 0.001-inch (0.025 mm), 0.002-inch (0.051 mm), and 0.010-inch (0.254 mm) undersize.

Selective fitting of both rod and main bearing inserts is necessary in production to obtain close tolerances. For this reason, a bearing may be comprised of a standard insert and a 0.001-inch (0.025 mm) undersize insert, which will decrease the clearance 0.0005 inch (0.013 mm) from that of two standard bearing inserts.

Inspection

In general, the lower insert (except No. 1 bearing) will have greater wear and the most distress from fatigue. If upon inspection the lower insert is suitable for use, it can be assumed that the upper insert is also satisfactory. If the lower insert has evidence of wear or damage, both upper and lower inserts should be replaced. Never replace one insert without replacing the other.

Clearance Measurement

To obtain the most accurate results with Plastigage, or equivalent, certain precautions must be observed. If the engine has been removed from the vehicle and turned upside down, the crankshaft will rest on the upper bearings and the total clearance can be measured between the lower bearing insert and journal. If the engine is installed in the vehicle, the crankshaft should be supported upward to remove the clearance from the upper bearing insert. The total clearance can then be measured between the lower bearing insert and journal.

To assure proper seating of the crankshaft, all bearing cap bolts must be tightened with the specified torque. In addition, before measuring the fit of bearings, the surface of the crankshaft journal and bearing should be wiped clean of oil.

(1) With oil pan and oil pump removed and starting with rear main bearing, remove bearing cap and wipe oil from journal and bearing cap.

(2) Place strip of Plastigage on full width of bearing surface area (parallel with crankshaft) on journal.

NOTE: *Do not rotate the crankshaft while the Plastigage is between the bearing and journal.*

(3) Install bearing cap and insert. Tighten retaining bolts evenly with 65 foot-pounds (88 N•m) torque.

(4) Remove bearing cap. Flattened Plastigage will be adhering to either bearing insert or journal.

(5) Without removing Plastigage, measure its compressed width (at the widest point) (fig. 1B-38).

NOTE: *Normally, main bearing journals wear evenly and are not out-of-round. However, if a bearing is being fitted to an out-of-round journal, fit to the maximum diameter of the journal. If the bearing is fitted to the minimum diameter and the journal is out-of-round, interference between the bearing and journal will result and rapid bearing failure will occur. If the flattened Plastigage tapers toward the middle or ends, there is a difference in clearance indicating taper, low spot or an irregularity in the bearing or journal. Measure the journal with a micrometer if the flattened Plastigage indicates more than 0.0005-inch (0.013 mm) difference.*

(6) If bearing clearance is within specification, bearing inserts are satisfactory. If clearance is not within specification, replace inserts. Always replace both upper and lower inserts as a unit.

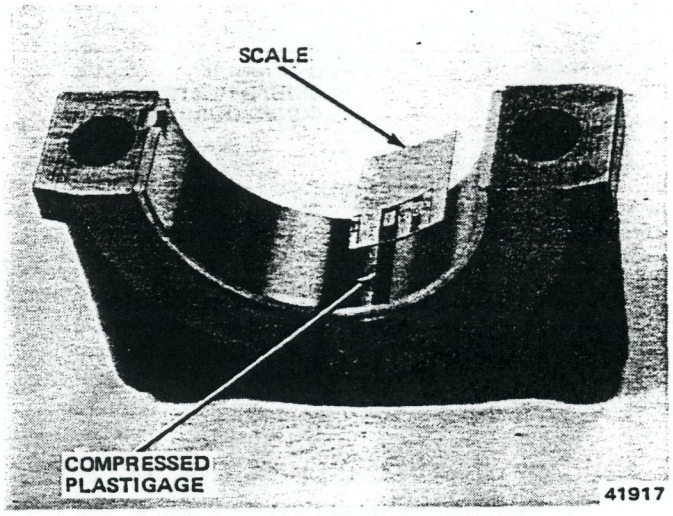


Fig. 1B-38 Measuring Bearing Clearance

(7) Standard 0.001-inch (0.254 mm) or 0.002-inch (0.508 mm) undersize bearing inserts should produce correct clearance.

(8) Proceed to next journal. After clearances of all journals and bearings have been measured, rotate crankshaft to ensure that there is no excessive drag.

(9) Measure crankshaft end play (refer to Specifications) by forcing crankshaft to extreme front position. Measure at front end of thrust bearing with feeler gauge.

Replacement

Main bearings may be replaced with either the crankshaft installed or removed from the engine.

Crankshaft Removed From Engine

(1) Remove and inspect crankshaft.

(2) Remove main bearing inserts from cylinder block and main bearing caps.

(3) Coat bearing surfaces of replacement main bearing inserts with oil and position in cylinder block and main bearing caps. Install crankshaft and caps with arrows pointing toward rear of engine. Tighten caps with 65 foot-pounds (88 N•m) torque.

Crankshaft Installed

(1) With oil pan, oil pump and spark plugs removed, remove cap from main bearing requiring replacement and remove lower bearing insert from cap.

(2) Insert upper main bearing insert removal and installation tool in oil hole in crankshaft journal. If tool is not available, tool (fig. 1B-39) may be fabricated from cotter pin by bending as required.

(3) Rotate crankshaft clockwise as viewed from front of engine. This will roll upper bearing insert out of block.

(4) Apply oil to replacement upper bearing insert and position plain (unnotched) end between crankshaft

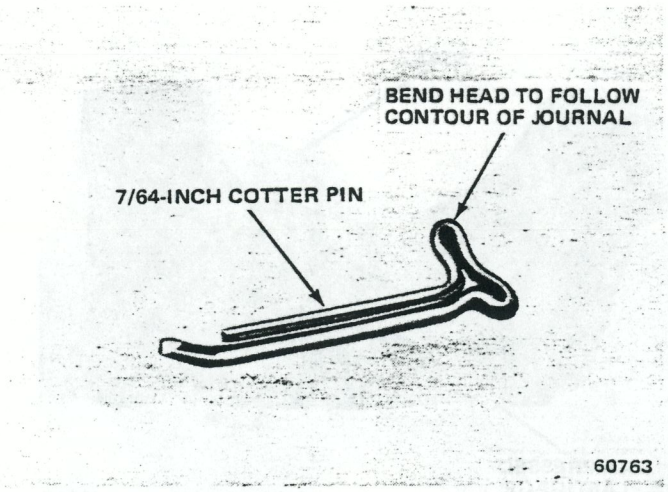


Fig. 1B-39 Fabricated Upper Main Bearing Insert Removal and Installation Tool

and indented or notched side of block. Rotate bearing into place and remove tool from oil hole in crankshaft journal.

(5) Apply oil to replacement lower bearing insert and install in bearing cap.

(6) Install main bearing cap with arrows pointing toward rear of engine.

(7) Tighten main bearing cap bolts with 65 foot-pounds (88 N•m) torque.

Rear Main Bearing Oil Seal Replacement

Removal

The rear main bearing oil seal is a one piece unit and can be removed and installed without removal of the oil pan or crankshaft.

(1) Disconnect battery negative cable.

(2) Raise vehicle.

(3) Remove transmission and transfer case as an assembly. Refer to Transmission Removal in Chapter 2B or 2C for procedure.

(4) Remove starter motor cable and solenoid wire. Remove starter motor.

(5) If manual transmission, remove inspection plate from flywheel housing.

(6) If manual transmission, remove hydraulic clutch slave cylinder from flywheel housing.

(7) Remove flywheel/drive plate housing bolts and housing from engine.

(8) If manual transmission, remove clutch pressure plate and disc assembly by loosening bolts 1/4 turn in equal amounts until pressure is relieved.

(9) Mark flywheel/drive plate location to facilitate correct assembly. Remove bolts and flywheel/drive plate.

(10) Using a small blade screwdriver, pry out rear main oil seal. Use care to prevent damaging seating groove or crankshaft.

Installation

(1) Center replacement seal over crankshaft with lip of seal facing toward front of engine. With a soft hammer (plastic), tap around perimeter of seal until it seats in groove. Use care to prevent seal from binding on crankshaft and not seating properly.

(2) Attach flywheel/drive plate to crankshaft and tighten bolts with 68 foot-pounds (93 N•m) torque.

(3) If manual transmission, install clutch pressure plate and disc assembly. Tighten bolts 1/4 turn in equal amounts until assembly is flush against flywheel. Tighten bolts with 18 foot-pounds (25 N•m) torque.

NOTE: *Use Alignment Tool J-5824-01, or equivalent, to align clutch disc prior to tightening bolts.*

(4) Install flywheel/drive plate housing and tighten bolts with 35 foot-pounds (47 N•m) torque.

(5) If manual transmission, install inspection plate on flywheel housing.

(6) If manual transmission, install hydraulic clutch slave cylinder on flywheel housing. Tighten bolts with 18 foot-pounds (25 N•m) torque.

(7) Install transmission/transfer case assembly. Refer to Chapter 2B for procedure.

(8) Install starter motor, cable and solenoid wire. Refer to Chapter 2B or 2C for procedure.

(9) Lower vehicle.

(10) Connect battery negative cable.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(11) Start engine and inspect for leaks.

CRANKSHAFT REPLACEMENT

Removal

(1) Remove engine from vehicle.

(2) Mount engine on suitable stand.

(3) Remove spark plugs.

(4) Remove fan and pulley.

(5) Remove crankshaft vibration damper and hub assembly.

(6) Remove oil pan and oil pump assembly.

(7) Remove timing case cover.

(8) Remove crankshaft timing gear.

(9) Remove connecting rod bearing caps and bearing inserts. Mark each for installation identity.

(10) Move connecting rod and piston assemblies away from crankshaft.

(11) Remove main bearing caps with bearing inserts and mark for installation identity.

(12) Remove crankshaft and upper bearing inserts. Mark inserts for installation identity.

Installation

(1) With upper main bearing inserts installed, position replacement crankshaft in block.

(2) Install main bearing caps (with lower bearing inserts), but do not tighten cap bolts. Oil bearings prior to assembly.

(3) Move connecting rods (with upper bearing inserts installed) and pistons into place.

(4) Install rod bearing caps (with bearing inserts), but do not tighten nuts. Apply oil to bearings prior to assembly.

(5) With rubber mallet, strike both ends of crankshaft to center thrust bearing. Rearward first, forward last.

(6) Tighten main bearing caps (65 foot-pounds, 88 N•m), then measure crankshaft end play. It should be between 0.0015 inch (0.038 mm) and 0.0085 inch (0.216 mm).

(7) Tighten connecting rod bearing caps (30 foot-pounds, 40 N•m).

(8) Measure bearing clearances using Plastigage method.

(9) Install key from original crankshaft in replacement crankshaft keyway.

(10) Install crankshaft timing gear and ALIGN TIMING MARKS ON TIMING GEARS BY ROTATING CRANKSHAFT, IF NECESSARY.

(11) Install timing case cover using replacement seal and gaskets.

(12) Install oil pump assembly and oil pan using replacement rear seal in rear main bearing cap and replacement front seal for timing case cover. Press front seal tips into holes in timing case cover.

(13) Coat front cover oil seal contact area of vibration damper hub with oil and push into position.

(14) Install fan pulley and fan.

NOTE: *The fan assembly and pulley must be installed with the drive belt(s) in position on pulley.*

(15) Install spark plugs.

(16) Remove engine from stand.

(17) Install engine in vehicle.

CYLINDER BLOCK

The cylinder block is manufactured from cast iron and has 4 in-line cylinders that are numbered from front to rear, 1 through 4. Five main bearings support the crankshaft, which is retained by recessed bearing caps that are machined with the block for proper alignment and clearances.

The cylinders are completely encircled by coolant jackets. (For details of engine cooling system, refer to Chapter 1C—Cooling Systems.)

Cylinder Bores

Inspect cylinder bores for out-of-round or excessive taper with an accurate Cylinder Measurement Gauge Tool J-8087, or equivalent. Measure at top, middle and bottom of bore (fig. 1B-40).

Measure cylinder bore parallel and at right angles to the centerline of the engine to determine out-of-roundness. Variation in measurement from top to bottom of cylinder indicates the taper in the cylinder. Figure 1B-41 illustrates the areas in the cylinder bore where wear

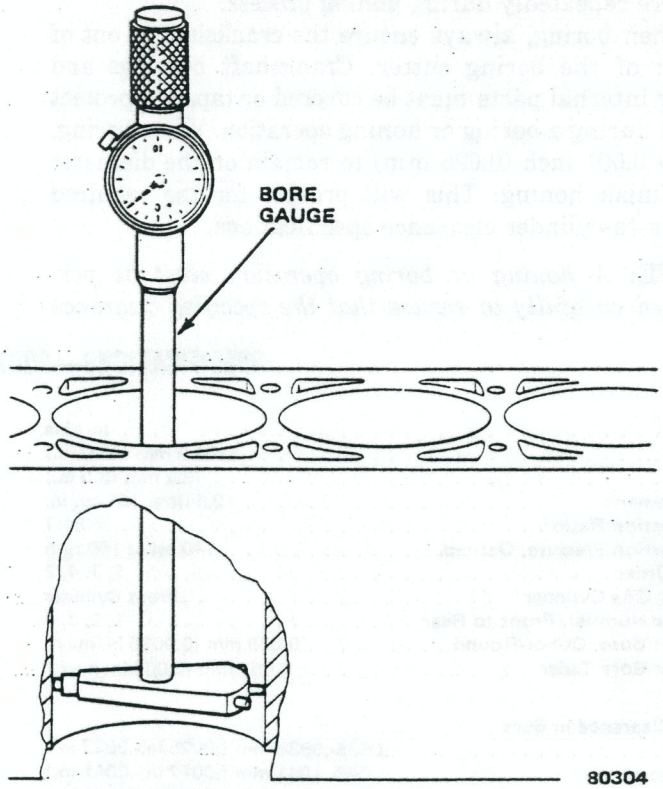


Fig. 1B-40 Measuring Cylinder Bore with Bore Gauge

normally occurs. If dimension A is larger than dimension B by 0.002 inch (0.051 mm) or more, it indicates the necessity for cylinder boring and installing replacement rings and pistons. Cylinder bores can be measured by setting the cylinder measurement gauge dial at zero in the cylinder bore at the location of desired measurement. Lock dial indicator at zero before removing from cylinder bore, and measure across the gauge contact points with outside micrometer (with the gauge at the same zero setting when removed from the cylinder).

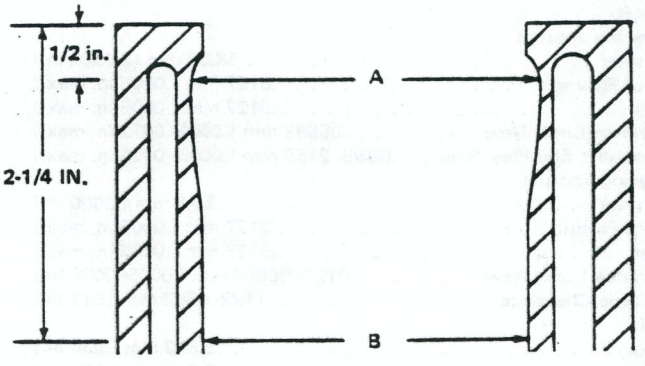


Fig. 1B-41 Normal Cylinder Bore Wear Pattern

Honing or Boring

If a piston other than standard size is to be installed, the cylinder should be bored, rather than honed, to obtain a true bore.

When honing to eliminate taper in the cylinder, use full strokes. Measure cylinder at top, middle and bottom of bore repeatedly during honing process.

When boring, always ensure the crankshaft is out of reach of the boring cutter. Crankshaft bearings and other internal parts must be covered or taped to protect them during a boring or honing operation. When boring, allow 0.001 inch (0.025 mm) to remain on the diameter for finish honing. This will provide for the required piston-to-cylinder clearance specifications.

NOTE: *A honing or boring operation must be performed carefully to ensure that the specified clearance between pistons, rings, and cylinder bores is maintained.*

By measuring the piston to be installed at the measuring locations and adding the mean of the clearance specification, the correct finish hone cylinder dimension can be determined. It is important that both the cylinder and piston be measured at normal room temperature.

After honing and before the piston is inserted for fit, each cylinder bore must be thoroughly cleaned. Use a hot, soapy water solution and wipe dry to remove all traces of abrasive. If all traces of abrasive are not removed, rapid wear of new rings and piston will result. After washing, thoroughly oil cylinder bores.

Intermixing different size pistons has no effect on engine balance because all pistons from standard size up to 0.030-inch (0.762 mm) oversize weigh exactly the same.

SPECIFICATIONS—FOUR-CYLINDER ENGINE

Type	In-Line
Bore	101.6 mm (4.00 in.)
Stroke	76.2 mm (3.0 in.)
Displacement	2.5 litre, 151 cu. in.
Compression Ratio	8.24:1
Compression Pressure, Desired	140 psi at 160 rpm
Firing Order	1, 3, 4, 2
Number One Cylinder	Front Cylinder
Cylinder Number, Front to Rear	1, 2, 3, 4
Cylinder Bore, Out-of-Round	0.038 mm (0.0015 in. max.)
Cylinder Bore Taper	0.051 mm (0.002 in. max.)
Piston	
Piston Clearance in Bore	
Top	.0635-.0838 mm (.0025 in.-.0033 in.)
Bottom	.043-.1041 mm (.0017 in.-.0041 in.)
Piston Diameter	101.519-101.580 mm (3.9968-3.9992 in.)
Compression Ring Side Clearance Top	.0762 mm (.0030 in.)
Compression Ring Side Clearance Bottom	.0762 mm (.0030 in.)
Compression Ring Width	
Top	1.9685-1.9812 mm (.0775-.0780 in.)
Bottom	1.9685-1.9812 mm (.0775-.0780 in.)
Upper Compression Ring Gap	.25-.56 mm (.010-.022 in.)
Lower Compression Ring Gap	.25-.71 mm (.010-.028 in.)
Oil Ring Gap	.381-1.397 mm (.015-.055 in.)
Piston Pin	
Diameter	23.547-23.557 mm (.92705-.92745 in.)
Length	76.2 mm (3.00 in.)
Pin to Piston	
Clearance	.003-.013 mm (.0003-.0005 in.)
Fit in Rod	Press
Crankshaft	
Main Bearing Journal	
Diameter	58.39 mm (2.2988 in.)
Out of Round	.0127 mm (.0005 in. max.)
Taper	.0127 mm (.0005 in. max.)
Clearance Limit New	.05588 mm (.0005-.0022 in. max.)
Crankshaft End Play New	.0889-.2159 mm (.0035-.0085 in. max.)
Rod Bearing Journal	
Diameter	50.8 mm (2.000 in.)
Out of Round	.0127 mm (.0005 in. max.)
Taper	.0127 mm (.0005 in. max.)
Clearance Limit New	.0127-.06604 mm (.0005-.0026 in.)
Rod Side Clearance	.1492-.4362 mm (.017 in.)
Lobe Lift	
Intake	5.842 mm (.230 in.)
Exhaust	5.842 mm (.230 in.)
Journal Diameter	47.4726 mm (1.869 in.)
Journal Clearance	.01778-.0685 mm (.0007-.0027 in.)
End Play Clearance	.031-0.127 mm (.0015-.1150 in.)
Valves	
Valve Train	
Lash Intake and Exhaust	0
Rocker Arm Ratio	1.75:1
Push Rod Length	226.746 mm (8.927 in.)
Valve Tappet	
Leak-Down Rate	12 to 90 sec. with 50 lb. load
Tappet Body Diameter	21.3868-21.4046 mm(.8120-.8427 in.)
Plunger Travel	3.175 mm (.125 in.)
Clearance in Boss	.635 mm (.0025 in.)
Tappet Bore Diameter	21.425-21.450 mm(.8435-.8445 in.)
Intake Valves	
Face Angle	45°
Seat Angle	46°
Head Diameter	43.688 mm (1.72 in.)
Stem Diameter	8.6995-8.68172 mm (.3425-.3418 in.)
Overall Length	115.75 mm (1.557 in.)
Stem-to-Guide Clearance	.0254-.06858 mm (.0010-.0027 in.)
Valve Seat Width	.897-1.897 mm (.353-.0747 in.)
Valve Installed Height (Spring Seat to Valve Tip)	52.265 mm (2.057 in.)
Exhaust	
Face Angle	45°
Seat Angle	46°
Head Diameter	38.4 mm (1.50 in.)
Stem Diameter	8.766-8.682 (3.418-3.125 in.)
Overall Length	114.02 (4.489 in.)
Stem-to-Guide Clearance Top	.0254-.06858 mm (.0010-.0027 in.)
Valve Seat Width	1.468-2.468 mm (.058-.097 in.)
Valve Installed Height (Spring Seat to Valve Tip)	44.024 mm (1.73 in.)
Valve Springs	
Intake and Exhaust	
Valve Spring Pressure and Length-Valve Closed	347-383 N at 42.16 mm (78-86 lb. at 1.66 in.)
Valve Spring Pressure and Length-Valve Open	.765-801 N at 31.85 mm (172-180 lb. at 1.254 in.)
Oil Capacity	
Without Filter Change	2.838 litre (3 qts.)
With Filter Change	2.838 litre (3 qts.)
Filter Type (full flow)	PF40 or equivalent
Oil Pressure at rpm	248-283 kPa (36-41 psi) at 2000 rpm
Oil Pump Gear to Body Clearance	0.10 mm (.004 in.) maximum
Gear End Clearance, Feeler Gauge	0.05-0.13 mm (0.0020-.005 in.) Above Pump Body

Torque Specifications

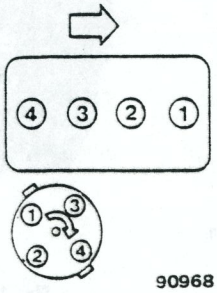
rvice Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft-lbs)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Adapter to Intake Manifold Bolt	15	12-18	20	16-24
Camshaft Thrust Plate to Block Bolt	80 in-lb	77-83 in-lb	9	6-12
Carburetor to Manifold Nut	15	13-18	20	24
Clutch Housing-to-Engine Bolts	54	51-57	73	70-76
Connecting Rod Nut	30	27-33	40	37-43
Converter-to-Drive Plate Bolts	40	35-40	54	51-57
Crankshaft Pulley Hub Bolt	160	157-163	220	212-221
Cylinder Head Cover Bolt	7	4-10	10	7-13
Cylinder Head Cover Screws	7	5-10	10	7-14
Cylinder Head to Block Bolt	92	81-103	125	110-140
Distributor Clamp Pivot to Block Bolt	12	9-15	17	14-21
Distributor Retaining Clamp Bolt	9	6-12	12	9-15
Drive Plate Ring Gear Assembly to Crankshaft Bolt	45	42-48	60	57-63
EGR Valve to Manifold Bolt	150 in-lb	147-153 in-lb	12	9-15
Exhaust Manifold to Cylinder Head Bolt	39	36-42	52	49-55
Exhaust Pipe to Manifold Nut	35	30-40	47	41-50
Fan and Pulley to Water Pump Bolt	18	15-21	24	21-27
Flywheel to Crankshaft Bolt	68	65-71	93	90-96
Fuel Pump to Block Bolt	15	12-18	20	17-23
Intake Manifold to Cylinder Head Bolt	37	34-40	50	47-53
Main Bearing to Block Bolt	65	62-68	88	85-91
Oil Filter	12	9-15	17	14-20
Oil Filter to Block Connector	35	32-38	47	44-50
Oil Pan Drain Plug	25	23-28	34	31-37
il Pan Bolts	45 in-lbs	43-48 in-lbs	5	2-8
il Pump Cover Bolt	9	6-12	17	14-20
Oil Pump to Block Bolt	18	15-21	25	22-28
Oil Pump to Drive Shaft Plate Bolt	10	7-13	14	11-17
Oil Screen Support Nut	28	25-31	38	35-41
Pressure Plate to Flywheel Bolts	18	15-22	25	20-30
Pulley to Crankshaft Hub Bolts	25	22-28	34	31-37
Push Rod Cover to Block Bolt	80 in-lb	77-83 in-lb	9	6-12
Radiator Hoses All Clamps	25 in-lb	22-28 in-lb	3	1-6
Rocker Arm Capscrew	20	17-23	27	24-30
Starter to Block Bolt	17	14-20	24	21-27
Thermostat Housing Bolt	22	19-25	30	27-33
Timing Case Cover Bolt	45 in-lb	42-48 in-lb	5	2-8
Timing Case Cover to Block Bolt	80 in-lb	77-83 in-lb	9	6-12
Water Outlet Housing Bolt	17	14-20	23	20-26
Water Pump to Block Bolt	17	14-20	23	20-26

All Torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

90892

Four-Cylinder Engine Firing Order



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SIX-CYLINDER ENGINE

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GENERAL

The 258 CID (4.2 liter), in-line, overhead valve, lightweight six-cylinder engine (figs. 1B-42 and 1B-43) operates only on no-lead gasoline. The cylinders are numbered from front to rear and the firing order is 1-5-3-6-2-4. Crankshaft rotation is clockwise, viewed from the front. The crankshaft is supported by seven two-piece bearings (inserts). The camshaft is supported by four one-piece, line bored bearings.

The six-cylinder engine features a quench-head combustion chamber design. The combustion chamber shape, both in the head and in the piston crown, compresses the combustion mixture closer to the spark plug. In most applications, this permits the use of more advanced ignition timing for better fuel economy.

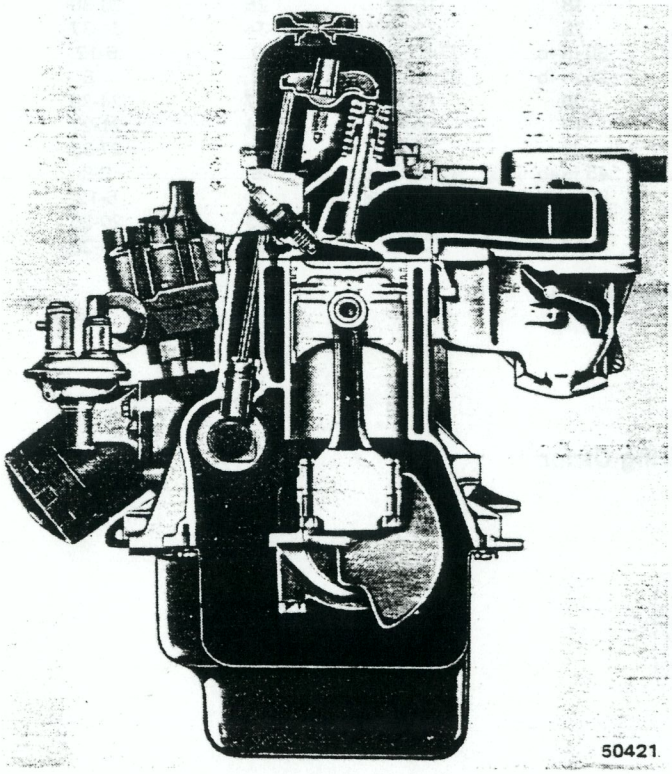
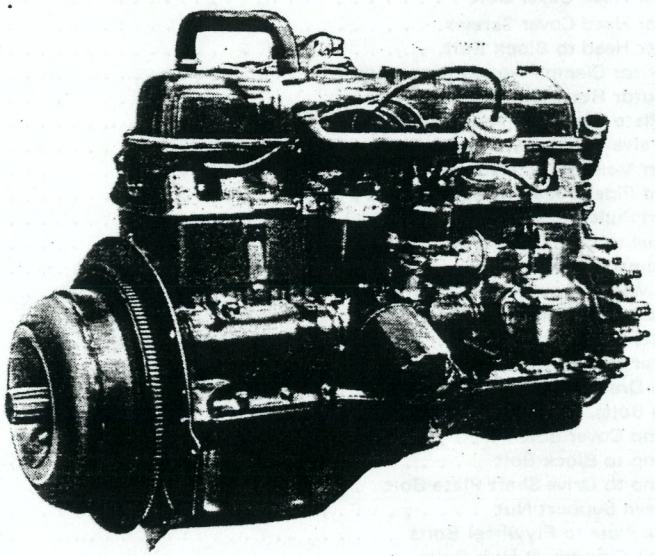


Fig. 1B-42 Six-Cylinder Engine Assembly—Sectional View



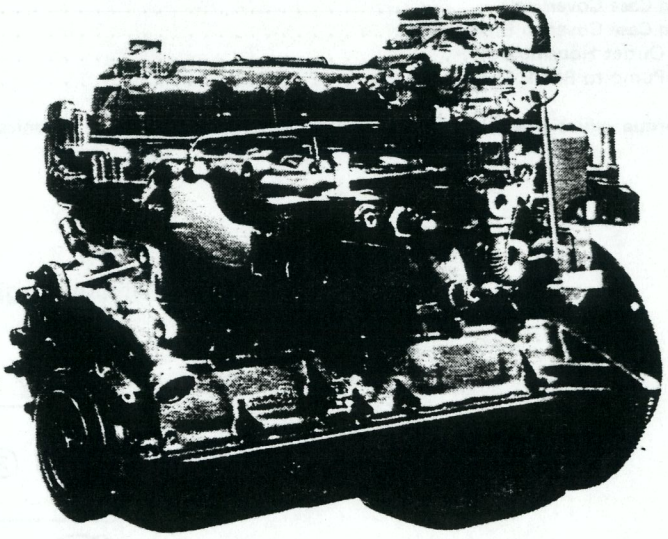


Fig. 1B-43 Six-Cylinder Engine Assembly—Typical

Identification

Build Date Code

The engine Build Date Code is located on a machined surface on the left side of the block (viewed from front) between the No. 2 and No. 3 cylinders (fig. 1B-44).

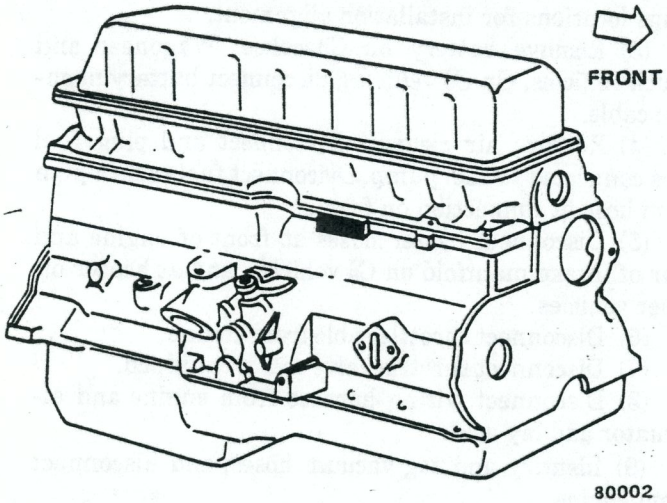


Fig. 1B-44 Engine Build Date Location

The numbers in the code identify the year, month and day that the engine was built.

The code letter identifies the cubic inch displacement, carburetor type and compression ratio. The data are decoded as listed in the Engine Build Date Code Chart.

Engine Build Date Code

Letter Code	CID	Carburetor	Compression Ratio
C	258	2V	8.0:1

1st Character (Year)	2nd and 3rd Characters (Month)	4th Character (Engine Type)	5th and 6th Characters (Day)
0 - 1980 1 - 1981	01 - 12	C	01 - 31

EXAMPLE: 4 10 C 18 60257

The example code identifies a 258 CID (4.2 liter) engine with 2V carburetor and 8.0:1 compression ratio that was built on October 18, 1980.

Oversize or Undersize Components

Some engines may be built with oversize or undersize components, such as oversize cylinder bores, undersize crankshaft main bearing journals, undersize connecting rod journals or oversize camshaft bearing bores. These engines are identified by a letter code stamped on a boss between the ignition coil and distributor (fig. 1B-45). The letters are decoded as listed in the Oversize or Undersize Components chart.

Oversize or Undersize Components

Code Letter	Definition	
B	All cylinder bores	-0.010-inch (0.254mm) oversize
M	All crankshaft main bearing journals	-0.010-inch (0.254mm) undersize
P	All connecting rod bearing journals	-0.010-inch (0.254mm) undersize
C	All camshaft bearing bores	-0.010-inch (0.254mm) oversize

EXAMPLE: The code letters PM mean that the crankshaft main bearing journals and connecting rod journals are 0.010-inch undersize.

60258

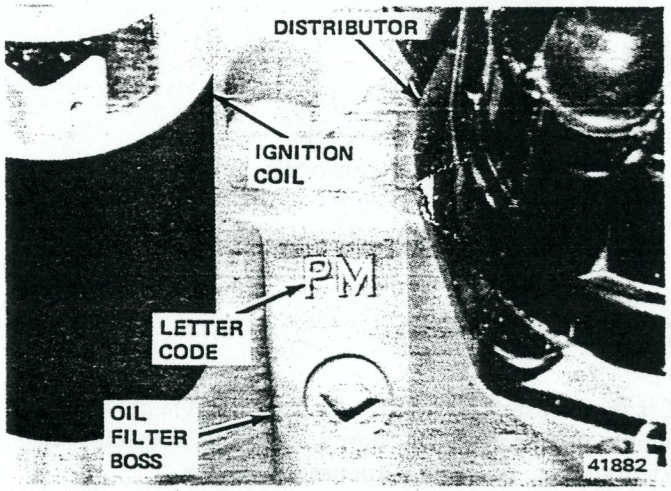


Fig. 1B-45 Oversize or Undersize Letter Code Location

SHORT ENGINE ASSEMBLY (SHORT BLOCK)

A service replacement short engine assembly (short block) may be installed whenever the original engine block is worn or damaged beyond feasible repair. It consists of engine block, piston and rod assemblies, crankshaft, camshaft, timing sprockets and chain.

NOTE: *Short engine assemblies have an S stamped on the same surface as the build date code for identification.*

Installation includes transfer of component parts from the worn or damaged original engine. Follow the appropriate procedures for cleaning, inspection, installation and tightening as outlined in this chapter.

ENGINE MOUNTING

Resilient rubber cushions support the engine and transmission at three points: at each side on the centerline of the engine and at the rear between the transmission extension housing and the rear support crossmember (fig. 1B-46). Replacement of a cushion may be accomplished by supporting the weight of the engine or transmission at the area of the cushion.

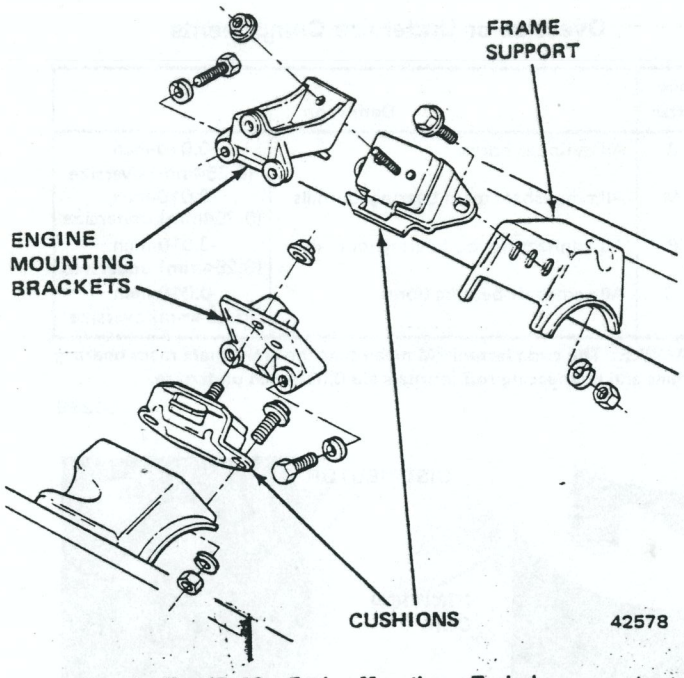


Fig. 1B-46 Engine Mounting—Typical

ENGINE HOLDING FIXTURE

If it is necessary to remove the front engine mounting brackets or cushions, an engine holding fixture may be fabricated (fig. 1B-47) to support the engine.

The engine also may be supported by a jack placed under the oil pan skid plate. Use a board between the jack and skid plate to distribute the weight evenly.

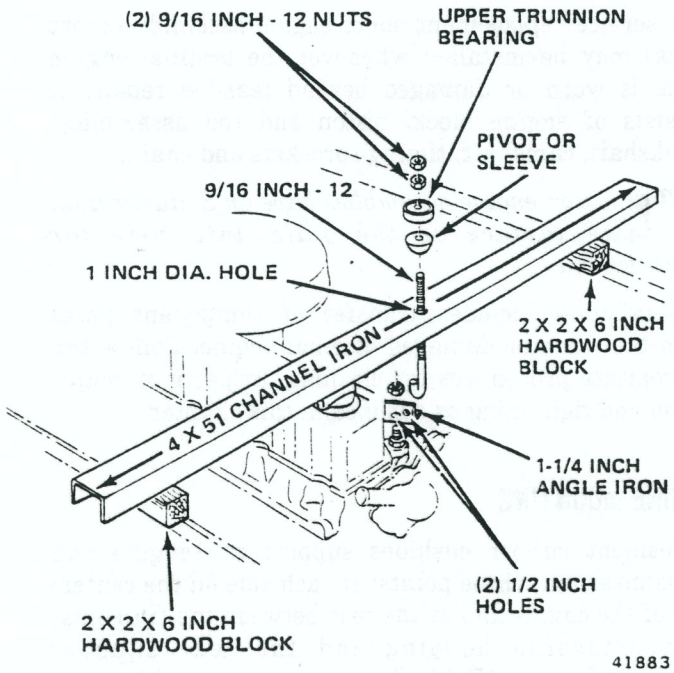


Fig. 1B-47 Engine Holding Fixture

ENGINE REMOVAL

The engine is removed without the transmission and flywheel/drive plate housing. Raise the vehicle slightly to provide working clearance.

(1) Drain cooling system.

NOTE: *Drain coolant in a clean container for re-use.*

(2) On all vehicles except CJ, remove hood. Mark hinge locations for installation alignment.

(3) Remove battery on Cherokee, Wagoneer and Truck vehicles. On CJ vehicles, disconnect battery negative cable.

(4) Remove air cleaner. Disconnect and plug fuel pipe connected to fuel pump. Disconnect fuel return pipe from hose at connection on frame.

(5) Disconnect heater hoses at front of engine and rear of intake manifold on CJ vehicles, and at heater on other vehicles.

(6) Disconnect throttle cable from engine.

(7) Disconnect throttle valve rod, if equipped.

(8) Disconnect wiring harness from engine and alternator and lay aside.

(9) Identify and tag vacuum hoses, and disconnect from engine.

(10) Disconnect shroud, if equipped, from radiator.

(11) Remove radiator, fan and shroud. Install bolt in pulley after fan is removed to maintain pulley in alignment with bolt holes in water pump.

(12) Disconnect cable from starter motor. Remove starter motor.

(13) Remove engine mount cushion-to-frame attaching nuts.

(14) Disconnect exhaust pipe.

(15) If equipped with manual transmission:

(a) Remove flywheel housing bolts.

(b) Remove clutch linkage and shield.

(16) If equipped with automatic transmission:

(a) Remove drive plate access cover.

(b) Mark converter and drive plate to facilitate correct installation alignment.

(c) Remove converter-to-drive plate bolts. Rotate crankshaft for access to each bolt.

(d) Remove drive plate housing-to-engine bolts. Remove oil pan screws that retain transmission fluid cooler lines.

(17) Support transmission with jack.

(18) If equipped with power steering, disconnect hoses at steering gear. Tie hoses to engine to prevent draining.

(19) If equipped with air conditioning:

(a) Turn compressor service fitting valve stem to seat position.

(b) Loosen service fitting.

(c) Allow compressor refrigerant to escape.

(d) Remove fittings from compressor.

(20) Attach engine lift device. Pull engine forward to disengage from transmission. Lift upward to remove.

ENGINE INSTALLATION

(1) Remove right mount from engine.
(2) Lower engine into compartment. Attach engine to transmission.
(3) Install flywheel/drive plate housing bolts and remove transmission jack.
(4) Attach engine mount to block. Lower engine and tighten all engine mount bolts and nuts.
(5) If equipped with manual transmission:
(a) Install flywheel housing shield and clutch linkage.
(b) Adjust clutch, if necessary.
(6) If equipped with automatic transmission:
(a) Align marks on converter and drive plate. Install converter-to-drive plate bolts.
(b) Install drive plate access cover.
(c) Attach transmission fluid cooler lines to engine with oil pan screws.
(7) Install exhaust pipe.
(8) Install starter motor and connect cable.
(9) Remove lifting device.
(10) Connect fuel supply and return pipes.
(11) If equipped with power steering, connect hoses to steering gear.
(12) Connect electrical wires and vacuum hoses.
(13) Connect heater hoses.
(14) Install fan. If equipped with shroud, position roud over fan blades.
(15) Install radiator and attach shroud to radiator.
(16) Connect radiator hoses. If equipped with automatic transmission, connect fluid cooler lines to radiator.
(17) Install throttle linkage.
(18) Connect throttle valve rod and retainer. Install throttle valve and spring.
(19) If equipped with air conditioning:
(a) Connect service valves to compressor.
(b) Open valve to mid-position.
(c) Open service port slightly. Allow small amount of refrigerant to escape to purge compressor of air.
(d) Tighten port cap.
(20) Install battery, if removed, and connect cables.
(21) Install coolant.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(22) Start engine. While engine is warming up, in- all hood.
(23) Inspect for fuel, oil and water leaks. Turn engine off and check fluid levels.
(24) Install air cleaner and road-test vehicle.

VALVE TRAIN

General

The six-cylinder engine has overhead valves that are operated by push rods and rocker arms. A chain-driven camshaft is mounted in the cylinder block. Hydraulic valve tappets provide automatic valve lash adjustments.

Rocker Arm Assembly

The intake and exhaust rocker arms of each cylinder pivot on a bridge and pivot assembly that is secured with two capscrews as illustrated in figure 1B-48. The bridge and pivot assembly maintains correct rocker arm-to-valve tip alignment. Each rocker arm is actuated by a hollow steel push rod with a hardened steel ball at each end. The hollow push rods route oil to the rocker arm assemblies.

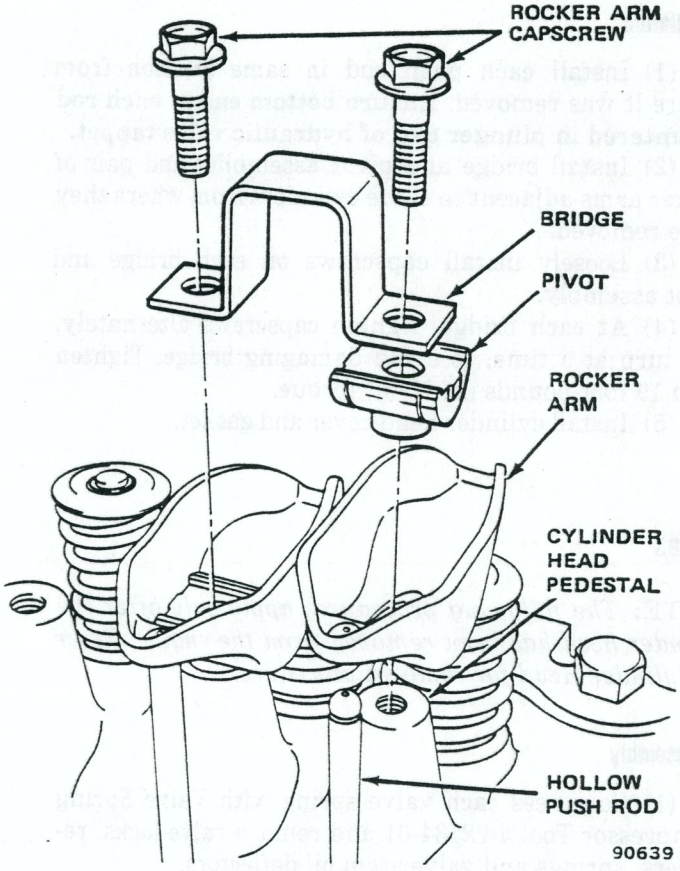


Fig. 1B-48 Rocker Arm Assembly

Removal

(1) Remove cylinder head cover and gasket.
(2) Remove two capscrews at each bridge and pivot assembly. Alternately loosen capscrews one turn at a time to avoid damaging bridge.
(3) Remove bridge and pivot assemblies and corresponding pairs of rocker arms and place on bench in same order as removed.

(4) Remove push rods and place on bench in same order as removed.

Cleaning and Inspection

Clean all parts with a cleaning solvent and use compressed air to blow out oil passages in the rocker arms and push rods.

Inspect the pivoting surface of each rocker arm and pivot. Replace any parts that are scuffed, pitted or excessively worn. Inspect valve stem tip contact surface of each rocker arm and replace any rocker arm that is deeply pitted. Inspect each push rod end for excessive wear and replace as required. If any push rod is excessively worn because of lack of oil, replace the push rod and inspect the corresponding tappet.

It is not normal to find a wear pattern along the length of the push rod. Examine the cylinder head for obstruction if this condition exists.

Installation

(1) Install each push rod in same location from where it was removed. **Ensure bottom end of each rod is centered in plunger cap of hydraulic valve tappet.**

(2) Install bridge and pivot assemblies and pair of rocker arms adjacent to same cylinders from where they were removed.

(3) Loosely install capscrews on each bridge and pivot assembly.

(4) At each bridge, tighten capscrews alternately, one turn at a time, to avoid damaging bridge. Tighten with 19 foot-pounds (26 N•m) torque.

(5) Install cylinder head cover and gasket.

Valves

NOTE: *The following procedures apply only after the cylinder head has been removed from the engine. Refer to Cylinder Head for removal procedure.*

Disassembly

(1) Compress each valve spring with Valve Spring Compressor Tool J-22534-01 and remove valve locks, retainers, springs and valve stem oil deflectors.

(2) Remove valves and place in rack in same order as removed from cylinder head.

Cleaning and Inspection

(1) Clean all carbon deposit from combustion chambers, valve ports, valve stems and head.

(2) Clean all foreign matter and gasket cement from cylinder head machined surface.

(3) Inspect for cracks in combustion chambers and valve ports.

(4) Inspect for cracks in gasket mating surface around each coolant passage.

(5) Inspect valves for burned, cracked or warped heads. Inspect for scuffed or bent valve stems. Replace valves displaying any damage.

Valve Refacing

Use a valve refacing machine to reface intake and exhaust valves to the specified angle. After refacing, at least 1/32-inch (0.787 mm) margin must remain. If not, replace the valve. Examples of correct and incorrect valve refacing are illustrated in figure 1B-49.

The valve stem tip can be resurfaced and rechamfered when worn. Do not remove more than 0.020 inch (0.508 mm).

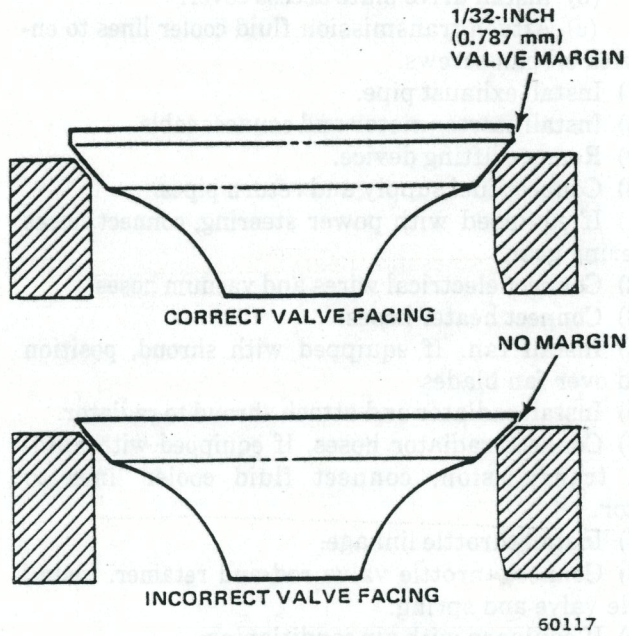


Fig. 1B-49 Valve Refacing

Valve Seat Refacing

Install a pilot of the correct size in the valve guide and reface the valve seat to the specified angle with a dressing stone in good condition. Remove only enough metal to provide a smooth finish.

Use tapered stones to obtain the specified seat widths when required.

Control seat runout to a maximum of 0.0025 inch (0.064 mm) (fig. 1B-50).

Valve Stem Oil Deflector Replacement

Nylon valve stem oil deflectors are installed on each valve stem to prevent lubricating oil from entering the combustion chamber through the valve guides. Replace the oil deflectors whenever valve service is performed or if the deflectors have deteriorated.

Valve stem oil deflector replacement requires removal of valve spring(s). Refer to Valve Springs for procedure.

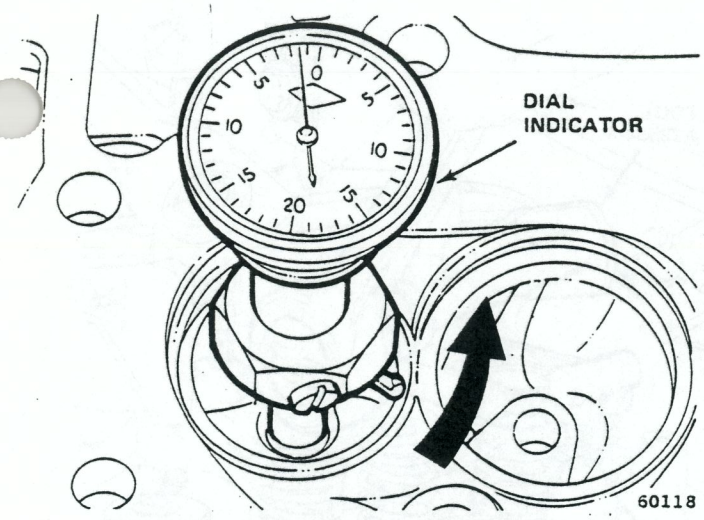


Fig. 1B-50 Measuring Valve Seat Runout

Valve Guides

The valve guides are an integral part of the cylinder head and are not replaceable. When the stem-to-guide clearance is excessive, ream the valve guide bores to accommodate the next larger oversize valve stem. Oversize service valves are available with 0.003-inch (0.076 mm), 0.015-inch (0.381 mm), and 0.030-inch (0.762 mm) stem diameter sizes. Refer to Valve Guide Reamer Sizes chart for reamer sizes.

Valve Guide Reamer Sizes

Reamer Tool Number	Size
J-6042-1	0.003-inch (.076 mm)
J-6042-5	0.015-inch (.381 mm)
J-6042-4	0.030-inch (.762 mm)

60260

NOTE: *Ream valve guides in steps, starting with the 0.003-inch (0.076 mm) oversize reamer and progressing to the size required.*

Valve Stem-to-Guide Clearance

Valve stem-to-guide clearance may be measured by either of the following two methods.

Preferred Method:

(1) Remove valve from head and clean valve guide bore with solvent and bristle brush.

(2) Insert telescoping gauge into valve guide bore approximately 3/8 inch (9.525 mm) from valve spring side of head (fig. 1B-51) with contacts crosswise to cylinder head. Measure telescoping gauge contacts with micrometer.

(3) Repeat measurement with contacts lengthwise to cylinder head.

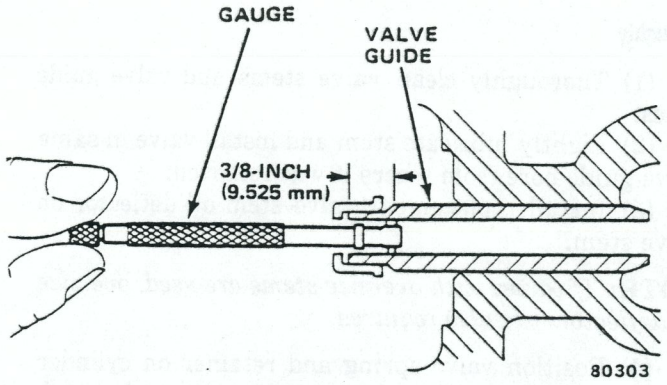


Fig. 1B-51 Valve Stem-to-Guide Clearance Measurement with Telescoping Gauge

(4) Compare crosswise to lengthwise measurements to determine out-of-roundness. If measurements differ by more than 0.0025 inch (0.064 mm), ream guide bore to accommodate oversize valve stem.

(5) Compare valve guide bore diameter with diameter listed in Specifications. If measurement differs more than 0.003 inch (0.076 mm), ream guide to accommodate oversize valve stem.

Alternate Method:

(1) Use dial indicator to measure lateral movement of valve stem with valve installed in its guide and barely off valve seat (fig. 1B-52).

(2) Correct clearance is 0.001 to 0.003 inch (0.025 mm to 0.076 mm). If indicated movement exceeds acceptable clearance, ream guide to accommodate oversize valve stem.

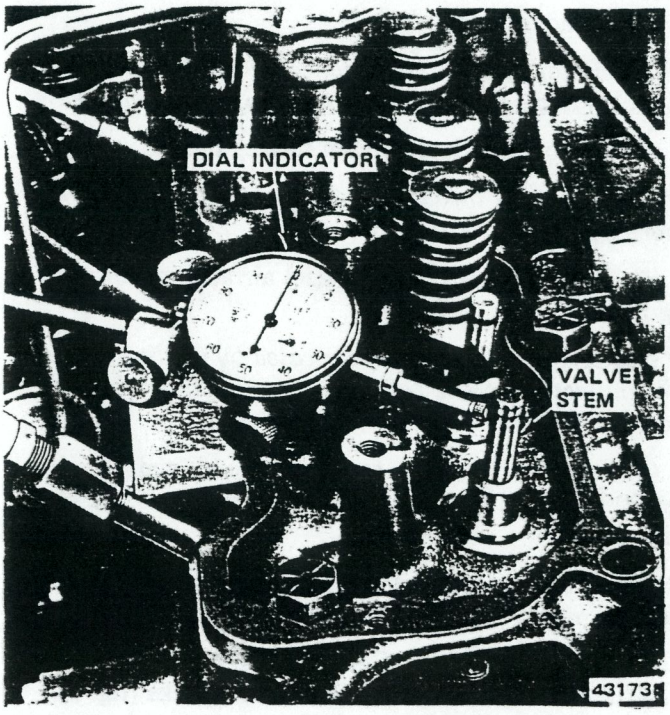


Fig. 1B-52 Valve Stem-to-Guide Clearance Measurement with Dial Indicator

Assembly

(1) Thoroughly clean valve stems and valve guide bores.

(2) Lightly lubricate stem and install valve in same valve guide bore from where it was removed.

(3) Install replacement valve stem oil deflector on valve stem.

NOTE: *If valves with oversize stems are used, oversize oil deflectors are also required.*

(4) Position valve spring and retainer on cylinder head and compress valve spring with compressing tool. Install valve locks and release tool.

(5) Tap valve spring from side-to-side with hammer to assure spring is properly seated on cylinder head.

Valve Springs

Valve Spring and Oil Deflector Removal

NOTE: *This procedure is for removal of valve springs and oil deflectors with the cylinder head installed on the engine. Refer to Valves for removal procedure with the head removed from the engine.*

The valve spring is held in place on the valve stem by a retainer and a pair of conical-type valve locks. The locks can be removed only by compressing the valve spring.

(1) Remove cylinder head cover.

(2) Remove bridge and pivot assemblies and rocker arms.

(3) Remove push rods.

NOTE: *Retain push rods, bridge and pivot assemblies and rocker arms in same order and position as removed.*

(4) Remove spark plug from each cylinder.

NOTE: *Steps (5) through (9) apply to each cylinder to be serviced.*

(5) Install 14-mm (thread size) air adapter in spark plug hole.

NOTE: *An adapter can be fabricated by welding an air hose connection to the body of a spark plug having the porcelain removed.*

(6) Connect air hose to adapter and maintain at least 90 psi (620 kPa) in cylinder to force valves against their seats.

NOTE: *On vehicles equipped with air conditioning, use a flexible air adapter when servicing No. 1 cylinder.*

(7) Use Valve Spring Remover and Installer Tool J-22534-01 to compress spring and remove locks (fig. 1B-53).

(8) Remove valve spring and retainer.

(9) Remove valve stem oil deflector.

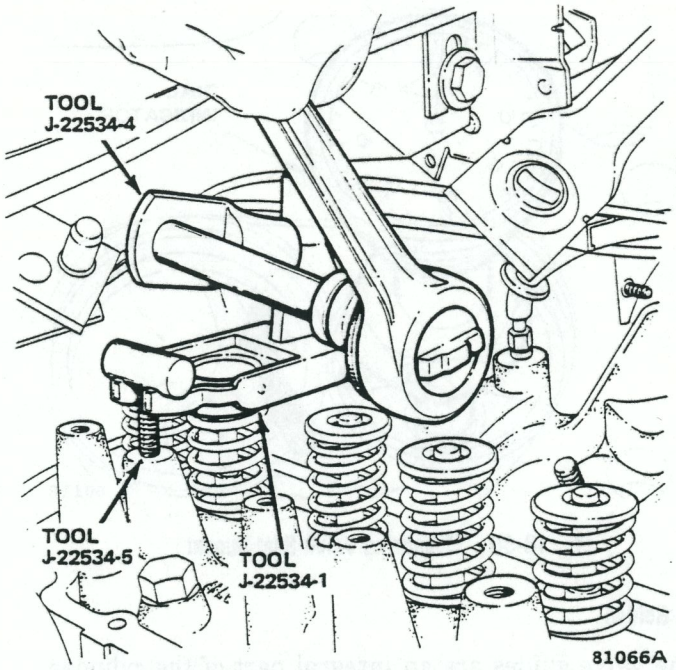


Fig. 1B-53 Valve Spring Removal

Valve Spring Tension Test

Use Valve Spring Tester J-8056, or equivalent, to test each valve spring for the specified tension value (fig. 1B-54). Replace valve springs that are not within the specification.

Oil Deflector and Valve Spring Installation

NOTE: *The following procedure applies to each cylinder being serviced.*

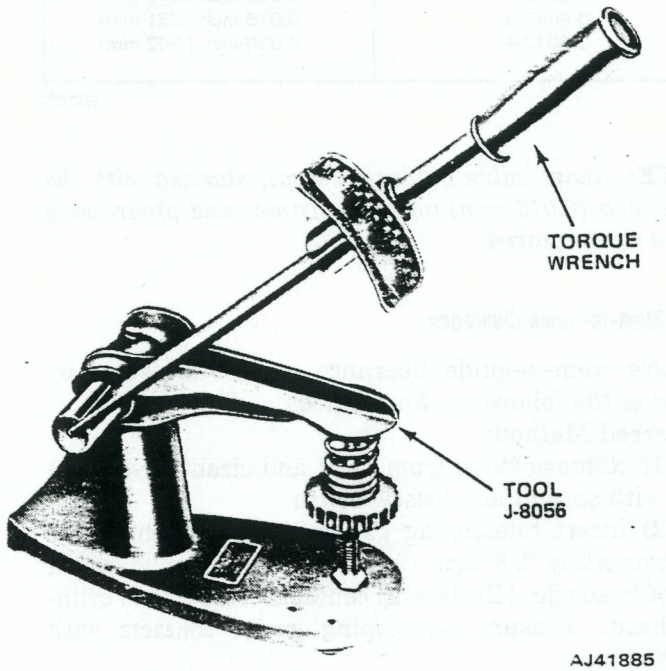


Fig. 1B-54 Valve Spring Tester—Typical

(1) Use 7/16-inch deep socket and small hammer to gently tap oil deflector onto valve stem.

CAUTION: *Install the deflector carefully to prevent damage from the sharp edges of the valve lock groove.*

(2) Install valve spring and retainer.

(3) Compress valve spring with tool J-22534-01 and position valve locks. Release spring tension and remove tool.

NOTE: *Tap spring from side-to-side to ensure spring is seated properly on cylinder head.*

(4) Disconnect air hose, remove adapter from spark plug hole and install spark plug.

(5) Install push rods. Ensure bottom end of each rod is centered in plunger cap of hydraulic valve tappet.

(6) Install rocker arms and bridge and pivot assembly. At each bridge and pivot assembly tighten capscrews alternately, one turn at a time, to avoid damaging bridge.

(7) Install cylinder head cover. Refer to Cylinder Head Cover for procedure.

CAMSHAFT AND BEARINGS

The camshaft is supported by form steel-shelled, babbitt-lined bearings pressed into the block and line reamed. The step-bored camshaft bearing bores are larger at the front bearing than at the rear to permit easy removal and installation of the camshaft. Camshaft bearings are pressure lubricated.

NOTE: *It is not advisable to replace camshaft bearings unless the special removal and installation tools are available.*

Camshaft end play is maintained by the load placed on the camshaft by the oil pump and distributor drive gear. The helical cut of the gear holds the camshaft sprocket thrust face against the cylinder block face. Camshaft end play is zero during engine operation.

Measuring Cam Lobe Lift

(1) Remove cylinder head cover.

(2) Remove bridge and pivot assemblies and rocker arms.

(3) Remove spark plugs.

(4) Install dial indicator on end of push rod. Use piece of rubber tubing to hold dial indicator plunger squarely on push rod (fig. 1B-55).

(5) Rotate crankshaft until cam lobe base (heel) circle (push rod down) is under valve tappet. Set dial indicator to zero.

(6) Rotate crankshaft until push rod reaches its maximum upward travel. Note distance on dial indicator. Correct cam lobe lift is 0.242 to 0.254 inch (6.147 to 6.451 mm).

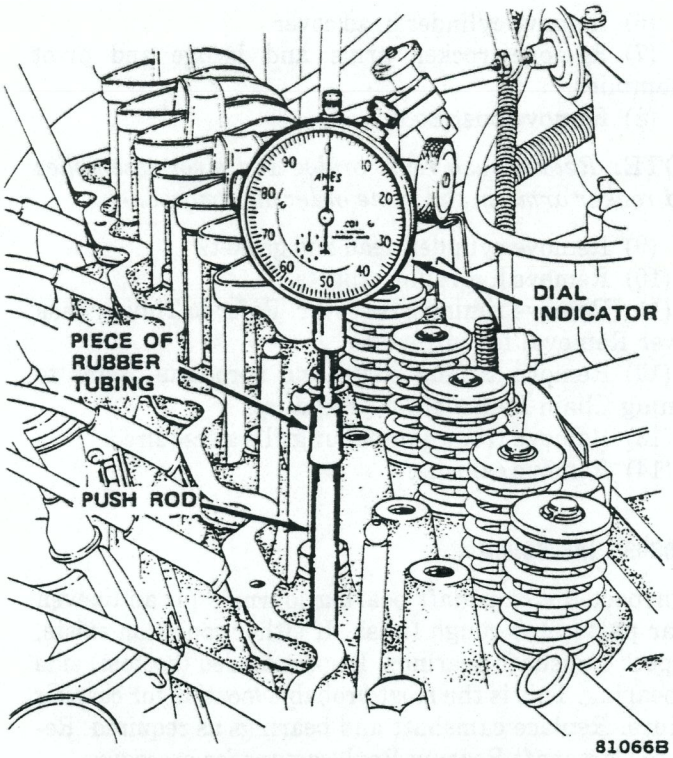


Fig. 1B-55 Cam Lobe Lift Measurement and Valve Timing

Valve Timing

(1) Disconnect ignition wires and remove spark plugs.

(2) Remove cylinder head cover.

(3) Remove bridge and pivot assembly and rocker arms from No. 1 cylinder.

(4) Rotate crankshaft until No. 6 piston is at TDC on compression stroke.

(5) Rotate crankshaft counterclockwise (viewed from front of engine) 90°.

(6) Install dial indicator on end of No. 1 cylinder intake valve push rod. Set dial indicator to zero (fig. 1B-55).

(7) Rotate crankshaft clockwise (viewed from front of engine) until dial indicator pointer indicates 0.016-inch (0.406 mm) lift.

(8) Timing mark on vibration damper should be indexed with TDC mark on timing degree scale. If timing mark is more than 1/2 inch (12.7 mm) from TDC in either direction, valve timing is incorrect.

Camshaft Removal

(1) Drain cooling system.

NOTE: *Drain coolant in clean container if reusable.*

(2) Remove radiator and fan assembly.

(3) Remove air conditioner condenser and receiver assembly as charged unit, if equipped.

(4) Remove fuel pump.

(5) Remove distributor and ignition wires.

(6) Remove cylinder head cover.
(7) Remove rocker arms and bridge and pivot assemblies.
(8) Remove push rods.

NOTE: *Retain push rods, bridge and pivot assemblies and rocker arms in the same order as removed.*

(9) Remove cylinder head and gasket.
(10) Remove hydraulic tappets.
(11) Remove timing case cover. Refer to Timing Case Cover Removal for procedure.
(12) Remove timing chain and sprockets. Refer to Timing Chain Removal for procedure.
(13) Remove front bumper or grille as required.
(14) Remove camshaft.

Camshaft Inspection

Inspect the camshaft bearing journals for an uneven wear pattern or rough finish. If either condition exists, inspect camshaft bearings. Inspect loaded (bottom) side of bearing. This is the most probable location for bearing failure. Replace camshaft and bearings as required. Refer to Camshaft Bearing Replacement for procedure.

Inspect the distributor drive gear for damage or excessive wear. Replace if necessary.

Inspect each cam lobe and the corresponding hydraulic valve tappet for wear. If the face of the tappet(s) is worn concave, the corresponding camshaft lobe(s) will also be worn. Replace both the camshaft and the tappet(s).

If the camshaft appears to have been rubbing heavily against the timing case cover, examine the oil pressure relief holes in the rear cam journal. These holes relieve oil pressure between the end of the camshaft and the rear bearing plug.

Camshaft Installation

(1) Lubricate camshaft with Jeep Engine Oil Supplement (E.0.S), or equivalent.
(2) Install camshaft carefully to prevent damaging camshaft bearings.
(3) Install timing chain, crankshaft sprocket and camshaft sprocket with timing marks aligned. Refer to Timing Chain Installation for procedure.
(4) Install camshaft sprocket retaining screw and tighten.
(5) Install timing case cover with replacement oil seal. Refer to Timing Case Cover Installation for procedure.
(6) Install vibration damper.
(7) Install damper pulley, if removed.
(8) Install engine fan and hub assembly.
(9) Install drive belt(s) and tighten to specified tension. Refer to Chapter 1C—Cooling Systems.
(10) Install fuel pump.
(11) Rotate crankshaft until No. 1 piston is at TDC position on compression stroke.
(12) Install distributor and ignition wires. Install distributor with rotor aligned with No. 1 terminal on cap when distributor housing is fully seated on block.
(13) Install hydraulic tappets. Lubricate tappets and all valve train components with Jeep Engine Oil Supplement (EOS), or equivalent.

NOTE: *The EOS must remain in the engine for at least 1,000 miles (1 609 km) but need not be drained until the next scheduled oil change.*

(14) Install cylinder head and gasket.
(15) Install push rods.
(16) Install rocker arms and bridge and pivot assemblies. Alternately tighten capscrews for each bridge one turn at a time to avoid damaging bridge.
(17) Install cylinder head cover. Refer to Cylinder Head Cover for procedure.
(18) Install air conditioner condenser and receiver assembly, if equipped.

CAUTION: *Open both service valves before the air conditioning system is operated.*

(19) Install radiator, connect hoses and fill cooling system with specified mixture. Refer to Chapter 1C—Cooling Systems.
(20) Install front bumper or grille, if removed.
(21) Check ignition timing and adjust as required.

Camshaft Bearing Replacement

Camshaft bearing replacement requires that the engine be removed from the vehicle. Remove timing case cover, crankshaft, camshaft and rear bearing plug. When installing bearings, use a screw-type tool that provides steady force. Do not use a driver-type tool to install bearings. Care must be taken to align oil holes in bearings with oil galleries in the block. It is not necessary to line ream camshaft bearings after installation.

HYDRAULIC VALVE TAPPETS

The hydraulic valve tappet consists of the tappet body, plunger, plunger return spring, check valve assembly metering disc, plunger cap and lockring (fig. 1B-56).

The tappet operates in a guide bore that intersects with the main oil gallery.

Operation

The operating cycle of the hydraulic tappet begins when the tappet is on the heel (base circle) of the cam lobe (engine valve closed). A groove in the tappet body aligns with the tappet oil gallery to admit pressurized oil into the tappet (fig. 1B-57). A hole and groove arrangement admits the oil to the inside of the plunger. Oil is

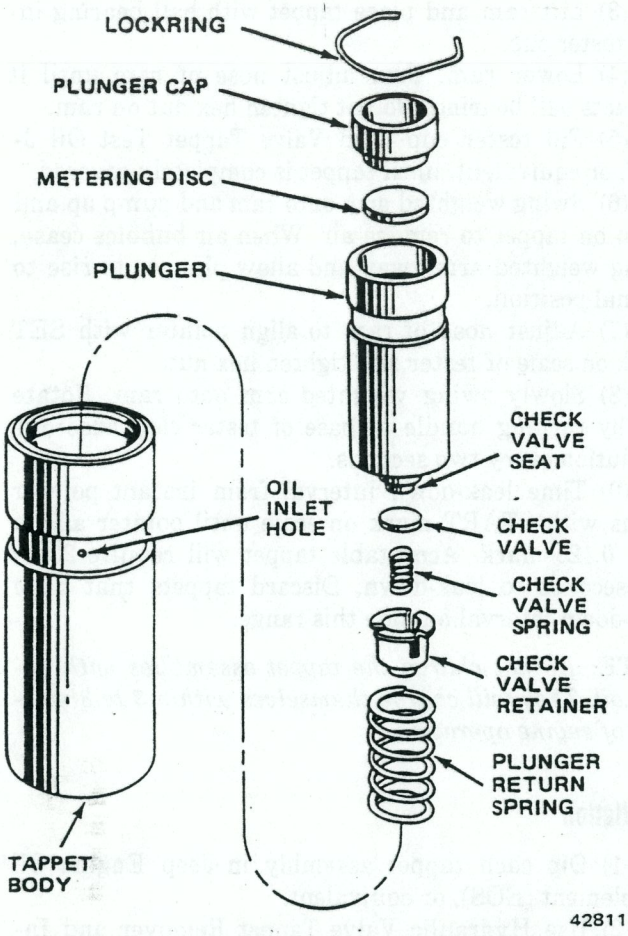


Fig. 1B-56 Hydraulic Valve Tappet Components

forced past the plunger check valve and fills the chamber between the plunger and tappet body. When the chamber is full, additional oil in the plunger body unseats the metering disc, and a spurt of oil flows up inside the push rod to lubricate the rocker assembly. These events described above all occur while the tappet is on the heel of the cam lobe. As the cam turns, the lobe begins exerting force on the tappet body. This force is transmitted by the trapped oil in the tappet chamber to the plunger and finally to the push rod and rocker assembly. The engine valve opens. While the valve is open, the trapped oil is subjected to considerable pressure and some of it escapes between the plunger and the tappet body (leak-down). The cycle is completed as the cam lobe rotates back to the starting position and another charging cycle begins. In this way, zero valve lash is maintained and engine noise is reduced.

Removal

(1) Drain cooling system.

NOTE: *Drain coolant in clean container if reusable.*

(2) Remove cylinder head cover.

(3) Remove bridge and pivot assemblies and rocker arms.

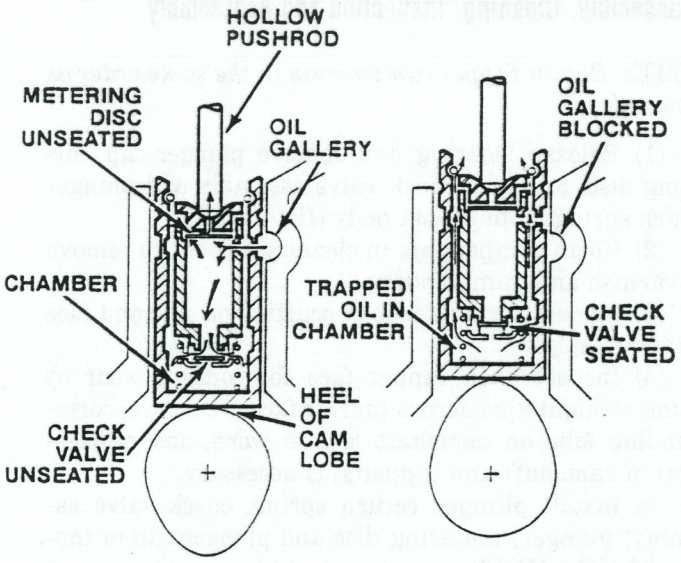


Fig. 1B-57 Hydraulic Valve Tappet Operation

NOTE: *When removing the two capscrews from each bridge, alternately loosen each screw one turn at a time to avoid damaging bridge.*

(4) Remove push rods.

NOTE: *Retain rocker arms, bridge and pivot assemblies and push rods in the same order as removed.*

(5) Remove cylinder head and gasket.

(6) Remove tappets through push rod openings in block with Hydraulic Valve Tappet Remover and Installer Tool J-21884 (fig. 1B-58).

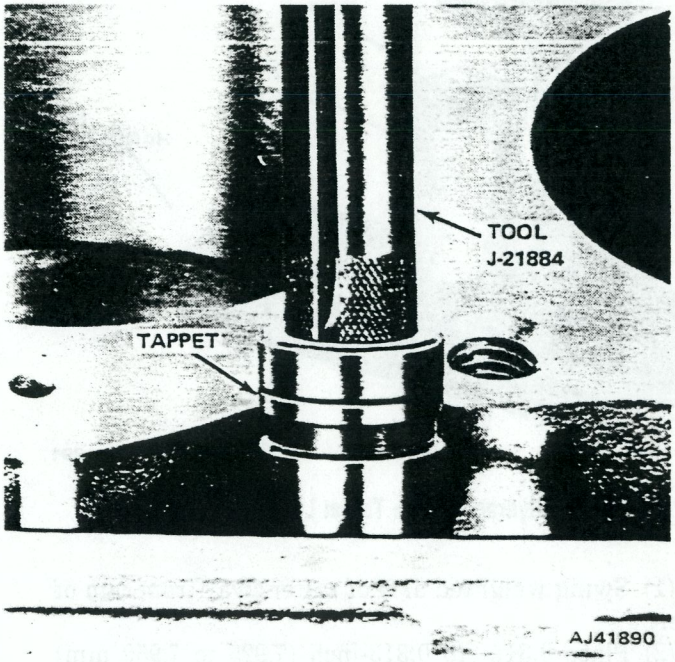


Fig. 1B-58 Hydraulic Valve Tappet Removal

Disassembly, Cleaning, Inspection and Reassembly

NOTE: *Retain tappet components in the same order as removed.*

(1) Release lockring and remove plunger cap, metering disc, plunger, check valve assembly and plunger return spring from tappet body (fig. 1B-56).

(2) Clean components in cleaning solvent to remove all varnish and gum deposits.

(3) Inspect for evidence of scuffing on side and face of tappet body.

(4) Inspect each tappet face for concave wear by laying straightedge across face. If face is concave, corresponding lobe on camshaft is also worn, and replacement of camshaft and tappet(s) is necessary.

(5) Install plunger return spring, check valve assembly, plunger, metering disc and plunger cap in tappet body (fig. 1B-56).

(6) Compress plunger assembly using push rod on plunger cap, and install lockring.

Hydraulic Valve Tappet Leak-Down Test

After cleaning, inspection and reassembly, leak-down test each tappet to ensure zero-lash operation. Figure 1B-59 illustrates tool J-5790, which can be used to accurately test tappet leak-down rate.

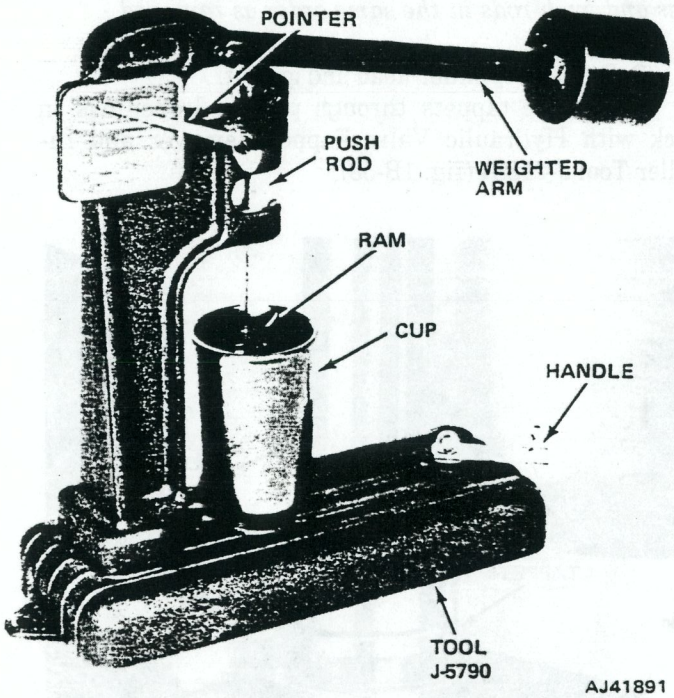


Fig. 1B-59 Hydraulic Valve Tappet Leak-Down Rate Tester

(1) Swing weighted arm of tester away from ram of tester.

(2) Place 0.312- to 0.313-inch (7.925 to 7.950 mm) diameter ball bearing on tappet plunger cap.

(3) Lift ram and place tappet with ball bearing inside tester cup.

(4) Lower ram, then adjust nose of ram until it contacts ball bearing. Do not tighten hex nut on ram.

(5) Fill tester cup with Valve Tappet Test Oil J-5268, or equivalent, until tappet is completely covered.

(6) Swing weighted arm onto ram and pump up and down on tappet to remove air. When air bubbles cease, swing weighted arm away and allow plunger to rise to normal position.

(7) Adjust nose of ram to align pointer with SET mark on scale of tester and tighten hex nut.

(8) Slowly swing weighted arm onto ram. Rotate cup by turning handle at base of tester clockwise one revolution every two seconds.

(9) Time leak-down interval from instant pointer aligns with START mark on scale until pointer aligns with 0.125 mark. Acceptable tappet will require 20 to 110 seconds to leak-down. Discard tappets that have leak-down interval outside this range.

NOTE: *Do not charge the tappet assemblies with engine oil. They will charge themselves within 3 to 8 minutes of engine operation.*

Installation

(1) Dip each tappet assembly in Jeep Engine Oil Supplement (EOS), or equivalent.

(2) Use Hydraulic Valve Tappet Remover and Installer Tool J-21884 to install each tappet in same bore from where it was removed.

(3) Install cylinder head and replacement gasket and tighten screws. Refer to Cylinder Head Installation for tightening sequence.

(4) Install push rods in same order as removed.

(5) Install rocker arms and bridge and pivot assemblies. Loosely install capscrews at each bridge. Tighten capscrews alternately, one turn at a time, to avoid damaging or breaking bridge.

(6) Pour remaining EOS over entire valve train.

NOTE: *The EOS must remain in the engine for at least 1,000 miles (1 607 km) but need not be drained until the next scheduled oil change.*

(7) Install cylinder head cover. Refer to Cylinder Head Cover for procedure.

(8) Install coolant.

TIMING CASE COVER

The timing case cover is provided with a seal and oil slinger to prevent oil leakage at the vibration damper hub (fig. 1B-60). A socket is attached in the cover for the use of a magnetic timing probe. A graduated timing degree scale is located on the cover for standard ignition timing.

It is important that the timing case cover be properly aligned with the crankshaft to prevent eventual damage to the oil seal. The oil seal may be replaced without removing the timing case cover.

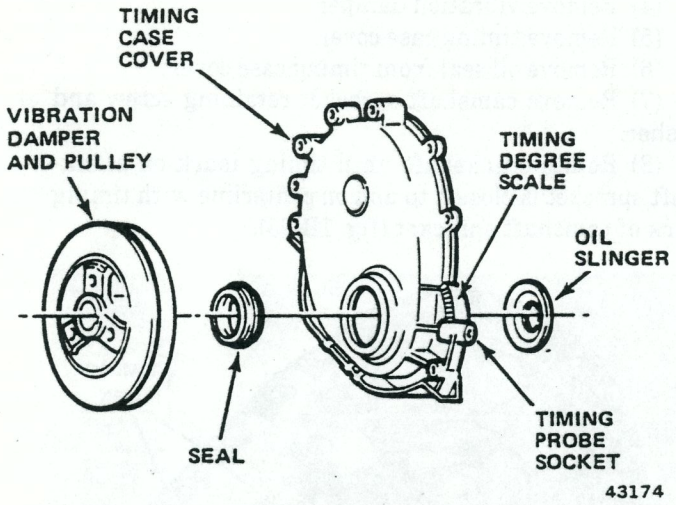


Fig. 1B-60 Timing Case Cover

Removal

(1) Remove drive belt(s), engine fan and hub assembly, damper pulley and vibration damper. Refer to Vibration Damper and Pulley Removal for procedure.

(2) Remove oil pan-to-timing case cover screws and cover-to-block screws.

(3) Remove timing case cover and gasket from engine.

(4) Cut off oil pan gasket end tabs flush with front face of cylinder block and remove gasket tabs.

(5) Clean timing case cover, oil pan and cylinder block gasket surfaces.

(6) Remove crankshaft oil seal from timing case cover.

Installation

(1) Apply seal compound (Perfect Seal, or equivalent) to both sides of replacement timing case cover gasket and position gasket on cylinder block.

(2) Cut end tabs off replacement oil pan gasket corresponding to pieces cut off original gasket. Cement these pieces on oil pan.

(3) Coat oil pan seal end tabs generously with Permatex No. 2, or equivalent, and position seal on timing case cover (fig. 1B-61).

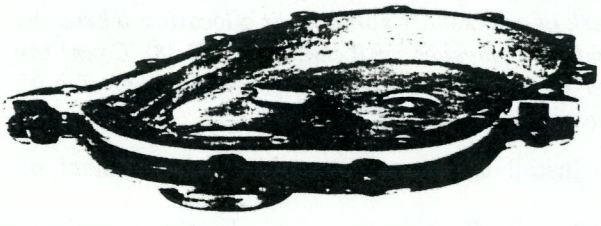


Fig. 1B-61 Oil Pan Front Seal Installation

(4) Position timing case cover on engine. Place Timing Case Cover Alignment Tool and Seal Installer J-22248 in crankshaft opening of cover (fig. 1B-62).

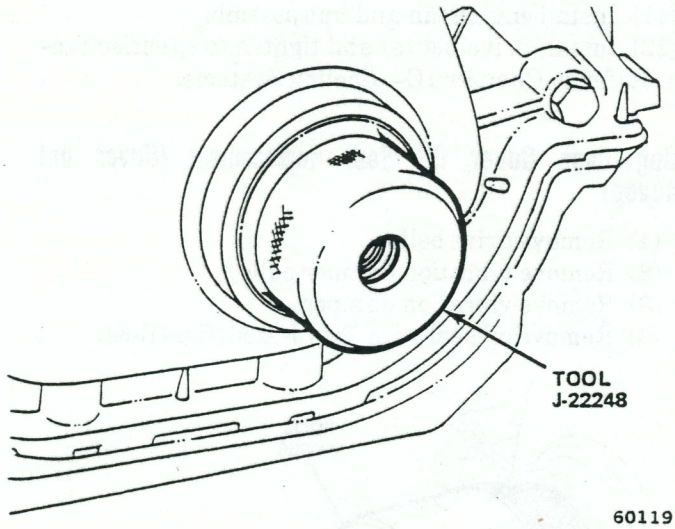


Fig. 1B-62 Timing Case Cover Alignment

(5) Install cover-to-block screws and oil pan-to-cover screws. Tighten cover-to-block screws with 5 foot-pounds (7 N•m) torque and oil pan-to-cover screws with 11 foot-pounds (15 N•m) torque.

(6) Remove cover aligning tool and position replacement oil seal on tool with seal lip facing outward. Apply light film of Perfect Seal, or equivalent, on outside diameter of seal.

(7) Insert draw screw from Tool J-9163 into seal installing tool. Tighten nut against tool until tool contacts cover (fig. 1B-63).

(8) Remove tools and apply light film of engine oil to seal lip.

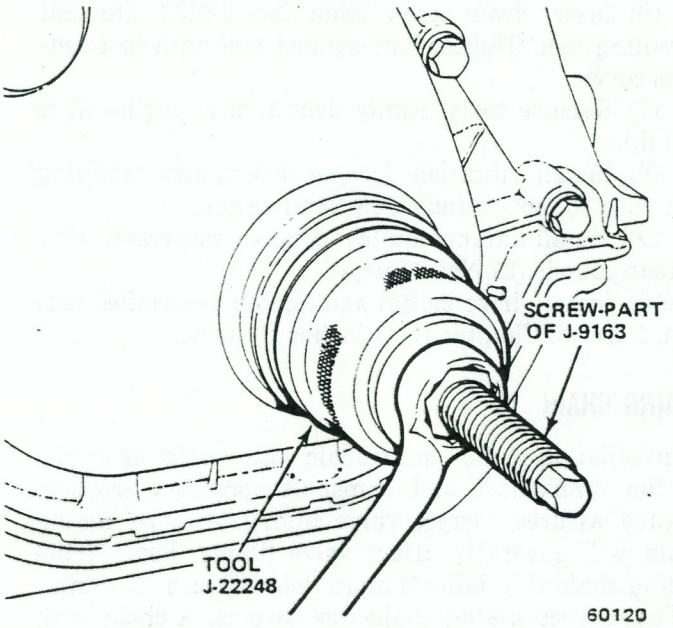


Fig. 1B-63 Timing Case Cover Oil Seal Installation

(9) Install vibration damper and tighten retaining screw with 80 foot-pounds (108 N•m) torque.

(10) Install damper pulley. Tighten capscrews with 20 foot-pounds (27 N•m) torque.

(11) Install engine fan and hub assembly.

(12) Install drive belt(s) and tighten to specified tension. Refer to Chapter 1C—Cooling Systems.

Timing Case Cover Oil Seal Replacement (Cover not Removed)

(1) Remove drive belts.
(2) Remove vibration damper pulley.
(3) Remove vibration damper.
(4) Remove oil seal with Tool J-9256 (fig. 1B-64).

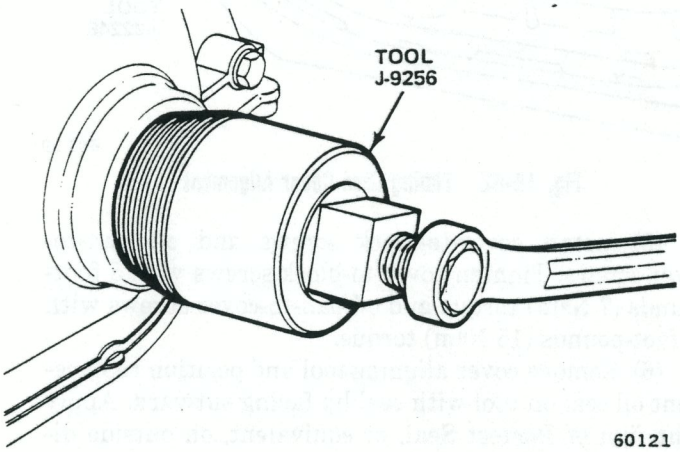


Fig. 1B-64 Timing Case Cover Oil Seal Removal

(5) Position replacement oil seal on Timing Case Cover Alignment Tool and Seal Installer J-22248 with seal lip facing outward. Apply light film of Perfect Seal, or equivalent, to outside diameter of seal.

(6) Insert draw screw from Tool J-9163 into seal installing tool. Tighten nut against tool until tool contacts cover.

(7) Remove tools. Apply light film of engine oil to seal lip.

(8) Install vibration damper and tighten retaining bolt with 80 foot-pounds (108 N•m) torque.

(9) Install damper pulley. Tighten capscrews with 20 foot-pounds (27 N•m) torque.

(10) Install drive belt(s) and tighten to specified tension. Refer to Chapter 1C—Cooling Systems.

TIMING CHAIN

Installation of the timing chain with the timing marks of the crankshaft and camshaft sprockets properly aligned assures correct valve timing. A worn timing chain will adversely affect valve timing. Replace the timing chain if it deflects more than 1/2 inch (13 mm).

The correct timing chain has 48 pins. A chain with more than 48 pins will cause excessive slack.

Removal

(1) Remove drive belt(s).
(2) Remove engine fan and hub assembly.
(3) Remove vibration damper pulley.
(4) Remove vibration damper.
(5) Remove timing case cover.
(6) Remove oil seal from timing case cover.
(7) Remove camshaft sprocket retaining screw and washer.
(8) Rotate crankshaft until timing mark on crankshaft sprocket is closest to and on centerline with timing mark of camshaft sprocket (fig. 1B-65).

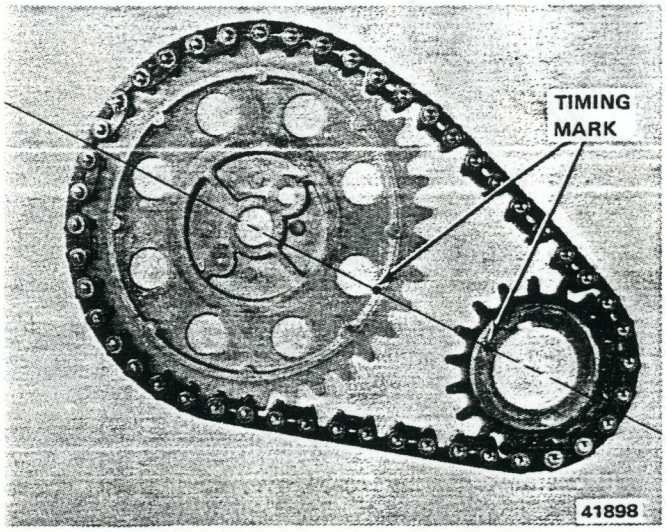


Fig. 1B-65 Timing Sprocket Alignment

(9) Remove crankshaft sprocket, camshaft sprocket and timing chain as assembly. Disassemble chain and sprockets.

Installation

(1) Assemble timing chain, crankshaft sprocket and camshaft sprocket with timing marks aligned (fig. 1B-65).

(2) Install assembly on crankshaft and camshaft.

(3) Install camshaft sprocket retaining screw and washer and tighten with 50 foot-pounds (68 N•m) torque.

NOTE: *To verify correct installation of the timing chain, position timing mark of the camshaft sprocket at approximately one o'clock position. This positions timing mark of crankshaft sprocket at a location where the adjacent tooth meshes with chain (fig. 1B-66). Count the number of chain pins between timing marks of both sprockets. There must be 15 pins.*

(4) Install timing case cover and replacement oil seal.

(5) Install vibration damper and tighten retaining bolt with 80 foot-pounds (108 N•m) torque.

(6) Install damper pulley and tighten capscrews with 20 foot-pounds (27 N•m) torque.

(7) Install engine fan and hub assembly.

(8) Install drive belt(s) and tighten to specified tension. Refer to Chapter 1C—Cooling Systems.

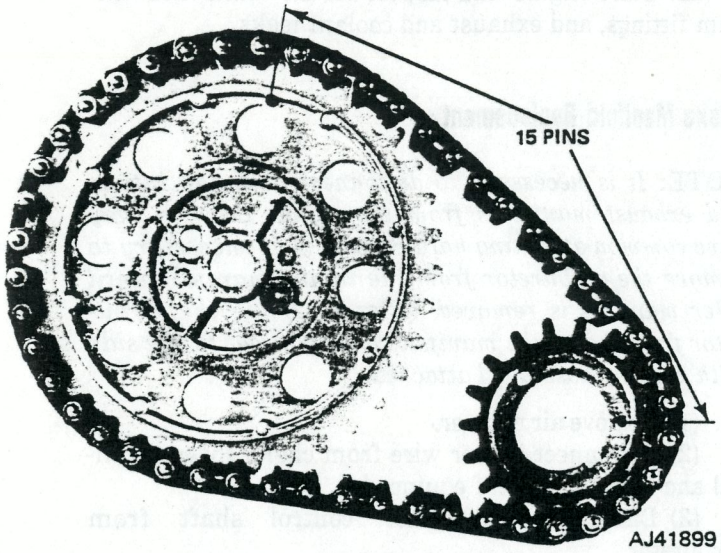


Fig. 1B-66 Timing Chain Installation

INTAKE AND EXHAUST MANIFOLDS

The aluminum intake and cast iron exhaust manifolds (fig. 1B-67) are attached to the cylinder head on the left side of the engine. A gasket is used between the intake manifold and the cylinder head. No gasket is used between the exhaust manifold and cylinder head.

An exhaust gas recirculation (EGR) valve is mounted on the side of the intake manifold. The intake manifold has an electric heater that improves fuel vaporization during warmup and shortens choke operation time. Coolant is also routed through the intake manifold to improve fuel vaporization.

Intake and Exhaust Manifold Removal

(1) Remove air cleaner. Disconnect fuel pipe, carburetor air horn vent hose, solenoid wire, if equipped, and choke heater wire.

(2) Disconnect throttle cable from throttle bellcrank. Disconnect throttle valve rod, if equipped.

(3) Disconnect PCV vacuum hose and heater wire from intake manifold.

(4) Drain coolant below intake manifold level.

NOTE: *Do not waste reusable coolant. Drain into clean container for reuse.*

(5) Disconnect coolant hoses from intake manifold.

(6) Disconnect spark CTO valve vacuum hoses.

(7) Disconnect vacuum hose from EGR valve. Disconnect EGR tube fittings from intake and exhaust manifold.

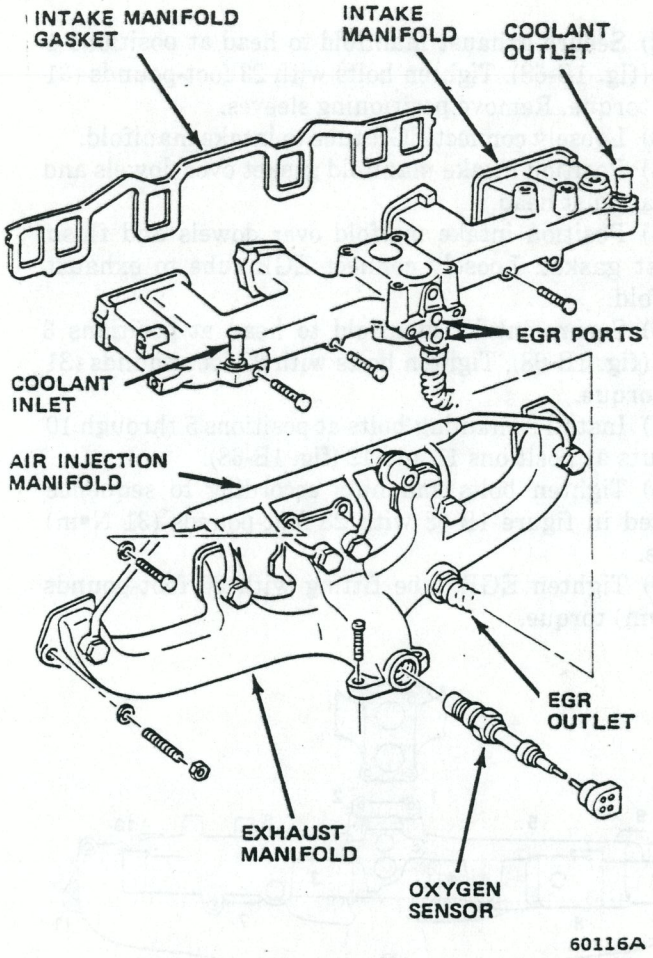


Fig. 1B-67 Intake and Exhaust Manifolds

(8) Disconnect air injection hoses at air pump and air injection manifold check valve. Disconnect diverter valve vacuum hose and remove diverter valve with hoses attached.

(9) Remove air pump/power steering mounting bracket, if equipped.

(10) Remove air pump.

(11) Detach power steering pump, if equipped, and set aside. Do not remove hoses.

(12) Remove air conditioner drive belt idler pulley assembly from cylinder head, if equipped.

(13) Disconnect exhaust pipe from exhaust manifold flange. Remove oxygen sensor, if equipped.

(14) Remove manifold attaching bolts, nuts and clamps. Remove intake and exhaust manifolds. Discard intake manifold gasket.

(15) Clean mating surfaces of manifolds and cylinder head.

Intake and Exhaust Manifold Installation

(1) Position exhaust manifold over end studs on cylinder head and install positioning sleeves over end studs.

(2) Secure exhaust manifold to head at positions 1 and 2 (fig. 1B-68). Tighten bolts with 23 foot-pounds (31 N•m) torque. Remove positioning sleeves.

(3) Loosely connect EGR tube to intake manifold.

(4) Position intake manifold gasket over dowels and flush against head.

(5) Position intake maifold over dowels and flush against gasket. Loosely connect EGR tube to exhaust manifold.

(6) Secure intake manifold to head at positions 3 and 4 (fig. 1B-68). Tighten bolts with 23 foot-pounds (31 Nm) torque.

(7) Install remaining bolts at positions 5 through 10 and nuts at positions 11 and 12 (fig. 1B-68).

(8) Tighten bolts and nuts according to sequence depicted in figure 1B-68 with 23 foot-pounds (31 N•m) torque.

(9) Tighten EGR tube fitting with 30 foot-pounds (41 N•m) torque.

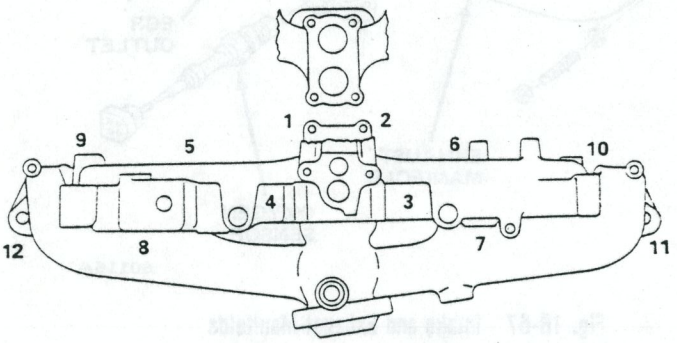


Fig. 1B-68 Manifold Tightening Sequence

(10) Position flange gasket and connect exhaust pipe to exhaust manifold flange. Tighten nuts with 20 foot-pounds (27 N•m) torque. Install oxygen sensor, if removed.

(11) Connect fuel pipe and air horn vent hose to carburetor. Connect solenoid wire, if equipped.

(12) Install AC drive belt idler pulley assembly, if removed.

(13) Install air pump, if removed.

(14) Install air pump/power steering pump mounting bracket, if removed.

(15) Install diverter valve. Connect air hoses to air pump and check valve. Connect vacuum hose.

(16) Install drive belt(s) and tighten to specified tension. Refer to Chapter 1C—Cooling Systems.

(17) Install spark CTO valve vacuum hoses.

(18) Connect vacuum hose to EGR valve.

(19) Connect throttle cable and PCV hose. Connect throttle valve rod, retainer and spring. Connect intake manifold heater wire.

(20) Connect coolant hoses to intake manifold.

(21) Install air cleaner.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(22) Start engine and inspect for air leaks into vacuum fittings, and exhaust and coolant leaks.

Intake Manifold Replacement

NOTE: *It is necessary to disconnect both the intake and exhaust manifolds from the engine because they have common attaching hardware. It is not necessary to remove the carburetor from the intake manifold until after manifold is removed. After removing the carburetor from the intake manifold, it may be set to one side with vacuum hoses still attached.*

(1) Remove air cleaner.

(2) Disconnect heater wire from choke cover terminal and solenoid wire, if equipped.

(3) Disconnect carburetor control shaft from carburetor.

(4) Remove carburetor from intake manifold and set aside. Remove carburetor insulator block.

(5) Remove carburetor mounting studs from intake manifold.

(6) Remove intake and exhaust manifolds from engine. Refer to Intake and Exhaust Manifold Removal for procedure.

(7) Remove throttle control bracket.

(8) Remove EGR valve and studs and install in replacement manifold.

(9) Remove intake manifold heater and install in replacement manifold.

(10) Install throttle control bracket. Tighten nuts with 2 to 4 foot-pounds (3 to 5 N•m) torque.

(11) Install vacuum hose fittings.

(12) Install intake and exhaust manifolds. Refer to Intake and Exhaust Manifold Installation for procedure.

(13) Install vacuum hoses.

(14) Install carburetor studs, replacement gaskets and spacer.

(15) Install carburetor and connect linkage, fuel pipe and hoses.

(16) Tighten carburetor mounting nuts with 14 foot-pounds (19 N•m) torque.

(17) Connect and choke heater wire to choke cover terminal.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(18) Start engine and inspect for leaks.

(19) Install air cleaner.

Exhaust Manifold Replacement

NOTE: *It is necessary to disconnect both the intake and exhaust manifolds from the engine because they have common attaching hardware. It is not necessary to remove the carburetor from the intake manifold until after manifold is removed. After removing the carburetor from the intake manifold, it may be set to one side with vacuum hoses still attached.*

(1) Remove air cleaner.
(2) Disconnect choke heater wire from choke cover terminal.
(3) Disconnect carburetor control shaft from carburetor.
(4) Remove carburetor from intake manifold and set aside.
(5) Remove intake and exhaust manifolds from engine. Refer to Intake and Exhaust Manifold Removal for procedure.
(6) Remove throttle control bracket.
(7) Remove spark CTO valve hose clamp and install on replacement manifold.
(8) Remove air injection manifold and fittings and install on replacement manifold.
(9) Install throttle control bracket. Tighten nuts with 2 to 4 foot-pounds (3 to 5 N•m) torque.
(10) Install intake and exhaust manifolds. Refer to Intake and Exhaust Manifold Installation for procedure.
(11) Install carburetor spring bracket.
(12) Install carburetor on intake manifold.
(13) Tighten carburetor mounting nuts with 14 foot-pounds (19 N•m) torque.
(14) Install carburetor control shaft. Install throttle return spring.
(15) Connect choke heater wire to choke cover terminal.
(16) Connect exhaust pipe to exhaust manifold. Tighten nuts with 20 foot-pounds (27 N•m) torque.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(17) Start engine and inspect for leaks.
(18) Install air cleaner.

CYLINDER HEAD AND COVER

The cylinder head incorporates hardened exhaust valve seats and exhaust valves with flash chrome stems.

Cylinder Head Cover

CAUTION: *Cylinder head cover is molded plastic. Use care when removing and installing.*

Removal

(1) Remove air cleaner and PCV molded hose.
(2) Disconnect distributor vacuum spark advance hose at spark CTO valve. Disconnect fuel pipe at fuel pump and move aside to allow removal of cylinder head cover.
(3) Disconnect PCV valve from grommet in cylinder head cover. Disconnect hoses from canister.
(4) Remove cylinder head cover holddown nuts. Insert thin bladed tool (e.g., razor blade or putty knife) between cover and head and cut RTV sealant to loosen from head.

CAUTION: *Do not strike cover with mallet to loosen RTV sealant.*

(5) Inspect cylinder head cover for cracks.

Installation

A room temperature vulcanizing (RTV) silicone rubber adhesive is required for installation. Use Jeep Gasket-in-a-Tube, or equivalent.
(1) Remove adhesive and gasket material from sealing surface area.
(2) Wipe gasket mating surface on cylinder head with oily rag. This prevents adhesion but permits sealing.
(3) Apply 1/8-inch (3.2 mm) bead of silicone along entire length of cover flange.
(4) Before silicone begins to cure, install cover on cylinder head. Do not allow silicone to contact rocker arms.

CAUTION: *Do not overtighten nuts because cover may crack from excess stress.*

(5) Initially, tighten nuts by hand, then tighten with 24 inch-pounds (3 N•m) torque.
(6) Connect PCV valve to grommet in cylinder head cover, connect canister hoses.
(7) Install air cleaner and connect PCV hose.

Cylinder Head

Removal

(1) Drain coolant and disconnect hoses from thermostat housing.
(2) Remove air cleaner.
(3) Remove cylinder head cover and sealant. Refer to Cylinder Cover Removal for procedure.
(4) Remove bridge and pivot assemblies and rocker arms. Alternately loosen each capscrew one turn at a time to avoid damaging bridge.
(5) Remove push rods.

NOTE: *Retain push rods, bridge and pivot assemblies and rocker arms in same order as removed.*

(6) Disconnect power steering pump, air pump and brackets. Lay pumps and brackets aside. Do not disconnect hoses.

(7) Remove intake and exhaust manifolds from cylinder head. Refer to Intake and Exhaust Manifold Removal for procedure.

(8) If equipped with air conditioning, perform the following:

(a) Remove air conditioning drive belt idler pulley bracket from cylinder head.

(b) Loosen alternator drive belt. Remove alternator bracket-to-head mounting bolt.

(c) Remove bolts from compressor mounting bracket and set compressor aside.

(9) Disconnect ignition wires and remove spark plugs.

(10) Disconnect coolant temperature sending unit wire and battery negative cable.

(11) Remove ignition coil and bracket assembly.

(12) Remove cylinder head bolts, cylinder head and gasket.

Cleaning and Inspection

(1) Thoroughly clean machined surfaces of cylinder head and block. Remove all deposits and gasket cement.

(2) Remove carbon deposits from combustion chambers and top of pistons.

(3) Use straightedge and feeler gauge to determine flatness of cylinder head and block mating surfaces. Refer to Specifications.

Installation

(1) If cylinder head is to be replaced and original valves used, measure valve stem diameter. Only standard size valve stems can be used with service replacement cylinder head unless replacement head valve guide bores are reamed to accommodate oversize valve stems. Remove all carbon deposits and reface valves as outlined within Valve Refacing procedure.

(2) Install valves in cylinder head using replacement valve stem oil deflectors.

(3) Transfer all detached components from original head that are not included with replacement head. Do not install coolant temperature sending unit until coolant is installed. This permits trapped air to escape from block and head.

CAUTION: *Do not apply sealing compound on head and block mating surfaces. Do not allow sealing compound to enter cylinder bore.*

(4) Apply an even coat of Perfect Seal sealing compound, or equivalent, to both sides of replacement head gasket and position gasket flush on block with word TOP facing upward.

(5) Install cylinder head. Tighten bolts in sequence with 85 foot-pounds (115 N•m) torque (fig. 1B-69).

(6) Connect battery negative cable.

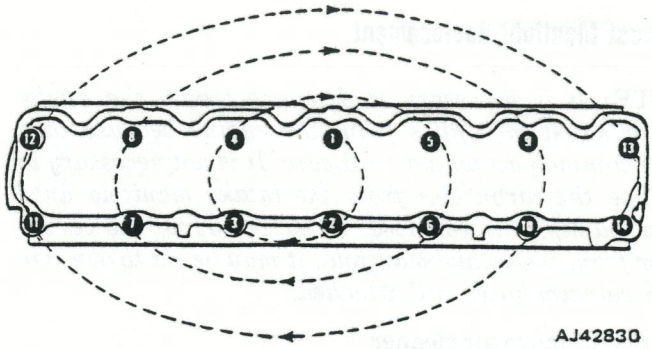


Fig. 1B-69 Cylinder Head Tightening Sequence

(7) Install ignition coil and bracket assembly.

(8) Install spark plugs and connect ignition wires.

(9) Attach air conditioning compressor mounting bracket to cylinder head, if removed.

(10) Install intake and exhaust manifolds. Refer to figure 1B-68 for correct tightening sequence. Refer to Intake Manifold Replacement for procedure.

(11) Install alternator bracket on head. Install alternator, belt and adjust tension. Refer to Chapter 1C—Cooling Systems for procedure.

(12) Install power steering bracket and pump. Adjust belt tension. Refer to Chapter 1C—Cooling Systems for procedure.

(13) Install air pump bracket on head. Install air pump and belt. Adjust belt tension. Refer to Chapter 1C—Cooling Systems for procedure.

(14) Install each push rod in its original location.

(15) Install rocker arms and bridge and pivot assemblies in original locations. Loosely install capscrews for each bridge and tighten capscrews alternately, one turn at a time, to avoid damaging bridge. Tighten screws with 19 foot-pounds (26 N•m) torque.

(16) Install cylinder head cover. Use silicone rubber (RTV) sealant.

(17) Connect coolant hoses to thermostat housing and fill cooling system to specified level. Refer to Cooling System Specifications, Chapter 1C. Install temperature sending unit.

NOTE: *The head gasket is constructed of aluminum-coated embossed steel and does not require the head bolts to be retightened after the engine has been operated.*

(18) Install fuel pipe and vacuum advance hose.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(19) Operate engine with radiator cap off. Inspect for leaks and continue operating engine until thermostat opens. Add coolant, if required. To vent air from system refer to Chapter 1C—Cooling Systems.

(20) Install air cleaner.

LUBRICATION SYSTEM

General

A gear-type positive displacement pump is mounted at the underside of the block opposite the No. 4 main bearing (fig. 1B-70). The pump brings oil up through the pickup screen and inlet tube from the sump at the rear of the oil pan. The oil is driven between the drive and idler gears and the pump body, then is forced through the outlet to the block. An oil gallery in the block routes the oil to the inlet side of the full flow oil filter. After passing through the filter element, the oil flows from the center outlet of the filter head through an oil gallery up to the main oil gallery, which extends the entire length of the block.

Smaller galleries extend downward from the main oil gallery to the upper insert of each main bearing. The crankshaft is drilled internally to route oil from the main bearing journals (except No. 4) to the connecting rod journals. Each connecting rod bearing cap has a small squirt hole. Oil passes through the squirt hole and is thrown off as the rod rotates. This oil throw-off lubricates the camshaft lobes, distributor drive gear, cylinder walls and piston pins.

The hydraulic valve tappets receive oil directly from the main oil gallery. Oil is also routed to the camshaft bearings through galleries. The front camshaft bearing journal directs oil through the camshaft sprocket to the timing chain. Rotation of the sprocket lubricates the crankshaft sprocket and chain. Oil drains back to the oil pan under the No. 1 main bearing cap.

The oil supply for the rocker arms and bridge and pivot assemblies is provided by the hollow push rods from the hydraulic valve tappets. Oil passes from each tappet through the hollow push rod to a hole in the corresponding rocker arm. Oil from the rocker arms lubricates the valve train components, then flows down through the push rod guide bores in the cylinder head past the valve tappet area, and returns to the oil pan.

Oil Filter

A full flow oil filter, mounted on the lower right side of the engine, is accessible through the hood opening. A bypass valve incorporated in the filter mounting head on the cylinder block provides a safety factor if the filter should become inoperative as a result of dirt or sludge accumulation (fig. 1B-71).

CAUTION: *Use the short, 4.25-inch (107.95 mm) filter on six-cylinder engine CJ vehicles. If the long, 5.44-inch (138.18 mm) filter is used, it may contact the engine support bracket or frame rail. This can puncture the filter and result in a loss of oil and possible engine damage.*

Tool J-22700 will facilitate removal of the oil filter. Before installation, apply a thin film of oil to the replacement filter gasket. Turn filter until gasket contacts the seat of the filter head. Tighten by hand only, following the instructions on the replacement filter. If the instructions are not printed on the filter, tighten the filter until the gasket contacts the seat and then tighten an additional 3/4 turn.

Operate engine at fast idle and check for leaks.

Oil Pump

The positive-displacement gear-type oil pump is driven by the distributor shaft, which is driven by a gear connected to the camshaft. Lubrication oil is pumped from the sump through an inlet tube and screen assembly that is pressed into the pump body (fig. 1B-71). The pump incorporates a non-adjustable pressure relief valve to regulate maximum pressure. The spring tension is calibrated for 75 psi (517 kPa) maximum pressure. In the relief position, the valve permits oil to bypass through a passage in the pump body to the inlet side of the pump.

Removal

NOTE: *Oil pump removal or replacement will not affect the distributor timing because the distributor drive gear remains in mesh with the camshaft gear.*

(1) Drain engine oil.

(2) Remove oil pan. Refer to Oil Pan Removal for procedure.

CAUTION: *Do not disturb position of oil inlet tube and screen assembly in pump body. If tube is moved within pump body, a replacement tube and screen assembly must be installed to assure an airtight seal.*

(3) Remove oil pump retaining screws, oil pump and gasket.

Disassembly and Inspection

(1) Remove cover retaining screws, cover and gasket from pump body.

(2) Measure gear end clearance.

- **Preferred Method:**

(a) Place strip of Plastigage across full width of each gear end (fig. 1B-72).

(b) Apply a bead of Loctite 515, or equivalent, around perimeter of pump cover and install. Tighten screws with 70 inch-pounds (8 N•m) torque.

(c) Remove pump cover and determine amount of clearance by measuring width of compressed Plastigage with scale on Plastigage envelope. Correct clearance by this method is 0.002 to 0.006 inch (0.002 inch preferred) [0.051 to 0.203 mm (0.051 mm preferred)].

- **Alternate Method:**

(a) Place straightedge across ends of gears and pump body.

(b) Select feeler gauge that fits snugly but freely between straightedge and pump body (fig. 1B-73).

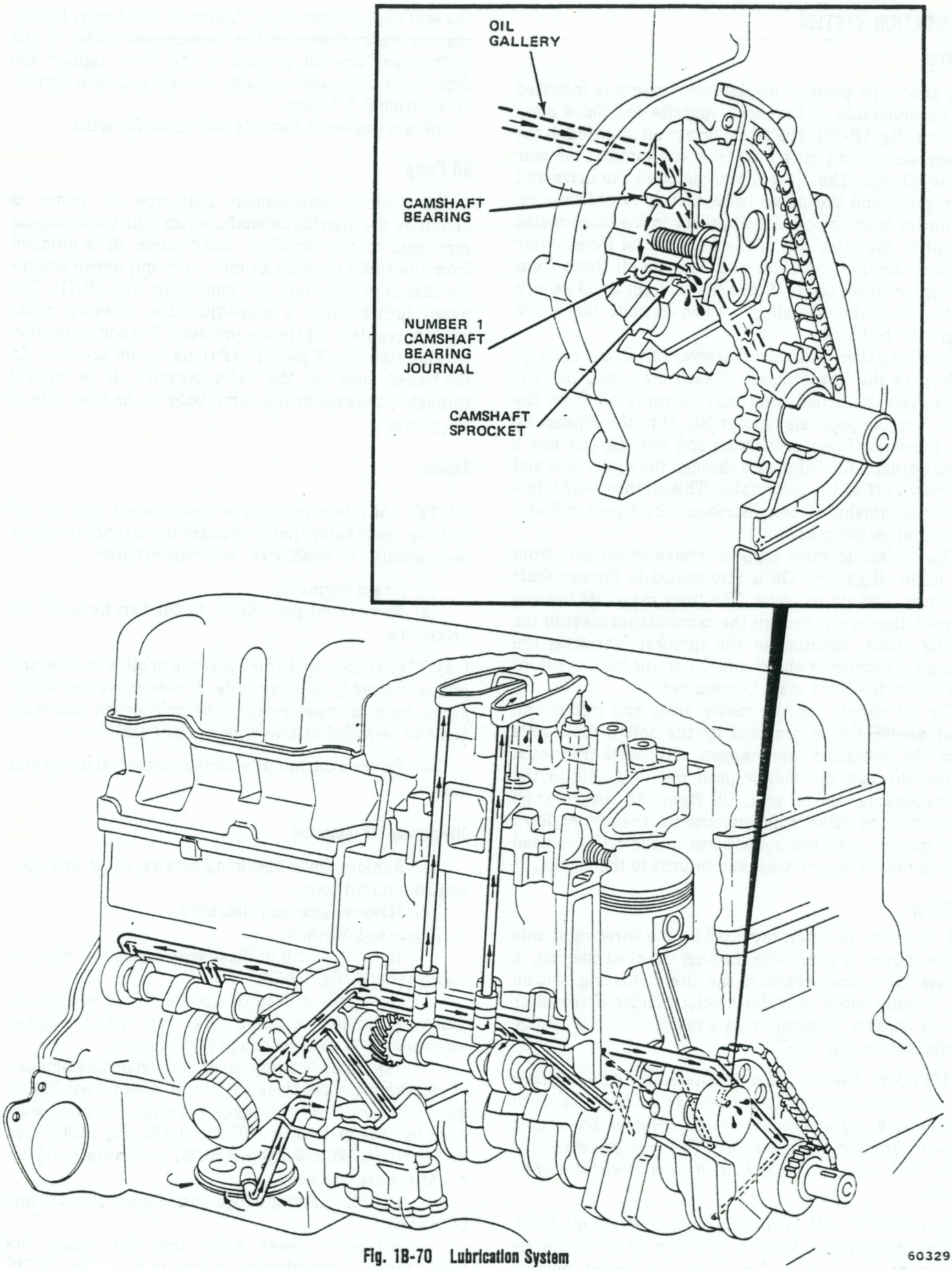


Fig. 1B-70 Lubrication System

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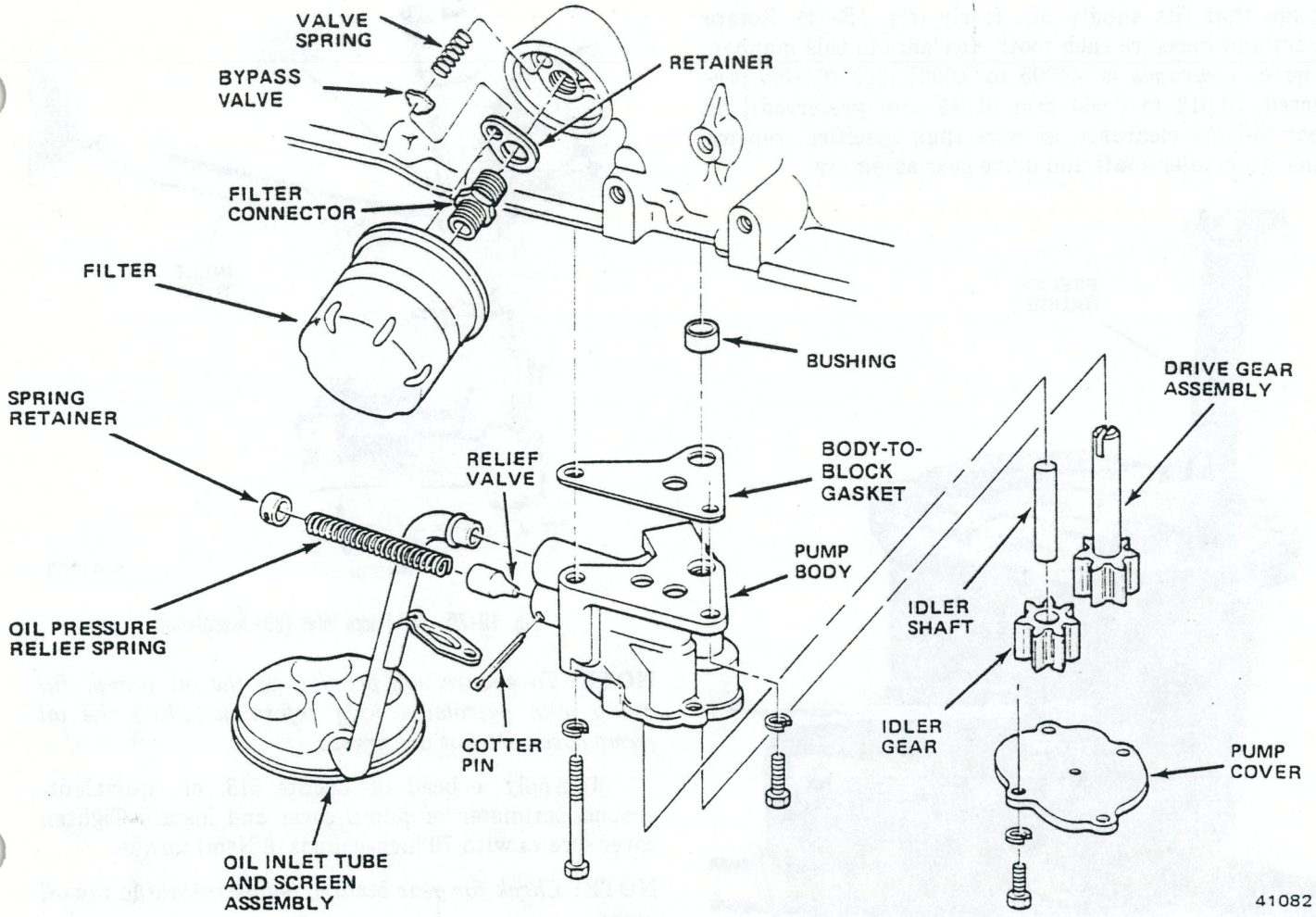

Fig. 1B-71 Oil Filter and Oil Pump Assembly

Correct clearance by this method is 0.004 to 0.008 inch (0.007 inch preferred) [0.102 to 0.203 mm (0.178 mm preferred)]. If gear end clearance is excessive, replace oil pump assembly.

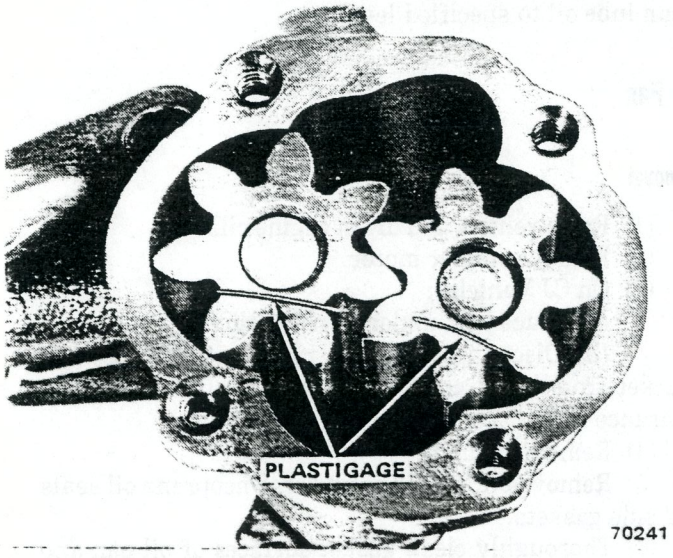

Fig. 1B-72 Oil Pump Gear End Clearance Measurement—Plastigage Method

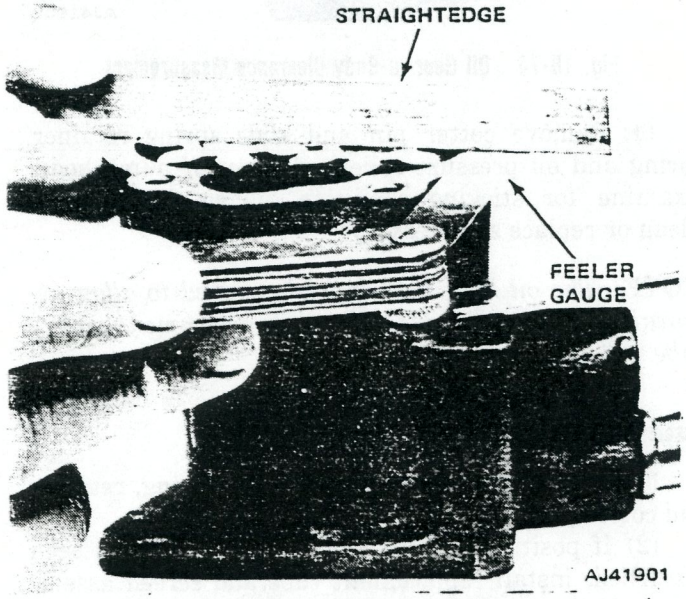

Fig. 1B-73 Oil Pump Gear End Clearance Measurement—Feeler Gauge Method

(3) Measure gear-to-body clearance by inserting feeler gauge between gear tooth and pump body inner wall directly opposite point of gear mesh. Select feeler

gauge that fits snugly but freely (fig. 1B-74). Rotate gears and measure each tooth clearance in this manner. Correct clearance is 0.0005 to 0.0025 inch (0.0005 preferred) [0.013 to 0.064 mm (0.013 mm preferred)]. If gear-to-body clearance is more than specified, replace idler gear, idler shaft and drive gear assembly.

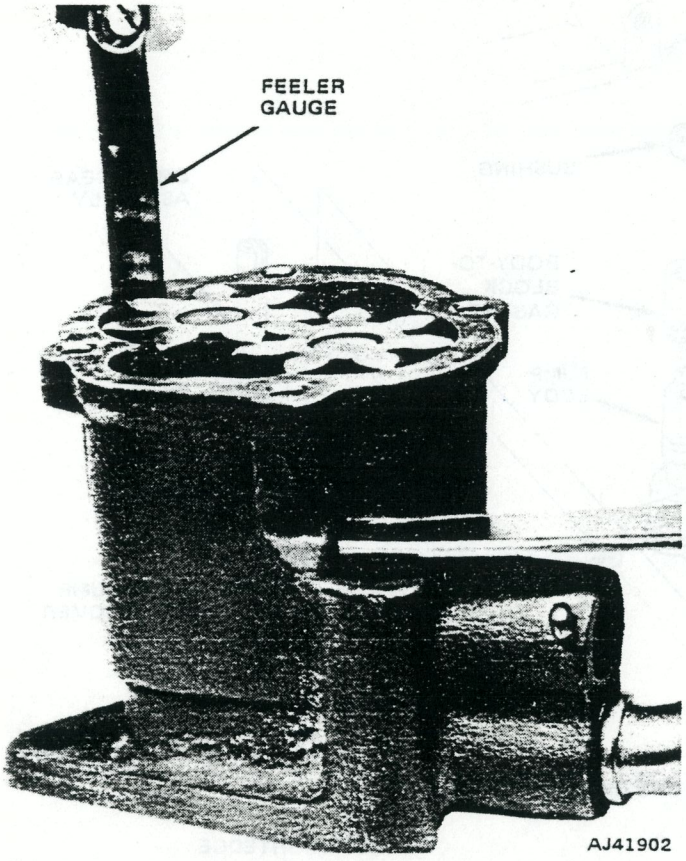

Fig. 1B-74 Oil Gear-to-Body Clearance Measurement

(4) Remove cotter pin and slide spring retainer, spring and oil pressure relief valve out of pump body. Examine for sticking condition during disassembly. Clean or replace as necessary.

NOTE: *The oil inlet tube must be moved to allow removal of the relief valve. Install a replacement pickup tube and screen assembly.*

Assembly and Installation

(1) Install oil pressure relief valve, spring, retainer and cotter pin.

(2) If position of inlet tube in pump body has been disturbed, install replacement tube and screen assembly. Apply light film of Permatex No. 2, or equivalent, around end of tube. Use Tool J-21882 to drive tube into body. Ensure support bracket is properly aligned (fig. 1B-75).

(3) Install idler shaft, idler gear and drive gear assembly.

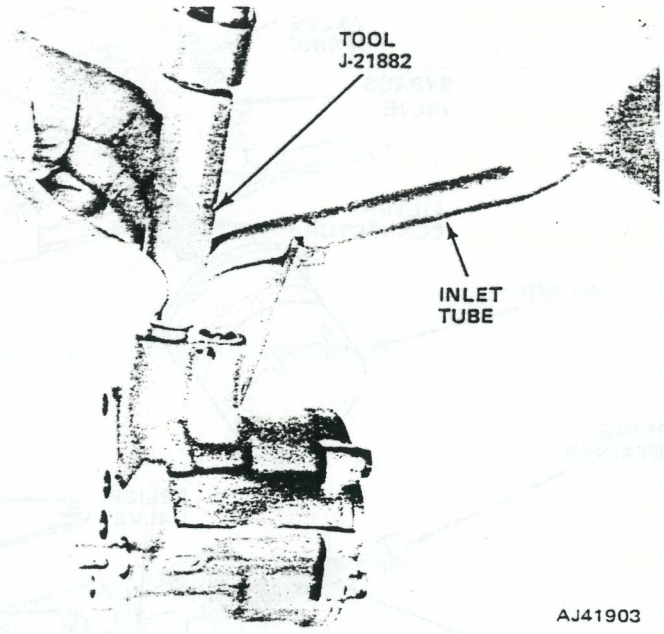

Fig. 1B-75 Oil Pump Inlet Tube Installation

NOTE: *To ensure self-priming of the oil pump, fill pump with petroleum jelly before installing the oil pump cover. Do not use grease.*

(4) Apply a bead of Loctite 515, or equivalent, around perimeter of pump cover and install. Tighten cover screws with 70 inch-pounds (8 N•m) torque.

NOTE: *Check for gear binding before installing the oil pump.*

(5) Install oil pump and replacement gasket. Tighten short screws with 10 foot-pounds (14 N•m) torque and long screws with 17 foot-pounds (23 N•m) torque.

(6) Install oil pan, using replacement gaskets and seals. Refer to Oil Pan Installation. Fill crankcase with clean lube oil to specified level.

Oil Pan

Removal

(1) Raise vehicle and drain engine oil.
(2) Remove starter motor.
(3) On CJ Vehicles:
(a) Place jack under transmission.
(b) Disconnect engine right support cushion bracket from block and raise engine to allow sufficient clearance for oil pan removal.
(4) Remove oil pan.
(5) Remove oil pan front and rear neoprene oil seals and side gaskets.
(6) Thoroughly clean gasket surfaces of oil pan and engine block. Remove all sludge and residue from oil pan sump.

Installation

(1) Install replacement oil pan front seal on timing case cover. Apply generous amount of Jeep Gasket-in-a-Tube (RTV silicone), or equivalent, to end tabs.

(2) Cement replacement oil pan side gaskets into position on engine block. Apply generous amount of Jeep Gasket-in-a-Tube (RTV silicone), or equivalent, to gasket ends.

(3) Coat inside curved surface of replacement oil pan rear seal with soap. Apply generous amount of Jeep Gasket-in-a-Tube (RTV silicone), or equivalent, to side gasket contacting surface of seal end tabs.

(4) Install seal in recess of rear main bearing cap, ensuring it is fully seated.

(5) Apply engine oil to oil pan contacting surface of front and rear oil pan seals.

(6) Install oil pan and tighten drain plug securely.

(7) Lower engine and connect right support cushion bracket to block. Remove jack.

(8) Install starter motor.

(9) Lower vehicle and fill crankcase with clean lube oil to specified level.

Oil Pressure Gauge

Refer to Chapter 1L—Power Plant Instrumentation for operation, diagnosis and replacement of oil pressure gauge.

CONNECTING ROD AND PISTON ASSEMBLIES

NOTE: *The following procedure is used to service connecting rod and piston assemblies with the engine installed in the vehicle.*

Removal

(1) Remove cylinder head.

(2) Position pistons near bottom of stroke and use ridge reamer to remove ridge from top end of cylinder walls.

(3) Drain engine oil.

(4) Remove oil pan and gaskets.

(5) Remove connecting rod bearing caps and inserts and retain in same order as removed.

NOTE: *Connecting rods and caps are stamped with the corresponding cylinder number.*

CAUTION: *Ensure that connecting rod bolts do not scratch the connecting rod journals or cylinder walls. Short pieces of rubber hose slipped over the bolts will provide protection during removal.*

(6) Remove connecting rod and piston assemblies through top of cylinder bores.

Installation

(1) Clean cylinder walls thoroughly. Apply light film of clean engine oil to walls with clean, lint-free cloth.

(2) Install piston rings on pistons. Refer to Piston Rings for procedure.

(3) Lubricate piston and rings with clean engine oil.

CAUTION: *Ensure that connecting rod screws do not scratch the connecting rod journals or cylinder walls. Short pieces of rubber hose slipped over the screws will provide protection during installation.*

(4) Use Piston Ring Compressor Tool J-5601 to install connecting rod and piston assemblies through top of cylinder bores (fig. 1B-76).

(5) Install connecting rod bearing caps and inserts in same order as removed.

NOTE: *Oil squirt holes in connecting rods must face camshaft.*

(6) Install oil pan using replacement gaskets and seals. Tighten drain plug.

(7) Install gasket and cylinder head.

(8) Fill crankcase with clean oil to specified dipstick level.

CONNECTING RODS

The connecting rods are malleable iron, balanced assemblies with bearing inserts at the crankshaft journal end. The piston pin is 2,000 pound (907.2 kg) press-fitted.

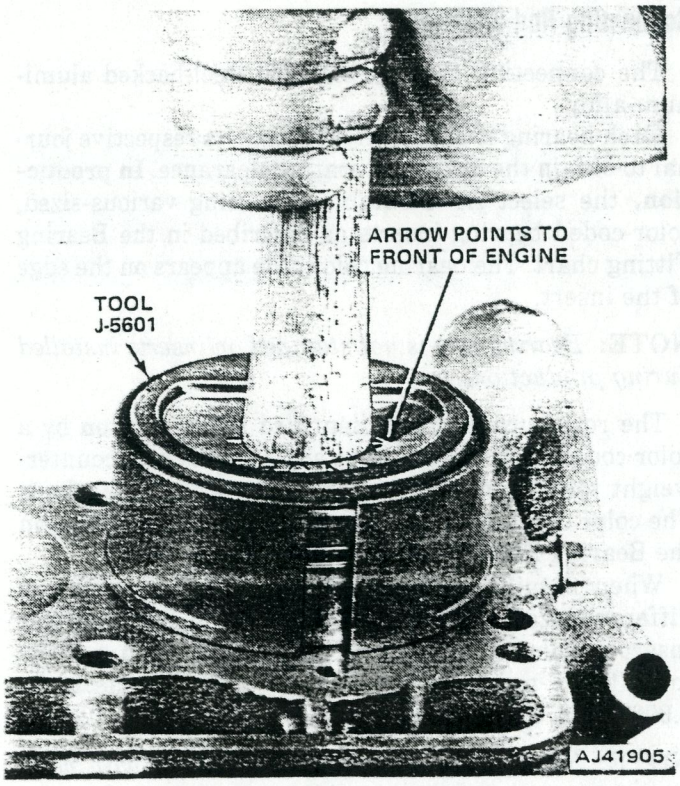

Fig. 1B-76 Piston Installation

Connecting Rod Bearing Fitting Chart

Crankshaft Connecting Rod Journal Color and Diameter in Inches (Journal Size)	Bearing Color Code	
	Upper Insert Size	Lower Insert Size
Yellow —2.0955 to 2.0948 (53.2257-53.2079mm) (Standard)		
Orange —2.0948 to 2.0941 (53.2079-53.1901mm) (0.0007 Undersize)	Yellow —Standard Yellow —Standard	Yellow —Standard Black —0.001-inch (0.025mm) Undersize
Black —2.0941 to 2.0934 (53.1901-53.1723mm) (0.0014 Undersize)	Black —0.001-inch (0.025mm) Undersize	Black —0.001-inch (0.025mm) Undersize
Red —2.0855 to 2.0848 (53.9717-52.9539mm) (0.010 Undersize)	Red —0.010-inch (0.254mm) Undersize	Red —0.010-inch (0.254mm) Undersize

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A squirt hole in the crankshaft end of the connecting rod provides lubrication for the camshaft lobes, distributor drive gear, cylinder walls and piston pins. The squirt hole faces the camshaft when the connecting rod is installed.

Misaligned or bent connecting rods cause abnormal wear on pistons, piston rings, cylinder walls, connecting rod bearings and crankshaft connecting rod journals. If wear patterns or damage to any of these components indicate the probability of a misaligned connecting rod, check rod alignment. Replace misaligned or bent rods.

Side Clearance Measurement

Slide snug-fitting feeler gauge between connecting rod and crankshaft journal flange. Correct clearance is 0.010 to 0.019 inch (0.25 to 0.48 mm). Replace connecting rod if side clearance is not within the specification.

Connecting Rod Bearings

The connecting rod bearings are steel-backed aluminum-alloy.

Each bearing is selectively fitted to its respective journal to obtain the desired operating clearance. **In production,** the select fit is obtained by using various-sized, color-coded bearing inserts as described in the Bearing Fitting chart. The bearing color code appears on the edge of the insert.

NOTE: *Bearing size is not stamped on inserts installed during production.*

The rod journal size is identified **in production** by a color coded paint mark on the adjacent cheek or counterweight toward the flanged (rear) end of the crankshaft. The color codes used to indicate journal size are listed in the Bearing Fitting chart.

When required, upper and lower bearing inserts of different sizes may be used as a pair. A standard size insert is sometimes used in combination with a 0.001-inch (0.025 mm) undersize insert to reduce clearance 0.0005 inch. (0.013 mm)

NOTE: *Never use a pair of bearing inserts with more than 0.001-inch (0.025 mm) difference in size.*

Example:

Bearing Insert Pairs

Insert	Correct	Incorrect
Upper	Standard	Standard
Lower	0.001-inch (0.025mm) undersize	0.002-inch (0.051mm) undersize

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Service replacement bearing inserts are available as pairs in the following sizes: standard, 0.001-, 0.002-, 0.010- and 0.012-inch undersize. The bearing size is stamped on the back of service replacement inserts.

NOTE: *The 0.002- and 0.012-inch undersize inserts are not used for production assembly.*

Removal

(1) Drain engine oil.
(2) Remove oil pan and gaskets.
(3) Rotate crankshaft as required to position two connecting rods at a time at bottom of stroke.
(4) Remove connecting rod bearing cap. Remove lower bearing insert.
(5) Remove upper bearing insert by rotating it out of connecting rod.

NOTE: *Do not interchange bearing caps. Each connecting rod and its matching cap is stamped with the cylinder number on a machined surface adjacent to the oil squirt hole, which faces the camshaft side of the engine block.*

Inspection

(1) Clean inserts.
(2) Inspect linings and backs of inserts for irregular wear pattern. Note any scraping, stress cracks or discoloration (fig. 1B-77). If bearing has "spun" in rod, replace bearing and connecting rod and inspect crankshaft journal for scoring.
(3) Inspect for material imbedded in linings that may indicate piston, timing sprocket, distributor gear or oil pump gear problems. Figures 1B-78 and 1B-79 depict common score patterns.

(4) Inspect fit of bearing locking tab in rod cap. If inspection indicates that insert may have been caught between rod and rod cap, replace upper and lower bearing inserts.

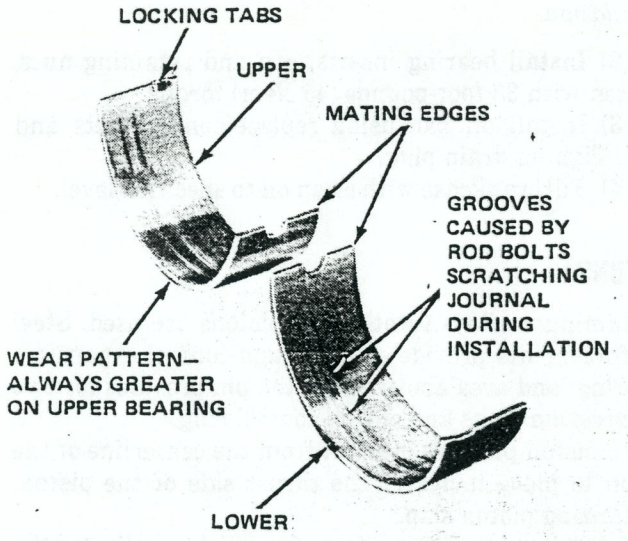

Fig. 1B-77 Connecting Rod Bearing Inspection

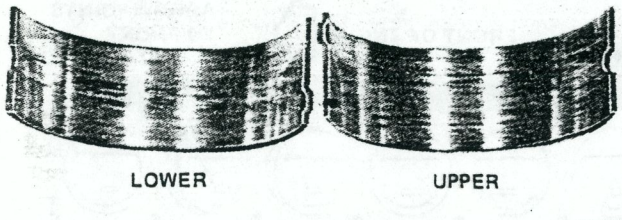

Fig. 1B-78 Scoring Caused by Insufficient Lubrication

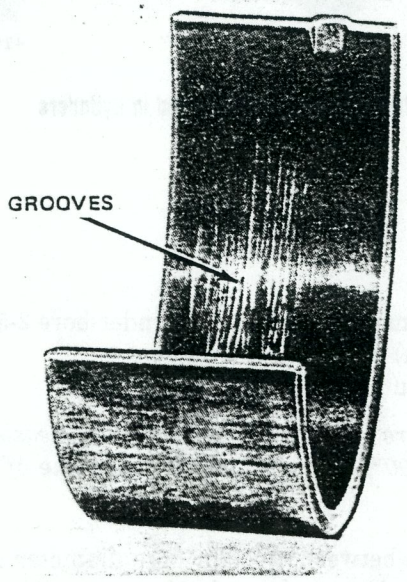

Fig. 1B-79 Scoring Caused by Imbedded Material

(5) Inspect insert in area of locking tab. Abnormal wear indicates bent tabs or improper installation of inserts (fig. 1B-80).

(6) Replace bearing inserts that are damaged or worn.

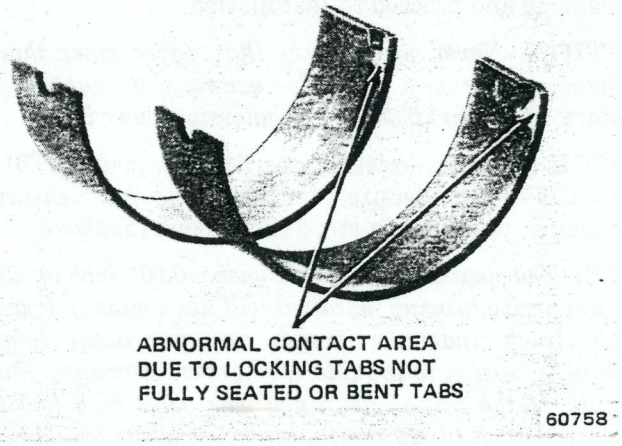

Fig. 1B-80 Locking Tab Inspection

Measuring Bearing Clearance with Plastigage

(1) Wipe journal clean.

(2) Lubricate upper insert and install in rod.

(3) Install lower insert in bearing cap. Lower insert must be dry. Place strip of Plastigage across full width of lower insert at center of bearing cap.

NOTE: *Plastigage must not crumble in use. If brittle, obtain a fresh stock.*

(4) Attach bearing cap to connecting rod and tighten nuts with 28 foot-pounds (38 N•m) torque.

NOTE: *Do not rotate crankshaft. Plastigage will shift, resulting in inaccurate clearance indication.*

(5) Remove bearing cap and determine amount of clearance by measuring width of compressed Plastigage with scale on Plastigage envelope (fig. 1B-81). Correct clearance is 0.001 to 0.0025 inch (0.025 to 0.064 mm).

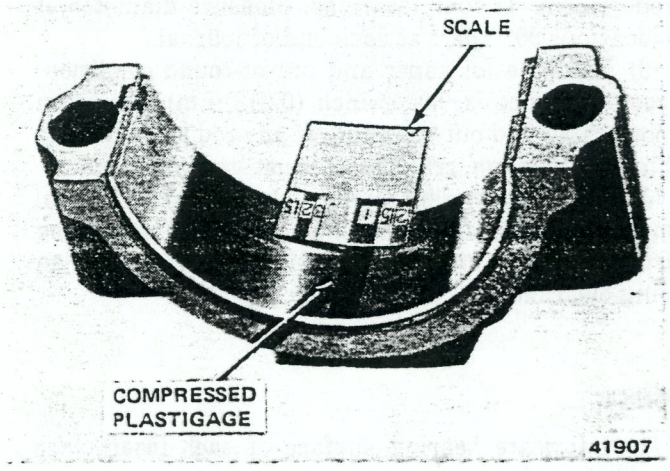

Fig. 1B-81 Rod Bearing Clearance Measurement with Plastigage

NOTE: *Plastigage should maintain the same size across the entire width of the insert. If size varies, it may indicate a tapered journal, bent connecting rod or foreign material trapped between the insert and rod.*

(6) If correct clearance is indicated, bearing fitting is not necessary. Remove Plastigage from crankshaft and bearing and proceed to Installation.

CAUTION: *Never use inserts that differ more than one bearing size as a pair. For example, do not use a standard upper and 0.002-inch undersize lower insert.*

(7) If clearance exceeds specification, install 0.001-inch (0.025 mm) undersize bearing inserts and measure clearance as described in steps (1) through (5) above.

NOTE: *The clearance indicated with a 0.001-inch (0.025 mm) undersize bearing installed will determine if a pair of 0.001-inch undersize inserts or some other combination is needed to provide the correct clearance. For example, if the initial clearance was 0.003 inch (0.076 mm), 0.001-inch (0.025 mm) undersize inserts would reduce clearance by 0.001 inch (0.025 mm). Oil clearance would be 0.002 inch (0.051 mm) and within specification. A 0.002-inch (0.051 mm) undersize insert and a 0.001-inch (0.025 mm) undersize insert would reduce this clearance an additional 0.0005 inch (0.013 mm). Oil clearance would then be 0.0015 inch (0.038 mm).*

(8) If oil clearance exceeds specification when pair of 0.002-inch (0.051 mm) undersize inserts are installed, measure connecting rod journal on crankshaft with micrometer. If journal size is correct (not less than 2.0934 inch or 53.172 mm), inside diameter of connecting rod is incorrect and rod must be replaced. If journal size is incorrect, replace crankshaft or grind journal to accept suitable undersize bearing.

Measuring Bearing Clearance with Micrometer

(1) Wipe connecting rod journal on crankshaft clean.

(2) Use micrometer to measure maximum diameter of rod journal at four locations. Measure diameter at two locations 90° apart at each end of journal.

(3) Examine for taper and out-of-round condition. Correct tolerance is 0.0005-inch (0.013 mm) maximum for both taper and out-of-round. If any rod journal is not within specification, crankshaft must be replaced.

(4) Compare measurement obtained with journal diameters listed in Connecting Rod Bearing Fitting Chart and select inserts required to obtain specified bearing clearance.

Installation

(1) Lubricate bearing surface of each insert with clean engine oil.

CAUTION: *Use care when rotating the crankshaft with bearing caps removed. Ensure the connecting rod bolts do not accidentally come in contact with the rod journals and scratch the surface. Bearing failure would result. Short pieces of rubber hose slipped over the connecting rod bolts will provide protection during installation.*

(2) Install bearing inserts, cap and retaining nuts. Tighten with 33 foot-pounds (45 N•m) torque.

(3) Install oil pan using replacement gaskets and seals. Tighten drain plug.

(4) Fill crankcase with clean oil to specified level.

PISTONS

Aluminum alloy Autothermic pistons are used. Steel reinforcements provide strength and control expansion. The ring land area above the piston pin provides for two compression rings and one oil control ring.

The piston pin boss is offset from the centerline of the piston to place it nearer the thrust side of the piston, minimizing piston slap.

An arrow on the top surface of the piston indicates the correct installation position in the bore. The arrow points toward the front of engine when installed correctly (fig. 1B-82).

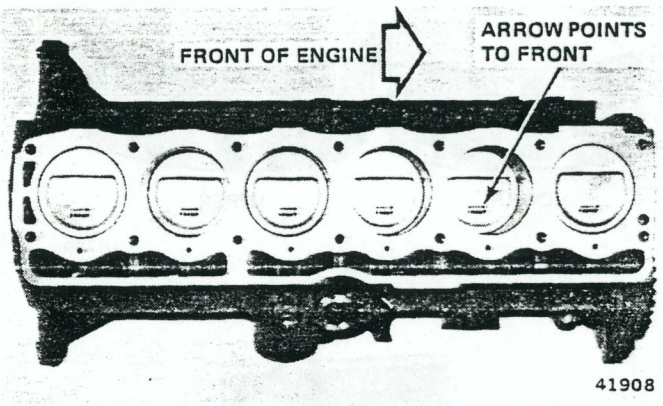

Fig. 1B-82 Pistons Correctly Positioned in Cylinders

Piston Fitting

Micrometer Method

(1) Measure inside diameter of cylinder bore 2-5/16 inches (58.725 mm) below top of cylinder.

(2) Measure outside diameter of piston.

NOTE: *Pistons are cam ground and must be measured at a right angle (90°) to piston pin at centerline of pin (fig. 1B-83).*

(3) Difference between cylinder bore diameter and piston diameter is piston-to-bore clearance.

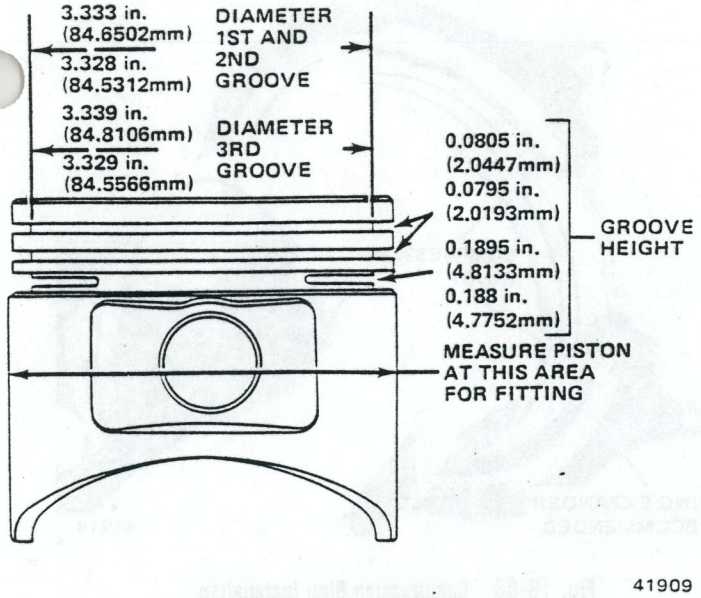

Fig. 1B-83 Piston Measurement

Feeler Gauge Method

(1) Remove rings from piston.

(2) Insert long 0.0005-inch (0.013 mm) feeler gauge into cylinder bore.

(3) Insert piston, top first, into bore alongside feeler gauge. With entire piston inserted in bore, piston should not bind against feeler gauge.

(4) Repeat steps (2) and (3) above with long 0.002-inch (0.051 mm) feeler gauge. Piston should bind.

If piston binds on 0.0005-inch (0.013 mm) gauge, piston is too large or bore is too small. If piston does not bind on 0.002-inch (0.051 mm) gauge, piston may be enlarged by knurling or shot-peening. Replace pistons that are 0.004 inch (0.102 mm) or more undersize.

Piston Rings

The two compression rings are made of cast iron. The oil control ring is a three-piece steel design.

Ring Fitting

(1) Clean carbon from all ring grooves. Oil drain openings in oil ring grooves and pin boss must be open. Do not remove metal from grooves or lands. This will change ring groove clearances and will damage ring-to-land seating.

(2) Measure ring side clearance with feeler gauge fitted snugly between ring land and ring. Rotate ring in groove. It must move freely at all points (fig. 1B-84). Refer to Specifications for correct ring side clearance.

(3) Place ring in bore and push down with inverted piston to position near lower end of ring travel. Measure ring gap (joint clearance) with feeler gauge fitting snugly in ring end gap (fig. 1B-85). Refer to Specifications for correct ring gap clearance.

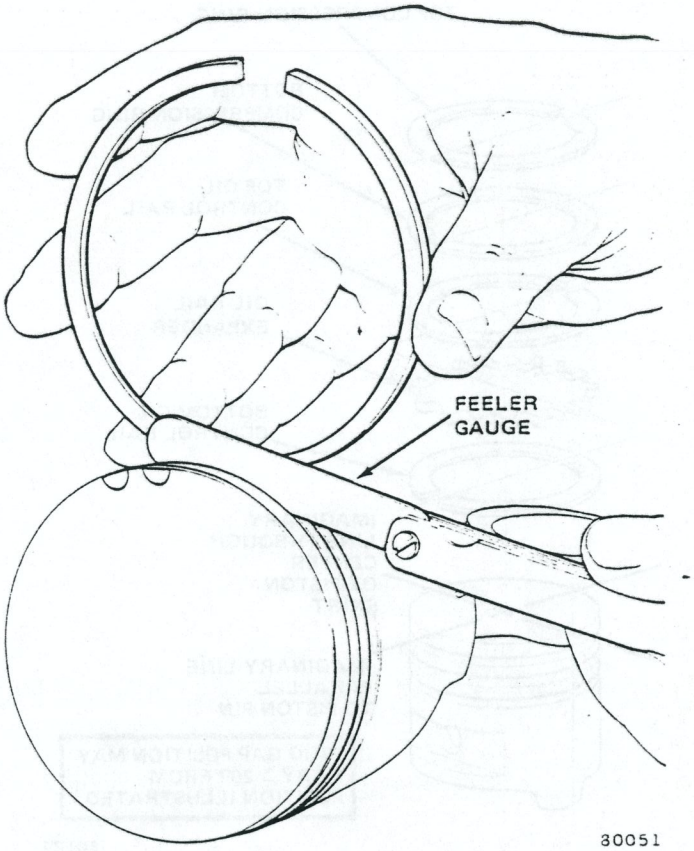

Fig. 1B-84 Ring Side Clearance

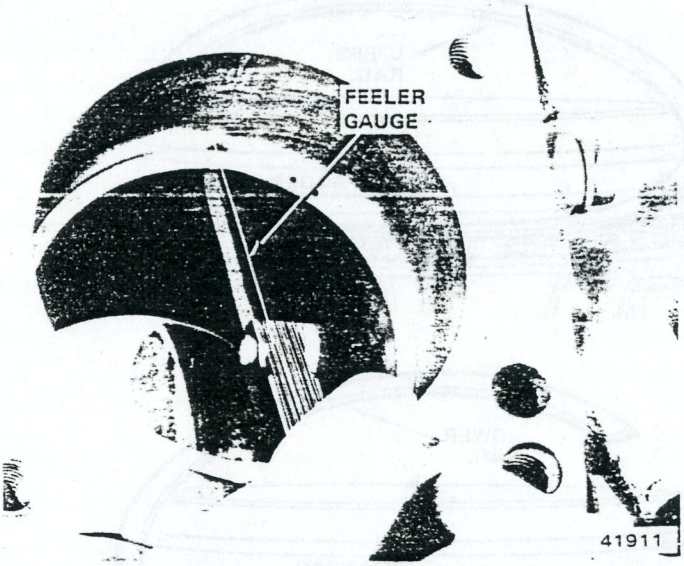

Fig. 1B-85 Ring Gap Clearance

Installation

Refer to figure 1B-86 for position of ring gaps when installing rings.

(1) Install oil control rings as indicated by instructions in package. It is not necessary to use tool to install upper and lower rails (fig. 1B-87). Insert expander ring first, then side rails.

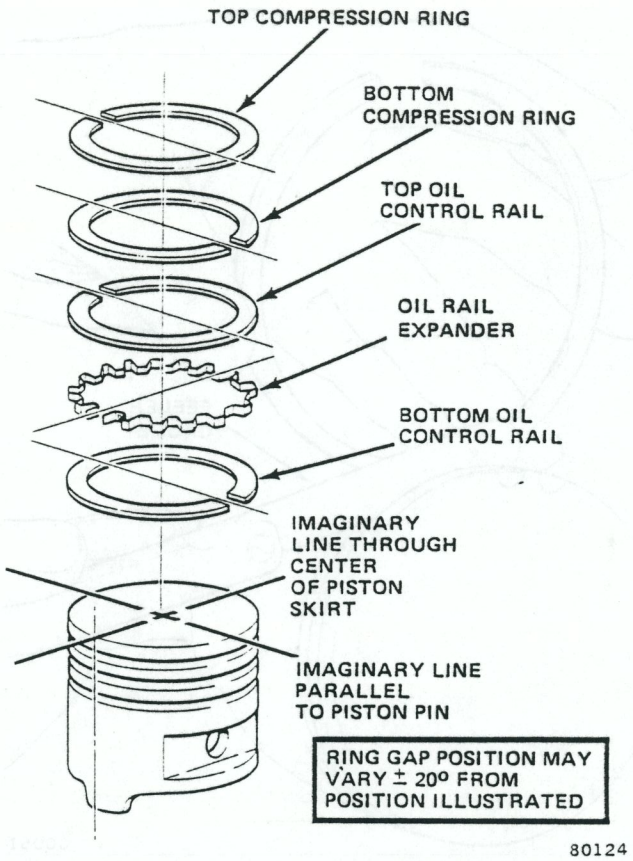

Fig. 1B-86 Piston Ring Gap Position

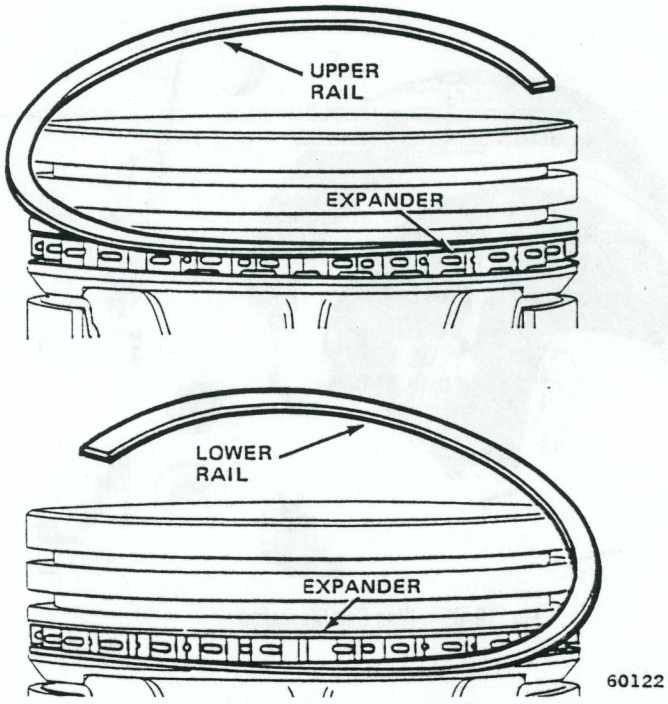

Fig. 1B-87 Oil Control Ring Rail Installation

(2) Install lower compression ring using ring installer to expand ring around piston (fig. 1B-88).

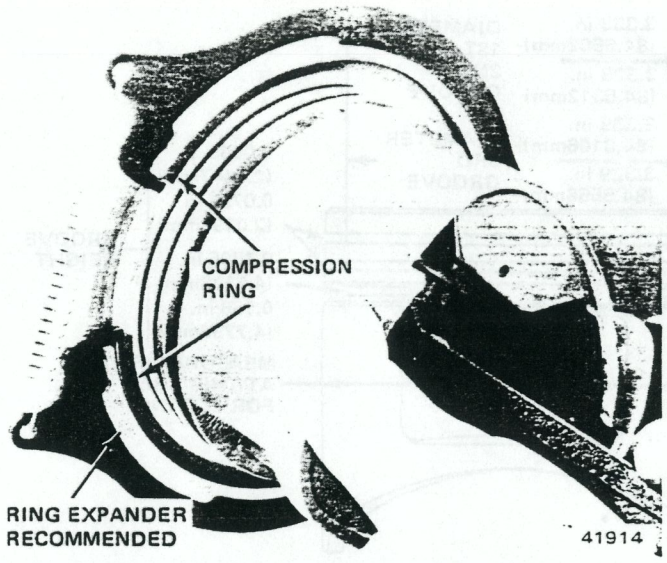

Fig. 1B-88 Compression Ring Installation

NOTE: *Ensure upper and lower compression rings are installed properly. Ideally, ring gaps should be located 180 degrees apart. Figure 1B-89 depicts typical ring markings that indicate the top side of each ring.*

(3) Install upper compression ring using ring installer to expand ring around piston (fig. 1B-88). Position ring gap 180° from lower compression ring.

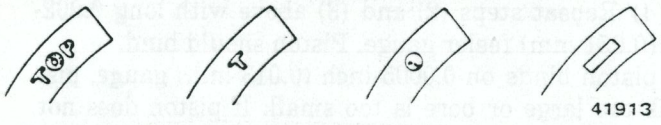

Fig. 1B-89 Typical Piston Ring Markings

Piston Pins

Piston pins are press fit into the connecting rod and require no locking device.

Removal

(1) Using Piston Pin Remover Tool J-21872 and arbor press, place piston on Remover Support Tool J-21872-1 (fig. 1B-90).

(2) Use Piloted Driver Tool J-21872-3 to press pin completely out of piston. Note position of pin through gauge window of remover support.

Pin Inspection

(1) Inspect pin and pin bore for nicks and burrs. Remove as necessary.

NOTE: *Never reuse piston pin after it has been installed in and removed from a connecting rod.*

(2) With pin removed from piston, clean and dry piston pin bore and replacement piston pin.

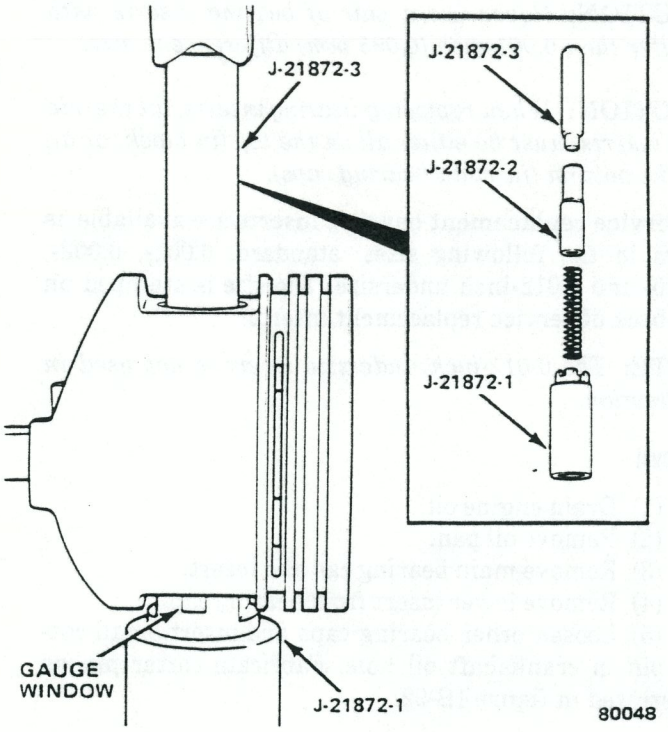

Fig. 1B-90 Piston Pin Removal or Installation

(3) Position piston so that pin bore is in vertical position. Insert pin in bore. At room temperature, the replacement pin should slide completely through pin bore without using force.

(4) Replace piston if pin jams in pin bore.

Installation

(1) Insert Pin Pilot Tool J-21872-2 through piston and connecting rod pin bores (fig. 1B-90).

(2) Position pin pilot, piston and connecting rod on Support Tool J-21872-1.

(3) Insert piston pin through upper piston pin bore and into connecting rod pin bore.

(4) Position Piloted Driver Tool J-21872-3 inside piston pin.

(5) Use arbor press to press piston pin through connecting rod and piston until pin pilot indexes with mark on support.

NOTE: *The piston pin requires a 2,000 pound (8.9 kN) press-fit. If little effort is required to install piston pin in connecting rod, or if rod moves along pin, replace connecting rod.*

(6) Remove piston and connecting rod assembly from press. Pin should be centered in rod, ±0.0312 inch (0.792 mm).

CRANKSHAFT

The nodular iron crankshaft is counterweighted and balanced. The crankshaft has four counterweights, even main bearing journals and six connecting rod journals. End thrust is controlled by the No. 3 main bearing.

An oil slinger is located at the rear main journal, inboard of the rear oil seal. The component parts and crankshaft are first individually balanced and then the complete assembly is balanced as a unit.

Service replacement vibration dampers, crankshafts, flywheels, drive plates, torque converters and clutch components are balanced individually and may be replaced as required without balancing the complete assembly.

Removal or Replacement

If the crankshaft is damaged to the extent that reconditioning is not feasible, it must be replaced. Removal and installation procedures are outlined under Cylinder Block.

Crankshaft End Play Measurement

The crankshaft end play is controlled by the No. 3 main bearing inserts, which are flanged for this purpose.

(1) Attach dial indicator to cylinder block adjacent to No. 3 main bearing (fig. 1B-91).

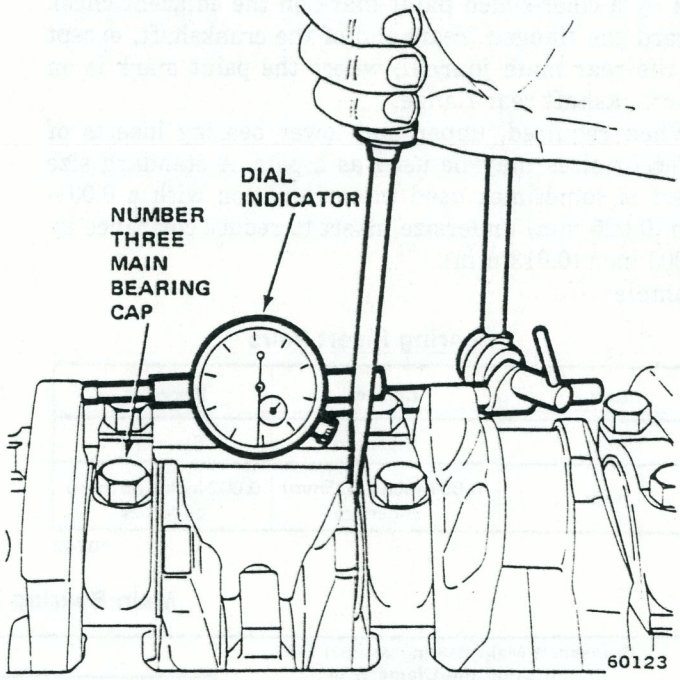

Fig. 1B-91 Measuring Crankshaft End Play

(2) Pry shaft forward with flat-bladed screwdriver and with dial indicator stem on face of crankshaft counterweight, set to zero.

(3) Pry shaft fore and aft and observe dial indicator. The end play is the difference between the high and low measurements. The correct crankshaft end play is 0.0015 to 0.0065 inch (0.0020 to 0.0025 desired) [0.038 to 0.165 mm (0.051 to 0.064 mm desired)].

(4) If end play is not within specifications, inspect crankshaft bearing thrust faces for wear. If wear is apparent, replace thrust bearing and measure end play. If end play is still not within specifications, replace crankshaft.

NOTE: *When replacing the thrust bearings, pry the crankshaft fore and aft to align the faces of the thrust bearings before the final tightening.*

Crankshaft Main Bearings

The main bearings are a steel-backed, micro-babbitt, precision type. The main bearing caps are numbered (front to rear) from 1 through 7, and an arrow indicates the forward position. The upper main bearing inserts are grooved while the lower inserts are smooth.

Each bearing is selectively fitted to its respective journal to obtain the desired operating clearance. **In production,** the select fit is obtained by using various sized color coded bearing inserts as described in the Main Bearing Fitting Chart. The bearing color code appears on the edge of the insert.

NOTE: *Bearing size is not stamped on inserts installed during production assembly.*

The main bearing journal size is identified **in production** by a color-coded paint mark on the adjacent cheek toward the flanged (rear) end of the crankshaft, except for the rear main journal, where the paint mark is on the crankshaft rear flange.

When required, upper and lower bearing inserts of different sizes may be used as a pair. A standard size insert is sometimes used in combination with a 0.001-inch (0.025 mm) undersize insert to reduce clearance by 0.0005 inch (0.013 mm).
Example:

Bearing Insert Pairs

Insert	Correct	Incorrect
Upper	Standard	Standard
Lower	0.001-inch (.025mm) undersize	0.002-inch (.051mm) undersize

70242

CAUTION: *Never use a pair of bearing inserts with greater than 0.001-inch (0.025 mm) difference in size.*

CAUTION: *When replacing bearing inserts, all the odd size inserts must be either all on the top (in block) or all on the bottom (in main bearing caps).*

Service replacement bearing inserts are available as pairs in the following sizes: standard, 0.001-, 0.002-, 0.010- and 0.012-inch undersize. The size is stamped on the back of service replacement inserts.

NOTE: *The 0.012-inch undersize insert is not used in production.*

Removal

(1) Drain engine oil.
(2) Remove oil pan.
(3) Remove main bearing cap and insert.
(4) Remove lower insert from bearing cap.
(5) Loosen other bearing caps and insert small cotter pin in crankshaft oil hole. Fabricate cotter pin as illustrated in figure 1B-92.

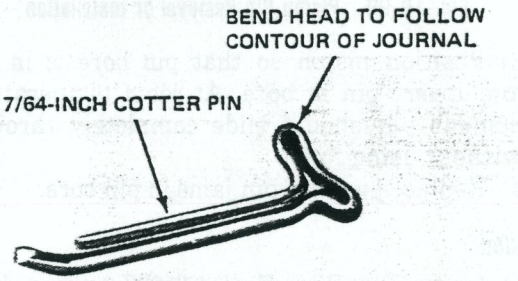

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Fig. 1B-92 Fabricated Upper Main Bearing Removal Tool

(6) With cotter pin in place, rotate crankshaft so that upper bearing insert rotates in direction of its locking tab.

Main Bearing Fitting Chart

Crankshaft Main Bearing Journal 1-6 Color Code and Diameter in Inches (Journal Size)	Bearing Color Code	
	Upper Insert Size	Lower Insert Size
Yellow — 2.5001 to 2.4996 (Standard) (63.5025 to 63.4898 mm)	Yellow — Standard	Yellow — Standard
Orange — 2.4996 to 2.4991 (0.0005 Undersize) (63.4898 to 63.4771 mm)	Yellow — Standard	Black — 0.001-inch Undersize (0.025 mm)
Black — 2.4991 to 2.4986 (0.001 Undersize) (63.4771 to 63.4644 mm)	Black — 0.001-inch Undersize (0.025 mm)	Black — 0.001-inch Undersize (0.025 mm)
Green — 2.4986 to 2.4981 (0.0015 Undersize) (63.4644 to 63.4517 mm)	Black — 0.001-inch Undersize (0.025 mm)	Green — 0.002-inch Undersize (0.051 mm)
Red — 2.4901 to 2.4896 (0.010 Undersize) (63.2485 to 63.2358 mm)	Red — 0.010-inch Undersize (0.254 mm)	Red — 0.010-inch Undersize (0.254 mm)

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Crankshaft Main Bearing Journal 7 Color Code and Diameter in Inches (Journal Size)	Bearing Color Code	
	Upper Insert Size	Lower Insert Size
Yellow — 2.4995 to 2.4990 (Standard) (63.4873 to 63.4746 mm)	Yellow — Standard	Yellow — Standard
Orange — 2.4990 to 2.4985 (0.0005 Undersize) (63.4746 to 63.4619 mm)	Yellow — Standard	Black — 0.001-inch Undersize (0.025 mm)
Black — 2.4985 to 2.4980 (0.001 Undersize) (63.4619 to 63.4492 mm)	Black — 0.001-inch Undersize (0.025 mm)	Black — 0.001-inch Undersize (0.025 mm)
Green — 2.4980 to 2.4975 (0.0015 Undersize) (63.4492 to 63.4365 mm)	Black — 0.001-inch Undersize (0.025 mm)	Green — 0.002-inch Undersize (0.051 mm)
Red — 2.4895 to 2.4890 (0.010 Undersize) (63.2333 to 63.2206 mm)	Red — 0.010-inch Undersize (0.254 mm)	Red — 0.010-inch Undersize (0.254 mm)

60262B

NOTE: *Because there is no hole in the number 4 main journal, use a tongue depressor or similar soft-faced tool to remove the bearing (fig. 1B-93). After moving the insert approximately one inch (25.40 mm), the insert can be removed by applying pressure under the tab.*

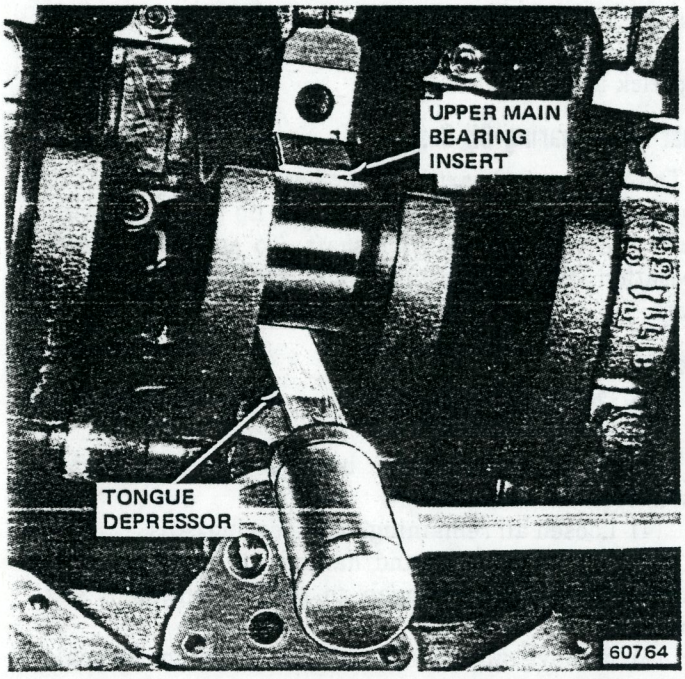

Fig. 1B-93 Removing No. 4 Main Bearing Insert

(7) In the same manner described above, remove remaining bearings one at a time for inspection.

Inspection

(1) Wipe lower insert clean and inspect for abnormal wear pattern and for metal or other foreign material imbedded in lining. Normal main bearing wear pattern is illustrated in figure 1B-94.

NOTE: *If the crankshaft journal is scored, remove the engine for crankshaft repair.*

(2) Inspect back of insert for fractures, scrapings or irregular wear pattern.

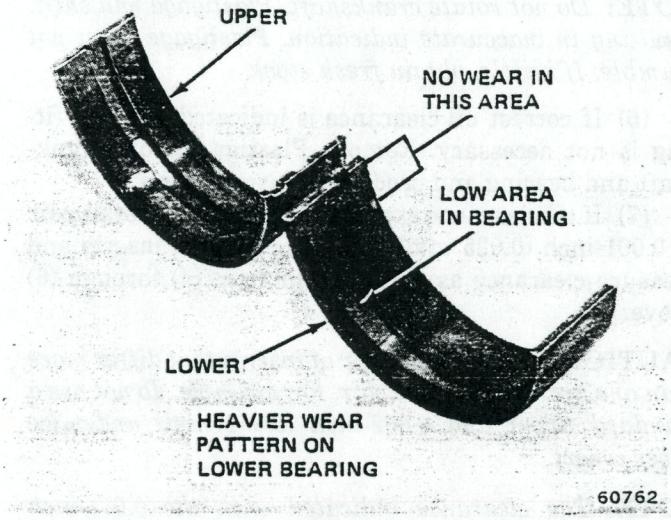

Fig. 1B-94 Normal Main Bearing Wear Pattern

(3) Inspect locking tabs for damage.

(4) Replace bearing inserts that are damaged or worn.

Measuring Bearing Clearance with Plastigage (Crankshaft Installed)

NOTE: *Measure clearance of one bearing at a time. All other bearings must remain tightened.*

(1) Remove main bearing cap and insert.

(2) Clean insert and exposed portion of crankshaft journal.

(3) Place strip of Plastigage across full width of bearing insert.

(4) Install bearing cap and tighten bolts with 80 foot-pounds (108 N•m) torque.

(5) Remove bearing cap and determine amount of clearance by measuring width of compressed Plastigage with scale on Plastigage envelope (fig. 1B-95). Correct clearance is 0.001 to 0.003 inch (0.025 to 0.076 mm) . The Plastigage should maintain same size across entire width of insert. If size varies, it may indicate tapered journal or foreign material trapped behind insert.

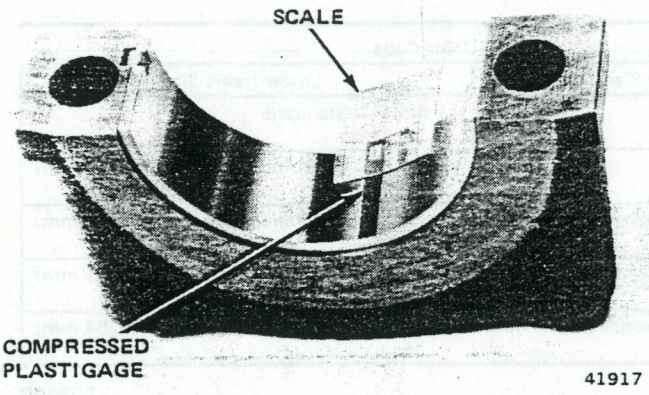

Fig. 1B-95 Measuring Main Bearing Clearance with Plastigage

NOTE: *Do not rotate crankshaft. Plastigage will shift, resulting in inaccurate indication. Plastigage must not crumble. If brittle, obtain fresh stock.*

(6) If correct oil clearance is indicated, bearing fitting is not necessary. Remove Plastigage from crankshaft and bearing and proceed to Installation.

(7) If oil clearance exceeds specification, install pair of 0.001-inch (0.025 mm) undersize bearing inserts and measure clearance as described in steps (4) through (6) above.

CAUTION: *Never use a pair of inserts that differ more than one bearing size as a pair. For example, do not use a standard upper and 0.002-inch (0.051 mm) undersize lower insert.*

NOTE: *The clearance indicated with the 0.001-inch (0.025 mm) undersize inserts installed will determine if the pair of 0.001-inch (0.025 mm) undersize inserts or some other combination will provide the correct clearance. For example, if the clearance was 0.0035 inch (0.089 mm) originally, a pair of 0.001-inch (0.025 mm) undersize inserts would reduce the clearance by 0.001 inch (0.025 mm). Oil clearance would be 0.0025 inch (0.064 mm) and within specification. A 0.002-inch (0.051 mm) undersize insert and a 0.001-inch (0.025 mm) undersize insert would reduce this clearance an additional 0.0005 inch (0.013 mm) and the oil clearance would be 0.002 inch (0.051 mm).*

(8) If oil clearance exceeds specification using 0.002-inch (0.051 mm) undersize bearing inserts, measure crankshaft journal with micrometer. If journal size is correct, crankshaft bore in cylinder block may be misaligned, which requires cylinder block replacement or machining to true bore. If journal size is less than 2.4981 inch (63.4517 mm), replace crankshaft or grind to accept suitable undersize inserts.

Measuring Main Bearing Journal with Micrometer (Crankshaft Removed)

(1) Clean main bearing journal.

(2) Measure maximum diameter of journal with micrometer. Measure at two locations 90 degrees apart at each end of journal.

(3) Compare measurements obtained with journal diameters listed in Main Bearing Fitting Chart and select inserts required to obtain specified bearing clearance.

Installation

(1) Lubricate bearing surface of each insert with clean engine oil.

(2) Loosen all main bearing caps and install main bearing upper insert(s).

(3) Install lower insert(s) and main bearing caps. Tighten bolts with 40 foot-pounds (54 N•m) torque. Then tighten with 60 foot-pounds (81 N•m) torque. Finally, tighten with 80 foot-pounds (108 N•m) torque. Rotate crankshaft after tightening each main bearing cap to ensure it rotates freely.

NOTE: *When installing a crankshaft kit (crankshaft plus bearing inserts), measure each bearing with Plastigage to determine if fit is correct.*

(4) Install oil pan, using replacement gaskets and seals. Tighten drain plug.

(5) Fill crankcase with clean lube oil to specified dipstick level.

Rear Main Bearing Oil Seal

The rear main bearing crankshaft oil seal consists of two pieces of neoprene with a single lip that effectively seals the rear of the crankshaft. To ensure leak-free operation, replace the upper and lower seal halves in pairs.

Removal

(1) Drain engine oil.

(2) Remove oil pan.

(3) Remove rear main bearing cap and discard lower seal.

(4) Loosen all remaining main bearing caps.

(5) Use brass drift and hammer to tap upper seal until seal protrudes enough to permit pulling it out completely.

(6) Remove oil pan front and rear neoprene oil seals and oil pan side gaskets.

(7) Clean gasket surfaces of oil pan and engine block. Remove all sludge and residue from oil pan sump.

(8) Clean main bearing cap thoroughly to remove all sealer.

Installation

(1) Wipe seal surface of crankshaft clean and lightly coat with engine oil.

(2) Coat lip of seal with engine oil.

(3) Install upper seal into engine block.

NOTE: *Lip of seal must face toward front of engine.*

(4) Coat both sides of lower seal end tabs with RTV silicone (Jeep Gasket-in-a-Tube, or equivalent). Use care to prevent applying sealer to lip of seal.

(5) Coat outer curved surface of lower seal with soap and lip of seal with engine oil.

(6) Install seal into cap recess and seat it firmly.

(7) Coat both chamfered edges of rear main bearing cap with RTV silicone (fig. 1B-96).

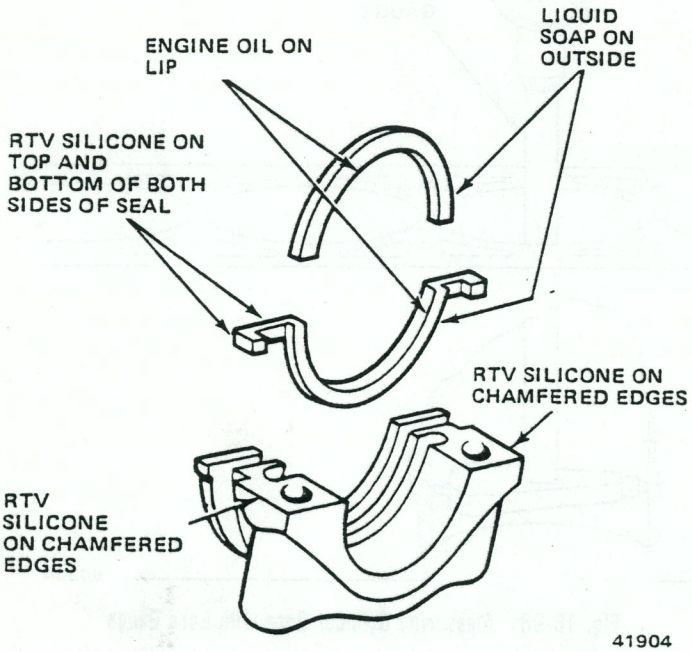

Fig. 1B-96 Rear Main Oil Seal and Cap Installation

CAUTION: *Do not apply sealer to cylinder block mating surfaces of rear main bearing cap because bearing clearance would be affected.*

(8) Install rear main bearing cap.

(9) Tighten all main bearing bolts in steps with 40, 60 and 80 foot-pounds (54, 81 and 108 N•m) torque.

(10) Install oil pan using replacement gaskets and seals. Tighten drain plug.

(11) Fill crankcase with clean oil to specified dipstick level.

Vibration Damper and Pulley

The vibration damper is balanced independently and then rebalanced as part of the complete crankshaft assembly.

Do not attempt to duplicate the vibration damper balance holes when installing a service replacement. The vibration damper is not repairable and is serviced only as a complete assembly.

Removal

(1) Remove drive belt(s).

(2) Remove three retaining bolts and separate vibration damper pulley from vibration damper.

(3) Remove vibration damper retaining screw and washer.

(4) Use Vibration Damper Remover Tool J-21791 to remove damper from crankshaft (fig. 1B-97).

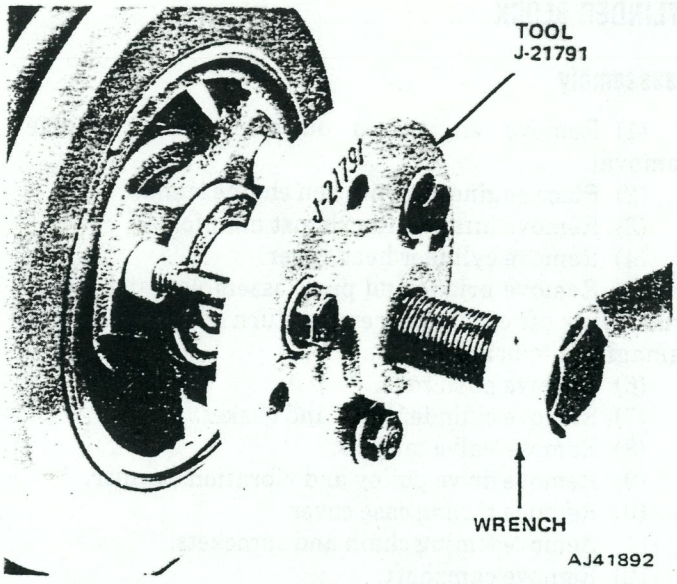

Fig. 1B-97 Vibration Damper Removal

Installation

(1) Align key way of vibration damper with crankshaft key and tap damper onto crankshaft.

(2) Install vibration damper retaining screw and washer. Tighten screw with 80 foot-pounds (108 N•m) torque.

(3) Install damper pulley with retaining bolts. Tighten bolts with 20 foot-pounds (27 N•m) torque.

(4) Install drive belt(s) and tighten to specified tension. Refer to Chapter 1C—Cooling System.

Flywheel/Drive Plate and Ring Gear Assembly

The ring gear can be replaced only for vehicles equipped with manual transmission. The ring gear is welded to and balanced as part of the converter drive plate on vehicles with automatic transmissions. The entire drive plate and ring gear assembly must be replaced on automatic transmission equipped vehicles.

Ring Gear Replacement (Manual Transmission)

(1) Position flywheel on arbor press with steel blocks equally spaced around perimeter and under ring gear.

(2) Press flywheel through ring gear.

NOTE: *Ring gear can also be removed by breaking with chisel.*

(3) Apply heat to expand inside diameter of replacement ring gear.

(4) Press flywheel into replacement ring gear.

NOTE: *On manual transmission equipped cars, the flywheel is balanced as an individual component and also as part of the crankshaft assembly. Do not attempt to duplicate original flywheel balance holes when installing a service replacement. Service flywheels are balanced during manufacture.*

CYLINDER BLOCK

Disassembly

(1) Remove engine as outlined within Engine Removal.
(2) Place engine assembly on engine stand.
(3) Remove intake and exhaust manifolds.
(4) Remove cylinder head cover.
(5) Remove bridge and pivot assemblies and rocker arms. Back off each capscrew one turn at a time to avoid damaging the bridge.
(6) Remove push rods.
(7) Remove cylinder head and gasket.
(8) Remove valve tappets.
(9) Remove drive pulley and vibration damper.
(10) Remove timing case cover.
(11) Remove timing chain and sprockets.
(12) Remove camshaft.
(13) Position pistons, one at a time, near bottom of stroke and use a ridge reamer to remove any ridge from top end of cylinder walls.
(14) Remove oil pan and gaskets.
(15) Remove oil pump.
(16) Remove connecting rod bearing caps and inserts and retain in same order as removed.

NOTE: *Connecting rods and caps are stamped with the number of the corresponding cylinder.*

(17) Remove piston and connecting rod assemblies through top of cylinder bores.

NOTE: *Ensure that the connecting rod bolts do not scratch the connecting rod journals or cylinder walls. Short pieces of rubber hose slipped over the rod bolts will prevent damage to the cylinder bores and crankshaft.*

(18) Remove main bearing caps and inserts.
(19) Remove crankshaft.

Cylinder Bore Reconditioning

Measuring Cylinder Bore

Use a bore gauge to measure the cylinder bore (fig. 1B-98). If a bore gauge is not available, use an inside micrometer.
(1) Measure cylinder bore crosswise to block near top of bore. Repeat measurement at bottom of bore.
(2) Determine taper by subtracting smaller dimension from larger dimension.
(3) Turn measuring device 120° and repeat step (1). Then turn another 120° and repeat measurements.
(4) Determine out-of-round by comparing difference between measurements taken 120° apart.
If the cylinder taper does not exceed 0.005 inch (0.013 mm) and the out-of-round does not exceed 0.003 inch (0.076 mm), the cylinder bore may be trued by honing. If

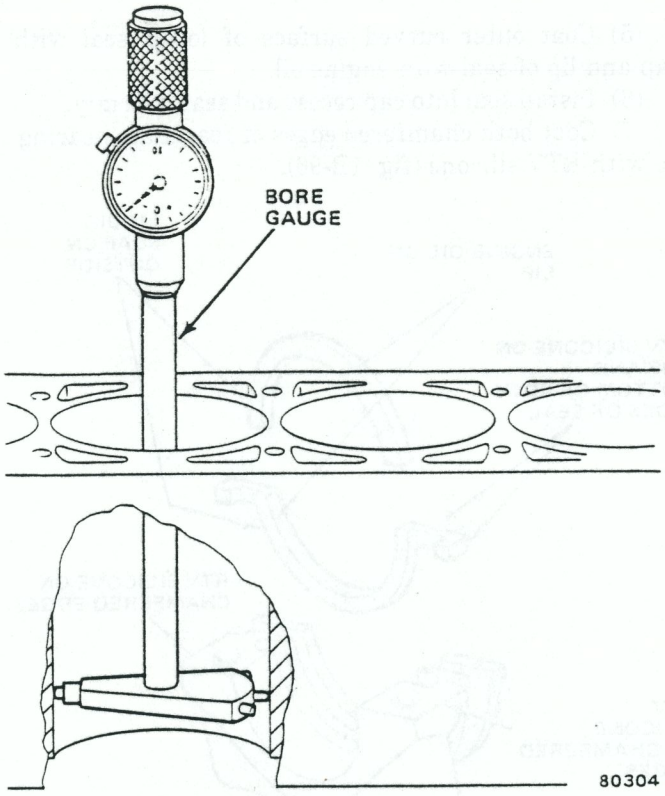

Fig. 1B-98 Measuring Cylinder Bore with Bore Gauge

the cylinder taper or out-of-round condition exceeds these limits, bore and then hone the cylinder for an oversize piston.

Resurfacing Cylinder Bore

CAUTION: *Do not use rigid type hones to remove cylinder wall glaze. A slight amount of taper always exists in cylinder walls after an engine has been in service for a period of time.*

(1) Use expanding hone to true cylinder bore and to remove glaze for faster ring seating. Move hone up and down at sufficient speed to produce uniform 60° angle crosshatch pattern on cylinder walls. Do not use more than ten strokes per cylinder (a stroke is one down and one up movement).

CAUTION: *Protect engine bearings and lubrication system from abrasives.*

(2) Scrub cylinder bores clean with solution of hot water and detergent.
(3) Immediately apply light engine oil to cylinder walls. Wipe with clean, lint-free cloth.

Assembly

(1) Install upper main bearing inserts in cylinder block.
(2) Install crankshaft.
(3) Install lower main bearing inserts and caps. Apply oil to insert before installing. Tighten bolts in steps

of 40, 60 and 80 foot-pounds torque (54, 81, 108 N•m). Plastigage all inserts if replacement inserts or crankshaft have been installed.

(4) Clean cylinder bores thorougly. Apply light film of clean engine oil to bores with clean, lint-free cloth.

(5) Install piston rings on piston. Refer to Piston Rings for procedure.

(6) Lubricate piston and rings with clean engine oil.

(7) Use Piston Ring Compressor Tool J-5601 to install connecting rod and piston assemblies through top of cylinder bores (fig. 1B-82).

NOTE: *Ensure that connecting rod bolts do not scratch the connecting rod journals or cylinder walls. Short lengths of rubber hose slipped over the connecting rod bolts will provide protection during installation.*

(8) Apply oil to inserts. Install connecting rod bearing inserts and caps in same location as removed. Tighten retaining nuts with 33 foot-pounds (45 N•m) torque.

NOTE: *Oil squirt holes in connecting rods must face camshaft.*

(9) Install oil pump with replacement pick-up tube and screen assembly.

(10) Install oil pan using replacement gaskets and seals. Tighten drain plug.

(11) Install camshaft and timing chain—sprocket assembly.

(12) Install timing case cover.

(13) Install vibration damper and drive pulley.

(14) Install valve tappets.

(15) Install gasket and cylinder head.

(16) Install push rods.

(17) Install rocker arms and bridge and pivot assemblies. Loosely install capscrews at each bridge, then tighten capscrews alternately, one turn at a time, to avoid damaging or breaking bridge.

(18) Install cylinder head cover, using silicone (RTV) rubber sealant.

(19) Install intake and exhaust manifolds.

(20) Remove engine from engine stand.

(21) Install engine assembly as outlined within Engine Installation.

SPECIFICATIONS

Six-Cylinder Engine Specifications

	(USA) Inches Unless Otherwise Specified	(METRIC) Millimeters Unless Otherwise Specified
Type	In Line, OHV, Six-Cylinder	
Bore	3.75	95.25
Stroke		
258	3.895	98.93
Displacement		
258	258 cubic inches	4.2 liters
Compression Ratio	8.0:1	
Compression Pressure		
258	120-150 psi	827-1034 kPa
Maximum Variation Between Cylinders	30 psi	206 kPa
Firing Order	1-5-3-6-2-4	
Taxable Horsepower	33.75 Bhp	25.2 kW
Fuel	unleaded	
Camshaft		
Fuel Pump Eccentric Diameter	1.615-1.625	41.02-41.28
Tappet Clearance	Zero Lash (Hydraulic tappets)	
End Play	Zero (engine operating)	
Bearing Clearance	0.001-0.003	0.025-0.076
Bearing Journal Diameter		
No. 1	2.029-2.030	51.54-51.56
No. 2	2.019-2.020	51.28-51.31
No. 3	2.009-2.010	51.03-51.05
No. 4	1.999-2.000	50.78-50.80
Base Circle Runout	0.001 (max)	0.03 (max)
Cam Lobe Lift	0.253	6.43
Intake Valve Timing		
Opens	9° BTDC	
Closes	73° ABDC	
Exhaust Valve Timing		
Opens	57° BBDC	
Closes	25° ATDC	
Valve Overlap	34°	
Intake Duration	262°	
Exhaust Duration	262°	

	(USA) Inches Unless Otherwise Specified	(METRIC) Millimeters Unless Otherwise Specified
Connecting Rods		
Total Weight (less bearings)		
258	695-703 grams	
Total Length (center-to-center)		
258	5.873-5.877	149.17-140.28
Connecting Rod Bore (less bearings)	2.2085-2.2080	56.09-56.08
Bearing Clearance	0.001-0.0025 (0.0015-0.002 preferred)	0.03-0.06 (0.044 preferred)
Side Clearance	.010-.019	.25-.48
Maximum Twist	0.001 per inch	0.025 per 25.4 mm
Maximum Bend	0.0005 per inch	0.0127 per 25.4 mm
Crankshaft		
End Play	0.0015-0.0065	0.038-0.165
Main Bearing Journal Diameter	2.4986-2.5001	63.464-63.502
Main Bearing Journal Width		
No. 1	1.086-1.098	27.58-27.89
No. 3	1.271-1.273	32.28-32.33
No. 2-4-5-6-7	1.182-1.188	30.02-30.18
Main Bearing Clearance		
No. 1 Main	.0005 to .0026 (.0015 preferred)	.013 to .066 (.04 preferred)
No. 2, 3, 4, 5, & 6 Mains	.0005 to .003 (.0017 preferred)	.013 to .076 (.045 preferred)
No. 7 Main	.0011 to .0035 (.0023 preferred)	.028 to .089 (.058 preferred)
Connecting Rod Journal Diameter	2.0934-2.0955	53.17-53.23
Connecting Rod Journal Width	1.070-1.076	27.18-27.33

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Six-Cylinder Engine Specifications (Continued)

	(USA) Inches Unless Otherwise Specified	(METRIC) Millimeters Unless Otherwise Specified
Maximum Out-of-Round (All Journals)	0.0005	0.013
Maximum Taper (All Journals)	0.0005	0.013
Cylinder Block		
Deck Height	9.487-9.493	240.97-241.12
Deck Clearance	0.0148 (below block)	0.376 (below block)
Cylinder Bore (standard)	3.7501-3.7533	95.253-95.334
Maximum Cylinder Taper	0.005	0.13
Maximum Cylinder (Out-of-Round)	0.003	0.08
Tappet Bore Diameter	0.9055-0.9065	23.0-23.025
Cylinder Block Flatness	0.001/1-0.002/6 (max)	0.03/25-0.05/152 0.20 (max)
Cylinder Head		
Combustion Chamber Volume	67.84-70.84cc	
Valve Arrangement	EI-IE-IE-EI-EI-IE	
Valve Guide ID (Integral)	0.3735-0.3745	9.487-9.512
Valve Stem-to-Guide Clearance	0.001-0.003	0.03-0.08
Intake Valve Seat Angle	30°	
Exhaust Valve Seat Angle	44.5°	
Valve Seat Width	0.040-0.060	1.02-1.52
Valve Seat Runout	0.0025	0.064
Cylinder Head Flatness	0.001/1-0.002/6 0.008 (max)	0.03/25-0.05/152 0.20 (max)
Lubrication System		
Engine Oil Capacity	4 quarts (Add 1 quart with filter change)	3.8 liters (Add 0.9 liter with filter change)
Normal Operating Pressure	13psi at 600 rpm; 37-75 psi (max) at 1600+ rpm	89.6 kPa at 600 rpm; 255.1-517.1 kPa (max) at 1600+ rpm
Oil Pressure Relief	75 psi (max)	517.1 kPa (max)
Gear-to-Body Clearance Radial	.002-.004 (.002 preferred)	.051-.102 (.051 preferred)
Gear End Clearance, Plastigage	0.002-0.006 (0.002 preferred)	0.051-0.152 (0.0508 preferred)
Gear End Clearance, Feeler Gauge	0.004-0.008 (0.007 preferred)	0.1016-0.2032 (0.1778 preferred)
Pistons		
Weight (less pin)	498-502 grams	
Piston Pin Bore Centerline-to-Piston Top	1.651-1.655	41.94-42.04
Piston-to-Bore Clearance	0.0009-0.0017 (0.0012-0.0013 preferred)	0.023-0.043 (0.030-0.033 preferred)
Piston Ring Gap Clearance — Compression (both)	0.010-0.020	0.25-0.51
Piston Ring Gap Clearance — Oil Control Steel Rails	0.010-0.025	0.25-0.64
Piston Ring Side Clearance		
No. 1 Compression	0.0017-.0032 (0.0017 preferred)	0.043-0.081 (0.043 preferred)
No. 2 Compression	0.0017-.0032 (0.0017 preferred)	0.043-0.081 (0.043 preferred)
Oil Control	0.001-0.008 (0.003 preferred)	0.03-0.20 (0.08 preferred)
Piston Ring Groove Height		
Compression (both)	0.0795-0.0805	2.019-2.045
Oil Control	0.188-0.1895	4.78-4.80
Piston Ring Groove Diameter		
No. 1 and No. 2	3.324-3.329	84.43-84.56
Oil Control	3.329-3.339	84.56-84.81
Piston Pin Bore Diameter	0.9308-0.9313	23.642-23.655
Piston Pin Diameter	0.9304-0.9309	23.632-23.645
Piston Pin-to-Clearance	0.0003-0.0005 loose (0.0005 preferred)	0.008-0.013 loose (0.013 preferred)
Piston Pin-to-Connecting Rod	2000 lbf press-fit	8.900 kN press-fit
Rocker Arms, Push Rods and Tappets		
Rocker Arm Ratio	1.6:1	
Push Rod Length	9.640-9.660	244.856-245.364
Push Rod Diameter	.312-.315	7.92-8.00
Hydraulic Tappet Diameter	0.904-0.9045	22.96-22.97
Tappet-to-Bore Clearance	0.001-0.0025	0.03-0.05
Valves		
Valve Length (Tip-to-Gauge Dim. Line)	4.7895-4.8045	121.653-122.034
Valve Stem Diameter	0.3715-0.3725	9.436-9.462
Stem-to-Guide Clearance	0.001-0.003	0.03-0.08
Intake Valve Head Diameter	1.782-1.792	45.26-45.52
Intake Valve Face Angle	29°	
Exhaust Valve Head Diameter	1.401-1.411	35.59-35.84
Exhaust Valve Face Angle	44°	
Maximum Allowable Removed for Tip Refinishing	0.010	0.25
Valve Springs, Exhaust		
Valve Open	80-88 at 1.625	
Valve Closed	210-226 at 1.188	
I.D.	1.000-1.020 in.	
Valve Springs, Intake		
Free Length	1.99 approx.	50.55 approx.
Spring Tension		
Valve Closed	64-72 lbf at 1.786	285-320 N at 45.24
Valve Open	188-202 lbf at 1.411	836-898 N at 35.84
Inside Diameter	0.948-0.968	24.08-24.59

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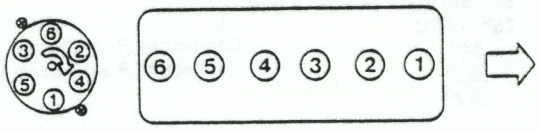
Six-Cylinder Engine Firing Order



Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft-lbs)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Air Injection Tube-to-Manifold	20	15-20	27	20-27
Air Pump Adjusting Strap-to-Pump	20	15-22	27	20-30
Air Pump Brackets-to-Engine (A/C Compressor or Pedestals)	25	18-28	34	24-38
Air Pump-to-Bracket	20	15-22	27	20-30
Alternator Adjusting Bolt	18	15-20	24	20-27
Alternator Mounting Bracket-to-Engine	28	23-30	38	31-41
Alternator Pivot Bolt or Nut	28	20-35	38	27-47
Alternator Pivot Mounting Bolt-to-Head	33	30-35	45	41-47
Block Heater Nut	20 in-lbs	17-25 in-lbs	2	2-3
Camshaft Sprocket Screw	50	45-55	68	61-75
Carburetor Hold-Down Nuts	14	12-20	19	16-27
Clutch Housing Spacer to Block Screws	12	9-15	16	12-20
Clutch Housing-to-Block Screws (bottom)	43	37-47	58	50-64
Clutch Housing-to-Block Screws (top)	27	22-30	37	30-41
Coil Bracket-to-Cylinder Head	14	10-18	19	14-24
Connecting Rod Bolt Nuts	33	30-35	45	41-47
Crankshaft Pulley-to-Damper Bolts	20	15-25	27	20-34
Cylinder Head Capscrews	85	80-90	115	108-122
Cylinder Head Cover Nuts	28 in-lbs	25-31 in-lbs	32	2.8-3.5
Distributor Clamp Bracket Screw	13	10-18	18	14-24
EGR Valve	13	9-18	18	12-24
Exhaust Manifold Bolts	23	18-28	31	24-38
Exhaust Pipe-to-Manifold	20	15-25	27	20-34
Fan and Hub Assembly Bolts	18	12-25	24	16-34
Drive Plate-to-Converter Screw	22	20-25	30	27-34
EGR Tube Nuts	30	25-35	41	34-47
Flywheel or Drive Plate-to-Crankshaft	105	95-115	142	129-156
Front Support Bracket-to-Block Screw	35	25-40	47	34-54
Front Support Cushion-to-Bracket	33	27-38	45	36-52
Front Support Cushion-to-Bracket-to-Frame	37	30-45	50	41-61
Fuel Pump Screws	16	13-19	22	18-26
Idler Arm Bracket-to-Sill	50	35-60	68	47-81
Idler Pulley Bracket-to-Front Cover Nut	7	4-9	9	5-12
Idler Pulley Bearing Shaft-to-Bracket Nut	33	28-38	45	38-52
Intake Manifold Coolant Fittings	20	15-25	27	20-34
Intake Manifold Heater Screws	7	5-9	9	7-12
Intake Manifold Screws	23	18-28	31	24-38
Main Bearing Capscrews	80	75-85	108	101-115
Oil Filter Adapter	48	42-55	65	57-75
Oil Pan Drain Plug	30	25-35	41	34-47
Oil Pan Screws—1/4 inch—20	7	5-9	9	7-12
Oil Pan Screws—5/16 inch—18	11	9-13	15	12-18
Oil Pump Attaching Screws (Long)	17	12-20	23	16-27
Oil Pump Attaching Screws (Short)	10	8-13	14	11-18
Oil Pump Cover Screws	70 in-lbs	60-80 in-lbs	8	7-9
Oxygen Sensor	35	32-38	48	43-52
Power Steering Pump Adapter Screw	23	18-28	31	24-38
Power Steering Pump Bracket Screw	43	37-47	58	50-64
Power Steering Pump Mounting Screw	28	25-35	38	34-47
Power Steering Pump Pressure Line Nut	38	30-45	52	41-61
Power Steering Pump Pulley Nut	58	40-65	79	54-88
Rear Crossmember-to-Side Sill Nut	30	20-35	41	27-47
Rear Support Bracket-to-Transmission	33	27-38	45	37-52
Rear Support Cushion-to-Bracket	48	40-55	65	54-75
Rear Support Cushion-to-Crossmember	18	12-25	24	16-34
Rocker Arm Assembly-to-Cylinder Head	19	16-26	26	22-35
Spark Plug	11	7-15	15	10-20
Starter to Converter Housing Bolt	18	13-25	24	18-34
Thermostat Housing Screw	13	10-18	18	14-24
Timing Case Cover-to-Block Screws	5	4-8	7	5-11
Timing Case Cover-to-Block Studs	16	13-19	22	18-26
Vibration Damper Screw, Lubricated	80	70-90	108	95-122
Water Pump Screws	13	9-18	18	12-24

All Torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

Refer to the Standard Torque Specifications and Capscrew Markings Chart in Chapter A of this manual for any torque specifications not listed above.

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EIGHT-CYLINDER ENGINE

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GENERAL

The 304 (5 liters) and 360 (6 liters) CID engines are 90-degree V-8 cylinder designs incorporating overhead valves (figs. 1B-99 and 1B-100). The cylinders are numbered from front to rear: 1-3-5-7 on the left bank and 2-4-6-8 on the right bank. The cylinder firing order is 1-8-4-3-6-5-7-2.

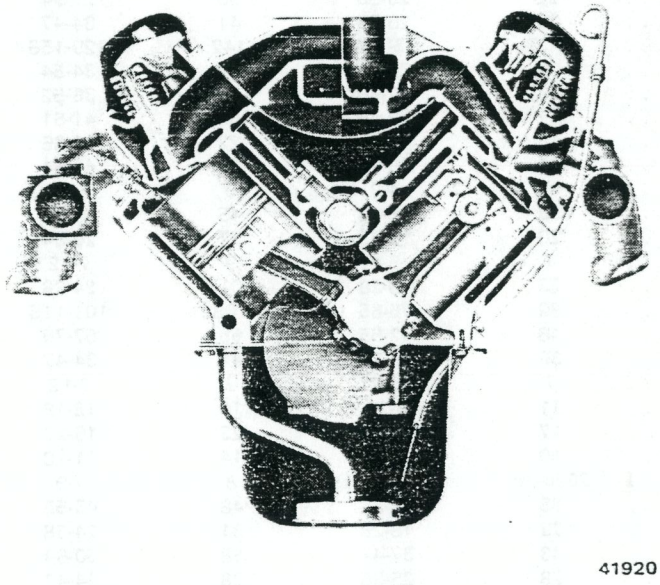

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Fig. 1B-99 Sectional View of Eight-Cylinder Engine Assembly

The crankshaft, supported by five two-piece main bearing inserts, rotates in a counterclockwise direction as viewed from the rear. The camshaft is supported by five one-piece, line-bored bearings.

Bridge and pivot assemblies control movement of intake and exhaust rocker arms and are paired by cylinder.

Because of the similarity of the two engines, service procedures have been consolidated and typical illustrations are used to represent both engines.

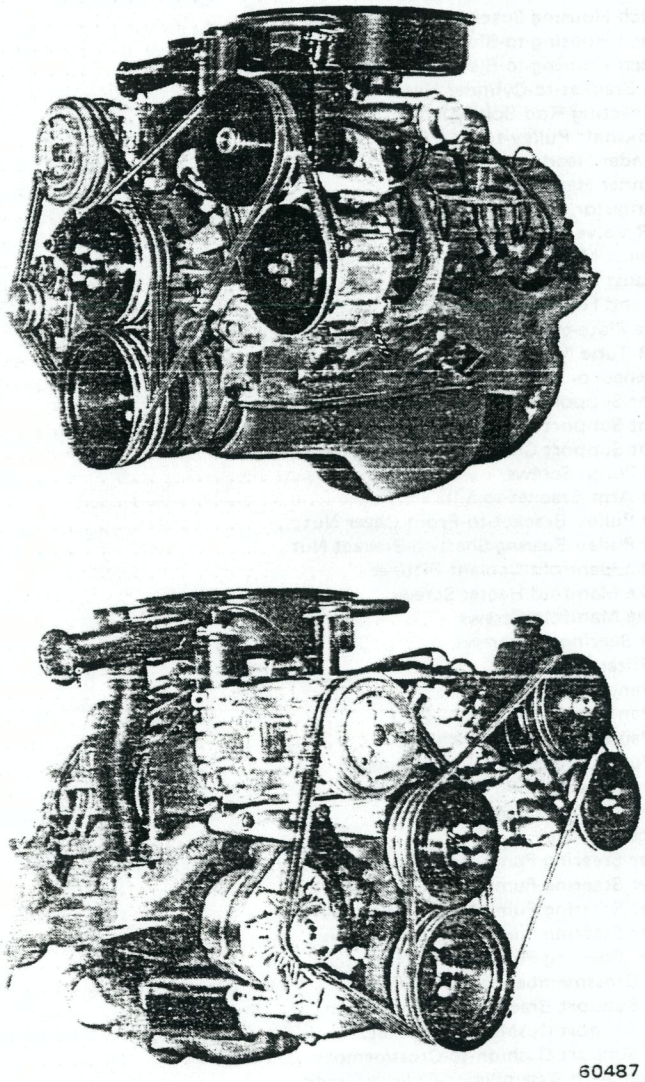

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Fig. 1B-100 Typical Eight-Cylinder Engine Assembly

Engine Identification

The cubic-inch displacement numbers are cast into both sides of the cylinder block. These numbers are located between the engine mounting bracket bosses.

Engine Type and Build Date Code

The engine Type and Build Date Code is located on a plate attached to the right bank cylinder head cover (fig. 1B-101).

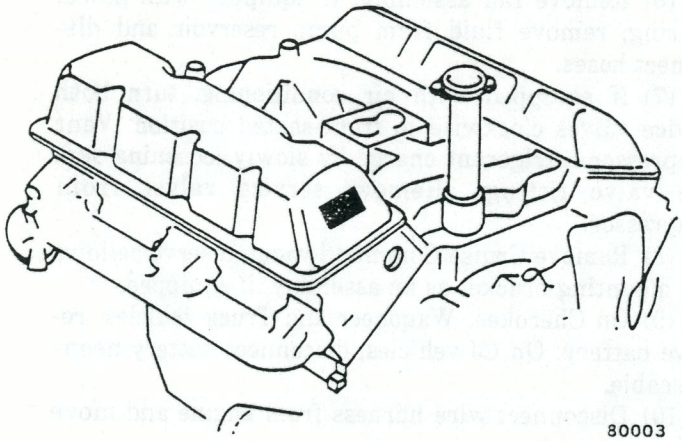

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Fig. 1B-101 Engine Type and Build Date Code Location

The code numbers identify the year, month, and day that the engine was built. The code letter identifies the cubic inch displacement, number of carburetor venturi and compression ratio.

The example code identifies a 304 CID (5 liters) engine with 2V carburetor and 8.4:1 compression ratio built on October 15, 1980.

Engine Type and Build Date Code

Letter Code	CID	Carburetor	Compression Ratio
H	304	2V	8.4:1
N	360	2V	8.25:1

1st Character (Year)	2nd and 3rd Characters (Month)	4th Character (Engine Type)	5th and 6th Characters (Day)
5-1981 4-1980	01 - 12	H or N	01 - 31

EXAMPLE: 4 10 H 15

60265

Oversize or Undersize Components

It is sometimes necessary to machine all cylinder bores 0.010-inch (0.254 mm) oversize, all crankshaft main bearing journals 0.010-inch (0.254 mm) undersize, all connecting rod journals 0.010-inch (0.254 mm) undersize, or all camshaft bearing bores 0.010-inch (0.254 mm) oversize. If so, the engine has a single or double letter code stamped adjacent to the Engine Type and Build Date Code on the plate attached to the right bank cylinder head cover. The code is explained in the Oversize or Undersize Components Code chart.

Oversize or Undersize Components Code

Single Letter B	cylinder bore 0.010-inch (0.254mm) oversize
Single Letter M	main bearings 0.010-inch (0.254mm) undersize
Single Letter F	connecting rod bearings 0.010-inch (0.254mm) undersize
Double Letters PM	main and connecting rod bearings 0.010-inch (0.254mm) undersize
Single Letter C	camshaft bearing bores 0.010-inch (0.254mm) oversize

60258

SHORT ENGINE ASSEMBLY (SHORT BLOCK)

A service replacement short engine assembly (short block) may be installed whenever the original engine block is damaged beyond feasible repair. A short engine assembly consists of an engine block, piston and connecting rod assemblies, crankshaft, camshaft, timing sprockets and chain. When installing a short engine assembly, always install a replacement oil pump pickup tube and screen assembly.

NOTE: *Short engine assemblies include a replacement engine type and build date code plate. Remove the original plate and attach the replacement plate to right cylinder head cover.*

Installation includes transfer of required component parts from the worn or damaged original engine. Follow the appropriate procedures for cleaning, inspection and tightening as outlined in this section.

ENGINE MOUNTING

Resilient rubber mounting cushions support the engine and transmission at three points. A cushion is located at each side on the centerline of the engine. The rear is supported by a cushion between the transmission extension housing and the rear support crossmember (fig. 1B-102).

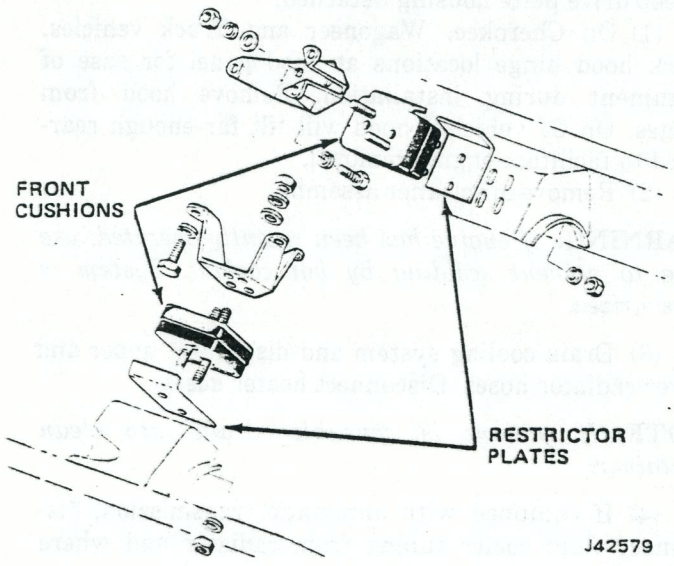

Fig. 1B-102 Typical Engine Mounting

Removal or replacement of any cushion may be accomplished by supporting the weight of the engine or transmission in the area of the cushion.

ENGINE HOLDING FIXTURE

If necessary to remove the front engine mounts to perform service such as oil pan removal, fabricate an engine holding fixture such as that illustrated in figure 1B-103.

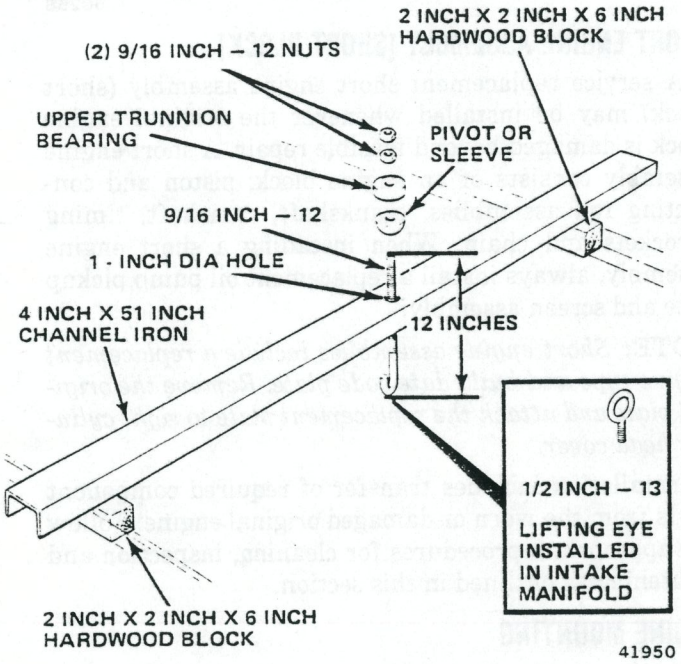

Fig. 1B-103 Engine Holding Fixture

ENGINE REMOVAL

The engine is removed with the transmission and flywheel/drive plate housing detached.

(1) On Cherokee, Wagoneer and Truck vehicles, mark hood hinge locations at hood panel for ease of alignment during installation. Remove hood from hinges. On CJ vehicles, hood will tilt far enough rearward to facilitate engine removal.

(2) Remove air cleaner assembly.

WARNING: *If engine has been recently operated, use care to prevent scalding by hot coolant. System is pressurized.*

(3) Drain cooling system and disconnect upper and lower radiator hoses. Disconnect heater hoses.

NOTE: *If coolant is reusable, drain into clean container.*

(4) If equipped with automatic transmission, disconnect fluid cooler tubing from radiator and where attached to engine.

NOTE: *If the vehicle is equipped with a radiator shroud, separate the shroud from the radiator to facilitate removal and installation of the radiator and fan assembly.*

(5) Remove radiator.

(6) Remove fan assembly. If equipped with power steering, remove fluid from pump reservoir and disconnect hoses.

(7) If equipped with air conditioning, turn both service valves clockwise to front-seated position. Vent compressor refrigerant charge by slowly loosening service valve fittings. Remove service valves from compressor.

(8) Remove Cruise Command vacuum servo bellows and mounting bracket as an assembly, if equipped.

(9) On Cherokee, Wagoneer and Truck vehicles, remove battery. On CJ vehicles, disconnect battery negative cable.

(10) Disconnect wire harness from engine and move aside.

(11) Disconnect following hoses, as applicable:

(a) Fuel supply and return hoses at chassis tubing.

(b) Vacuum hose at power brake unit.

(c) Vacuum hose for heater damper doors at intake manifold.

(12) If equipped with automatic transmission, disconnect transmission filler tube bracket from right cylinder head. Do not remove filler tube from transmission.

(13) Remove both engine front support cushion-to-frame retaining nuts.

(14) Support weight of engine with lifting device.

(15) On CJ vehicles, remove left front support cushion and bracket from cylinder block.

(16) On CJ vehicles equipped with manual transmission, remove transfer case shift lever boot, floormat (if equipped), and transmission access cover.

(17) On vehicles equipped with automatic transmission, remove upper screws securing drive plate housing to engine. If equipped with manual transmission, remove upper screws securing flywheel housing to engine.

(18) Disconnect exhaust pipe from exhaust manifolds and support bracket.

(19) Remove starter motor.

(20) Support transmission with floor jack.

(21) If equipped with automatic transmission:

(a) Remove drive plate housing inspection cover. Scribe mark to indicate assembled position of converter and drive plate and remove converter-to-drive plate bolts.

(b) Remove lower throttle valve and inner manual linkage support. Disconnect throttle valve rod at lower end of bellcrank.

(22) Remove remaining screws securing flywheel/drive plate housing to engine. If equipped with manual transmission, remove flywheel housing lower cover.

CAUTION: *If equipped with power brakes, avoid damaging the power unit while removing the engine.*

(23) Remove engine by lifting upward and forward.

ENGINE INSTALLATION

(1) Lower engine slowly into engine compartment and align with flywheel/drive plate housing. With manual transmissions, ensure clutch shaft is aligned properly with splines of clutch driven plate.

(2) Install flywheel/drive plate housing screws. Tighten screws with specified torque. Automatic transmission: 28 foot-pounds (38 N•m). Manual transmission: 27 foot-pounds (37 N•m).

(3) Remove floor jack used to support transmission.

(4) If equipped with automatic transmission, align scribe marks previously made on converter and drive plate, install converter-to-drive plate bolts and tighten with specified torque. Install throttle valve bellcrank and manual linkage support.

(5) Install inspection cover (automatic transmission) or flywheel housing lower cover (manual transmission).

(6) Install starter motor.

(7) On CJ vehicles, install left front support cushion and bracket on cylinder block. Tighten screws with 28 foot-pounds (38 N•m) torque.

(8) Lower engine onto supports. Remove lifting device.

(9) Install front support cushion retaining nuts. Tighten nuts with 33 foot-pounds (45 N•m) torque.

(10) Connect exhaust pipe to exhaust manifolds and support bracket.

(11) If equipped with automatic transmission, connect transmission filler tube bracket to right cylinder head.

(12) Install battery, if removed.

(13) Install Cruise Command vacuum servo bellows and mounting bracket, if removed.

(14) Connect all wires, tubing, linkage and hoses to engine.

(15) Connect receiver outlet to disconnect coupling. Connect condenser and evaporator lines to compressor.

CAUTION: *Both service valves must be open before the air conditioning system is operated.*

(16) Purge compressor of air.

(17) If equipped with power steering, connect hoses and fill pump reservoir to specified level.

(18) Install radiator fan assembly and tighten retaining screws with 18 foot-pounds (24 N•m) torque.

(19) Install radiator and connect upper and lower hoses. If equipped with automatic transmission, connect fluid cooler tubing.

(20) Fill cooling system to specified level.

(21) Install air cleaner assembly.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(22) Start engine. Inspect all connections for leaks. Stop engine.

(23) If removed, install and align hood assembly.

(24) If removed, install transmission access cover, floormat and transfer case shift lever boot.

VALVE TRAIN

General

All eight-cylinder engines have overhead valves operated by hydraulic tappets, push rods and rocker arms. A chain-driven camshaft is mounted in the cylinder block. The hydraulic valve tappets provide automatic valve lash adjustment.

Rocker Arm Assembly

The intake and exhaust rocker arms for each cylinder pivot on a bridge and pivot assembly that is secured to the cylinder head by two capscrews (fig. 1B-104). The bridge and pivot assembly maintains correct rocker arm-to-valve tip alignment. Each rocker arm is actuated

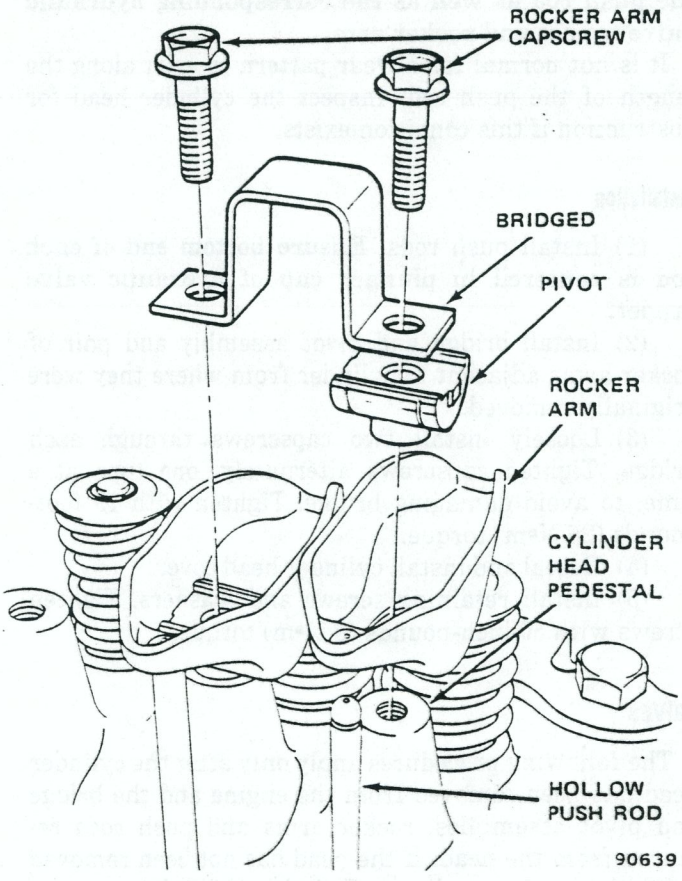

Fig. 1B-104 Rocker Arm Assembly

by a hollow steel push rod with a hardened steel ball at each end. The hollow push rods also route oil to the rocker arm assemblies.

Removal

(1) Remove cylinder head cover.
(2) Remove two capscrews at each bridge. Alternately loosen capscrews one turn at a time to avoid damaging bridge.
(3) Remove bridge and pivot assemblies and place on bench in same order as removed.
(4) Remove rocker arms and place on bench in same order as removed.
(5) Remove push rods and place on bench in same order as removed.

Cleaning and Inspection

Clean all parts with cleaning solvent. Use compressed air to clean out the oil passages in the rocker arms and push rods.

Inspect the pivot contact surface of each rocker arm and push rod. Replace parts that are scuffed, pitted or excessively worn. Inspect the valve stem contact surface of each rocker arm and replace if deeply pitted. Inspect each push rod end for scuffing or excessive wear. **If any push rod is excessively worn from lack of oil, replace the push rod as well as the corresponding hydraulic valve tappet and rocker arm.**

It is not normal for a wear pattern to exist along the length of the push rod. Inspect the cylinder head for obstruction if this condition exists.

Installation

(1) Install push rods. **Ensure bottom end of each rod is centered in plunger cap of hydraulic valve tappet.**
(2) Install bridge and pivot assembly and pair of rocker arms adjacent to cylinder from where they were originally removed.
(3) Loosely install two capscrews through each bridge. Tighten capscrews alternately, one turn at a time, to avoid damaging bridge. Tighten with 19 foot-pounds (26 N•m) torque.
(4) Reseal and install cylinder head cover.
(5) Install retaining screws and washers. Tighten screws with 50 inch-pounds (6 N•m) torque.

Valves

The following procedures apply only after the cylinder head has been removed from the engine and the bridge and pivot assemblies, rocker arms and push rods removed from the head. If the head has not been removed from the engine, refer to Cylinder Head for removal procedure.

Removal

(1) Compress each valve spring with C-clamp type spring compressor tool. Remove valve locks and retainers. Release compressor tool.
(2) Remove valve springs.
(3) Remove valve stem oil deflectors.
(4) Remove valves individually and place in rack in same order as installed in cylinder head.

Cleaning and Inspection

Remove all carbon deposits from the combustion chambers, valve ports, and valve stems and heads.

Remove all foreign material and gasket cement from the cylinder head gasket mating surface.

Inspect for cracks in the combustion chambers and valve ports and in the gasket surface area at each coolant passage.

Inspect for burned or cracked valve heads and scuffed valve stems. Replace any valve that is bent, warped or scuffed.

Valve Refacing

Use a valve refacing machine to reface intake and exhaust valves to specified angle. After refacing, at least 1/32-inch (0.787 mm) margin must remain. If not, replace the valve. Examples of correct and incorrect valve refacing are illustrated in figure 1B-105.

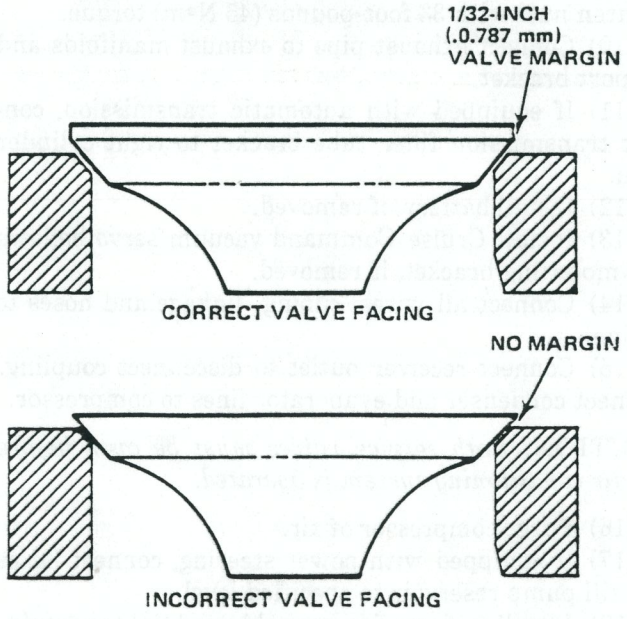

Fig. 1B-105 Valve Refacing

Resurface and rechamfer the valve stem tip when excessively worn. **Never remove more than 0.020 inch (0.508 mm).**

Valve Seat Refacing

Install a pilot of the correct size in the valve guide and reface the valve seat to the specified angle with a dressing stone in good condition. Remove only enough metal to provide a smooth finish. This is especially important on exhaust valve seats. The seat hardness varies in depth. Use tapered stones to obtain the specified seat widths when required. Maximum seat runout is 0.0025 inch (0.064 mm) (fig. 1B-106).

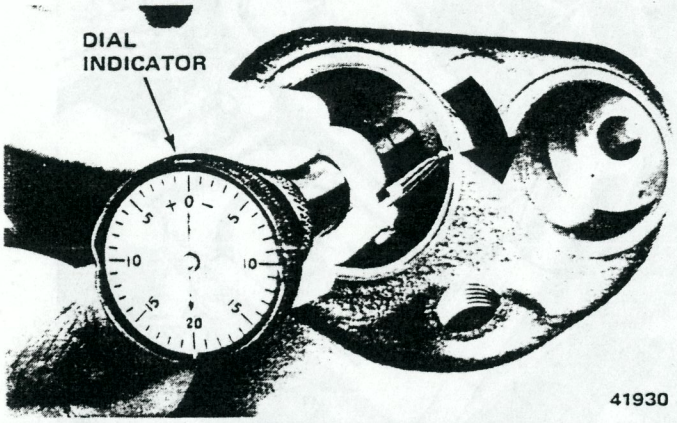

Fig. 1B-106 Valve Seat Runout Measurement

Valve Stem Oil Deflector Replacement

Nylon valve stem oil deflectors are installed on each valve stem to prevent lubrication oil from entering the combustion chamber through the valve guide bores. Replace oil deflectors whenever valve service is performed or if the deflectors have deteriorated.

Oil deflector replacement requires removal of valve springs. Refer to Valve Springs for procedure.

Valve Guides

The valve guides are an integral part of the cylinder head and are not replaceable. When the stem-to-guide clearance is excessive, ream the valve guide bores to the next larger valve stem size. Service valves are available with 0.003-inch (0.076 mm), 0.015-inch (0.127 mm) and 0.030-inch (0.760 mm) oversize stems.

Refer to the Valve Guide Reamer Size chart for listing of reamers.

Valve Guide Reamer Sizes

Reamer Tool Number	Size
J-6042-1	0.003-inch (0.076mm)
J-6042-5	0.015-inch (0.381mm)
J-6042-4	0.030-inch (0.762mm)

60268

NOTE: *Ream valve guide bores in steps. Start with the 0.003-inch (0.076 mm) reamer and progress to the size required.*

Valve Stem-to-Guide Clearance

Valve stem-to-guide clearance can be measured by either one of two methods:

Preferred Method

(1) Remove valve from head and clean valve guide bore with solvent and bristle brush.

(2) Insert telescoping gauge into valve guide bore approximately 3/8 inch (9.525 mm) from valve spring side of head (fig. 1B-107) with contacts crosswise to head. Measure telescoping gauge with micrometer.

(3) Repeat measurement with contacts lengthwise to cylinder head.

(4) Compare lengthwise and crosswise measurements to determine out-of-roundness. If measurements differ by more than 0.0025 inch (0.0635 mm), ream guide bore to accommodate oversize valve stem.

(5) Compare valve guide bore diameter measurement with diameter listed in Specifications. If measurement is larger by more than 0.003 inch (0.076 mm), ream guide bore to accommodate oversize valve stem.

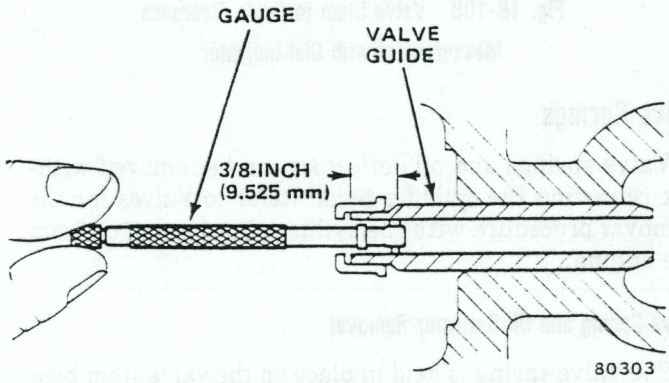

Fig. 1B-107 Measuring Valve Guide Bore with Telescoping Gauge

Alternate Method

Use a dial indicator to measure the lateral movement of the valve stem with the valve installed in its guide and barely off the valve seat (fig. 1B-108). Correct clearance is 0.001 to 0.003 inch (0.025 to 0.076 mm).

Installation

(1) Thoroughly clean valve stems and valve guide bores.

(2) Lightly lubricate stem and install valve in same valve guide bore from where it was originally removed.

(3) Install replacement valve stem oil deflector on valve stem.

(4) Position valve spring and retainer on cylinder head and compress valve spring with compressor tool. Install valve locks and release tool.

(5) Tap valve spring from side to side with light hammer to seat spring properly on cylinder head.

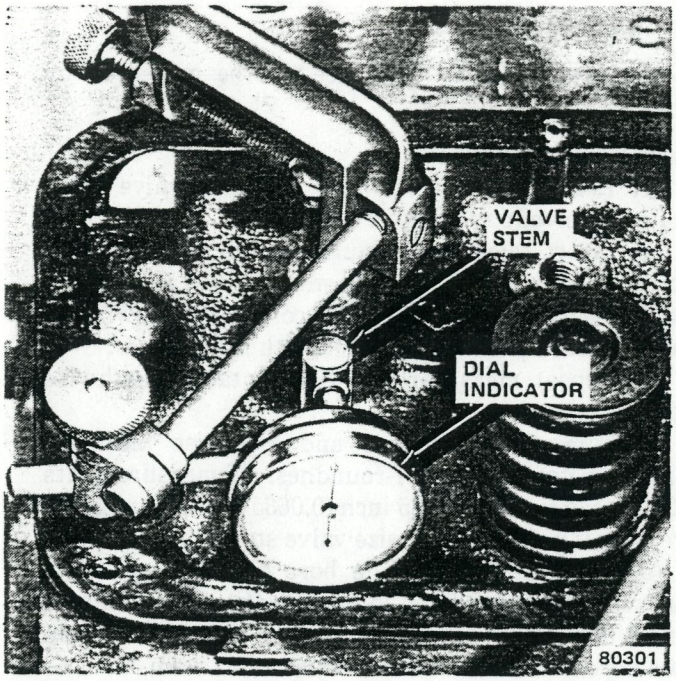

Fig. 1B-108 Valve Stem-to-Guide Clearance Measurement with Dial Indicator

Valve Springs

Valve springs and oil deflectors can be removed without removing the cylinder head. Refer to Valves for the removal procedure with the cylinder head removed from the engine.

Valve Spring and Oil Deflector Removal

The valve spring is held in place on the valve stem by a retainer and a set of valve locks. The locks can be removed only by compressing the valve spring.

(1) Remove cylinder head cover.

(2) Remove bridge and pivot assemblies and rocker arms from valves requiring valve spring or oil deflector removal. Remove two capscrews at each bridge. Alternately loosen capscrews, one turn at a time, to avoid damaging bridge.

(3) Remove push rods.

NOTE: *Retain rocker arms, bridge and pivot assemblies and push rods in the same order as removed.*

(4) Remove spark plug from cylinder that requires valve spring or oil deflector removal.

(5) Install 14 mm (thread size) air adapter in spark plug hole.

NOTE: *An adapter can be constructed by welding an air hose connection to the body of a spark plug having the porcelain removed.*

(6) Connect air hose to adapter and maintain at least 90 psi (620 kPa) in cylinder to hold valves against their seats.

(7) Use Valve Spring Remover and Installer Tools J-22534-1, J-22534-4, and J-22534-5 to compress valve spring. Remove valve locks (fig. 1B-109).

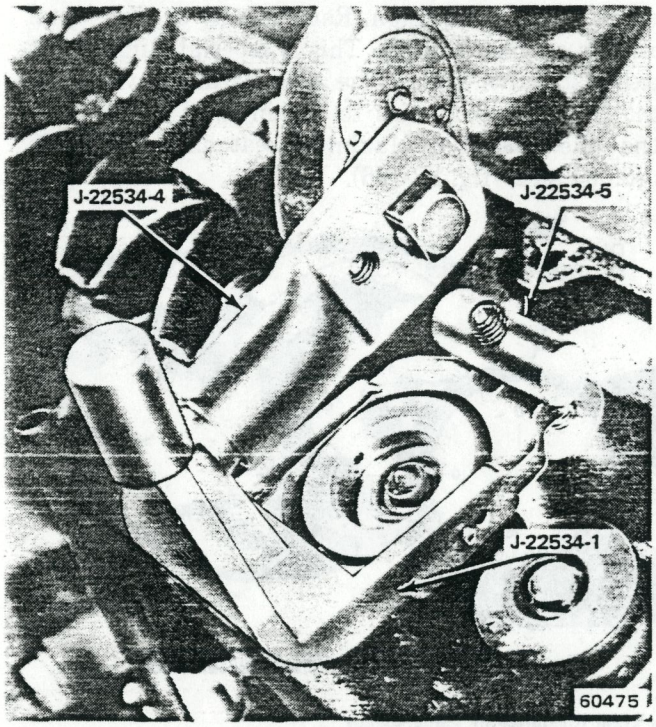

Fig. 1B-109 Valve Spring Removal

(8) Remove valve spring and retainer from cylinder head.

(9) Remove oil deflector.

Valve Spring Tension Test

Use Valve Spring Tester J-8056, or equivalent, to test each valve spring for the specified tension value (fig. 1B-110). Replace springs that are not within specification. Replace springs that bind because of warpage.

Installation

(1) Use 7/16-inch (11 mm) deep socket and hammer to gently tap oil deflector onto valve stem.

NOTE: *A close-coil valve spring is used with all valves. The close-coil end must face the cylinder head when installed.*

(2) Install valve spring and retainer.

(3) Compress valve spring with Valve Spring Remover and Installer Tools J-22534-1, J-22534-4 and J-22534-5. Insert valve locks. Release spring compression and remove tool.

(4) Tap valve spring from side to side with light hammer to ensure spring is seated properly on cylinder head.

(5) Disconnect air hose, remove air adapter from spark plug hole and install spark plug.

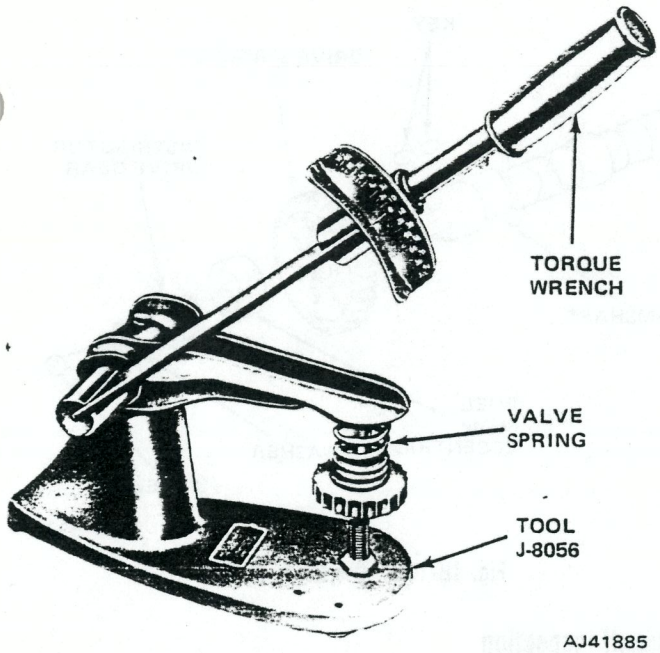

Fig. 1B-110 Valve Spring Tester

(6) Install push rods. Ensure bottom end of each rod is centered in plunger cap of hydraulic valve tappet.

(7) Install rocker arms and bridge and pivot assembly. At each bridge, tighten capscrews alternately, one turn at a time, to avoid damaging bridge. Tighten capscrews with 19 foot-pounds (25 N•m) torque.

(8) Reseal and install cylinder head cover.

(9) Install retaining screws and washers. Tighten screws with 50 inch-pounds (6 N•m) torque.

CAMSHAFT AND BEARINGS

General

The 304 CID (5 liter) engine uses the same camshaft as the 360 CID (6 liter) engine. The camshaft is supported by five steel-shelled, babbitt-lined bearings pressed into the block and line reamed. The step bored camshaft journals are larger at the front bearing than at the rear to permit easy removal and installation of the camshaft. All camshaft bearings are pressure lubricated.

NOTE: *Do not replace camshaft bearings unless special removal and installation tools are available.*

Camshaft end play is maintained by the load placed on the camshaft by the oil pump and distributor drive gear. The helical cut of the gear holds the camshaft sprocket thrust face against the cylinder block face to maintain zero camshaft end play during engine operation. The rear camshaft bearing journal has two holes drilled through it to relieve pressure that could develop between the journal and camshaft plug and force the camshaft forward.

Cam Lobe Lift Measurement

(1) Remove cylinder head cover and gasket.

(2) Remove bridge and pivot assemblies and rocker arms. Alternately loosen capscrews one turn at a time to avoid damaging bridge.

(3) Remove spark plugs.

(4) Use piece of rubber tubing to secure dial indicator on end of push rod (fig. 1B-111).

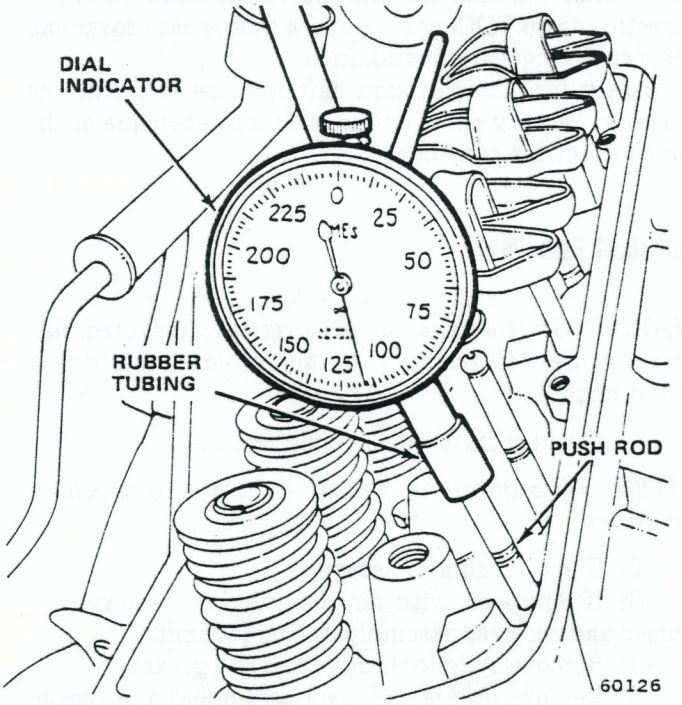

Fig. 1B-111 Cam Lobe Lift Measurement

(5) Rotate crankshaft until cam lobe base circle (push rod down) is under valve tappet.

(6) Set dial indicator to zero.

(7) Rotate crankshaft until point of maximum push rod upward movement occurs.

(8) Note travel on dial indicator. Correct lift is 0.260 to 0.270 inch (6.604 to 6.858 mm) for both 304 (5 liter) and 360 (6 liter) CID engines.

NOTE: *Rocker arm ratio is 1.6:1. Multiply cam lift by 1.6 to determine valve lift.*

Valve Timing

(1) Remove spark plugs.

(2) Remove cylinder head covers and gaskets.

(3) Remove bridge and pivot assemblies and rocker arms from No. 1 cylinder.

(4) Rotate crankshaft until No. 6 piston is at top dead center (TDC) on compression stroke. This positions No. 1 piston at TDC on exhaust stroke in valve overlap position.

(5) Rotate crankshaft counterclockwise 90° as viewed from front.

(6) Install dial indicator on No. 1 intake valve push rod end. Use rubber tubing to secure stem on push rod.

(7) Set dial indicator at zero.

(8) Rotate crankshaft slowly in direction of normal rotation (clockwise viewed from front) until dial indicator indicates 0.020 inch (0.508 mm).

(9) This should align milled timing mark on vibration damper with TDC mark on timing degree scale. If more than 1/2-inch (13 mm) variation exists in either direction from TDC mark, remove timing case cover and inspect timing chain installation.

Inspect for incorrect camshaft sprocket location. The sprocket keyway should align with the centerline of the first lobe of the camshaft.

Camshaft Removal

WARNING: *If engine has been recently operated, use care to prevent scalding by hot coolant. System is pressurized.*

(1) Drain radiator and cylinder block.

NOTE: *If coolant is reusable, drain into clean container.*

(2) Remove radiator assembly.

(3) If equipped with air conditioning, remove condenser and receiver assembly as charged unit.

(4) Remove cylinder head covers and gaskets.

(5) Remove bridge and pivot assemblies and rocker arms. Alternately loosen capscrews, one turn at a time, to avoid damaging bridge.

(6) Remove push rods.

NOTE: *Retain push rods, rocker arms, bridge and pivot assemblies and tappets in the same order as removed.*

(7) Remove intake manifold assembly.

(8) Remove tappets.

(9) Remove drive belts.

(10) Remove fan and hub assembly.

(11) Remove distributor.

(12) Remove damper pulley and vibration damper.

(13) Remove timing case cover.

(14) Install vibration damper screw with two or more flat washers to provide means of rotating crankshaft.

(15) Rotate crankshaft until timing mark on crankshaft sprocket is closest to and on centerline with timing mark on camshaft sprocket (fig. 1B-121).

(16) Remove retaining screw from camshaft. Remove retaining screw from crankshaft.

(17) Remove distributor drive gear and fuel pump eccentric from the camshaft (fig. 1B-112).

(18) Remove crankshaft sprocket, camshaft sprocket and timing chain as assembly.

(19) Remove hood latch support bracket, front bumper or grille as required and remove camshaft.

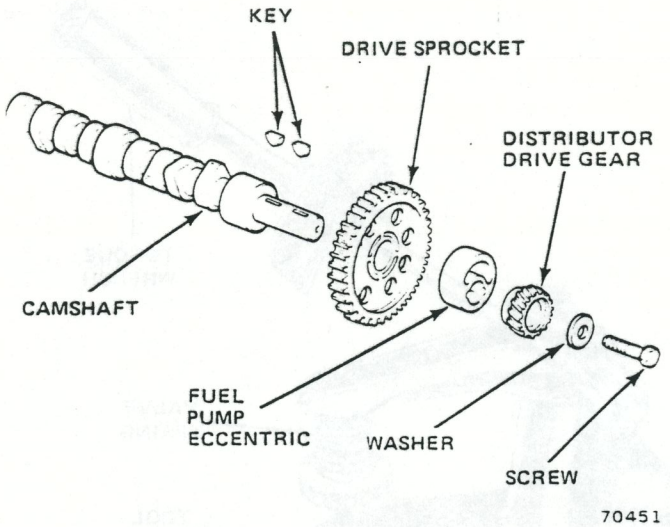

Fig. 1B-112 Camshaft Assembly

Camshaft Inspection

Inspect the camshaft bearing journals for an uneven wear pattern or rough finish. Replace camshaft if either condition exists.

Inspect the distributor drive gear for damage or excessive wear.

Inspect fuel pump eccentric for excessive wear.

Inspect each cam lobe and the associated hydraulic valve tappet for wear. If the face of the tappet(s) is worn concave and the corresponding camshaft lobe(s) is also worn, replace both camshaft and tappet(s).

Camshaft Installation

(1) Lubricate entire camshaft generously with Jeep Engine Oil Supplement (EOS), or equivalent.

(2) Carefully install camshaft into engine block.

(3) Assemble timing chain, crankshaft sprocket and camshaft sprocket with timing marks aligned. Refer to Timing Chain Installation for procedure.

(4) Install oil slinger on crankshaft.

(5) Install fuel pump eccentric and distributor drive gear on camshaft (fig. 1B-112). Tighten retaining screw with 30 foot-pounds (41 N•m) torque.

NOTE: *The fuel pump eccentric has the word "REAR" stamped on it to indicate proper installed position. The camshaft washer (fig. 1B-112) fits into the recess in the distributor drive gear.*

(6) Install replacement timing case cover gasket.

(7) Install timing case cover.

(8) Install replacement oil seal. Apply light film of engine oil to lips of seal.

(9) Install vibration damper.

(10) Install damper pulley with retaining bolts. Tighten bolts with 30 foot-pounds (41 N•m) torque.

(11) Install hydraulic valve tappets lubricated with Jeep Engine Oil Supplement (EOS), or equivalent.

NOTE: *Do not drain the EOS from the engine for at least 1,000 miles (1 609 km) or until the next scheduled oil change.*

(12) Install intake manifold assembly with replacement gasket.

(13) Install push rods.

(14) Install rocker arms and bridge and pivot assemblies. Tighten capscrews alternately, one turn at a time, to avoid damaging bridge. Tighten capscrews with 19 foot-pounds (26 N•m) torque.

(15) Reseal and install cylinder head covers.

(16) Install fuel pump.

(17) Rotate crankshaft until No. 1 piston is at TDC position on compression stroke.

NOTE: *After No. 1 intake valve has closed, TDC can be attained by rotating the crankshaft clockwise as viewed from the front until the timing mark on the vibration damper aligns with the TDC index on the timing degree scale.*

(18) Install distributor so that rotor is aligned with No. 1 terminal of cap when fully seated on block.

(19) Install distributor cap.

(20) Install ignition wires.

(21) If removed, install air conditioner condenser and receiver assembly.

CAUTION: *Both service valves must be open before the air conditioning system is operated.*

(22) Install hood latch support bracket, front bumper or grille, if removed.

(23) Install radiator.

(24) Install fan and hub assembly.

(25) Fill cooling system to specified level.

(26) Install and adjust drive belts to proper tension. Refer to Chapter 1C—Cooling Systems for procedures.

HYDRAULIC VALVE TAPPETS

A hydraulic valve tappet consists of a tappet body, plunger, plunger return spring, check valve assembly, metering disc, plunger cap and lockring (fig. 1B-113).

The tappet operates in a guide bore that has an oil passage drilled into the adjoining oil gallery.

The operating mode of the hydraulic tappet begins when the tappet is on the heel (base circle) of the cam lobe (engine valve closed). A groove in the tappet body aligns with the tappet oil gallery, admitting pressurized oil into the tappet (fig. 1B-114). A hole and groove arrangement admits the oil to the inside of the plunger. Oil is forced past the plunger check valve and fills the chamber between the plunger and tappet body. When the chamber is full, additional oil in the plunger body unseats the metering disc, and a spurt of oil flows up the pushrod to lubricate the rocker arm assembly. These events all take place while the tappet is on the heel of the cam lobe. As the cam turns, the lobe begins exerting force on the tappet body. This force is transferred by the trapped oil in the tappet chamber to the plunger and finally to the pushrod and rocker arm assembly. The engine valve opens. While the valve is open, the trapped oil is subjected to considerable pressure and some of it escapes between the plunger and the tappet body (leakdown). The cycle is completed as the cam lobe rotates back to the starting position and another charging cycle begins. In this way, zero valve lash is maintained and engine noise is reduced.

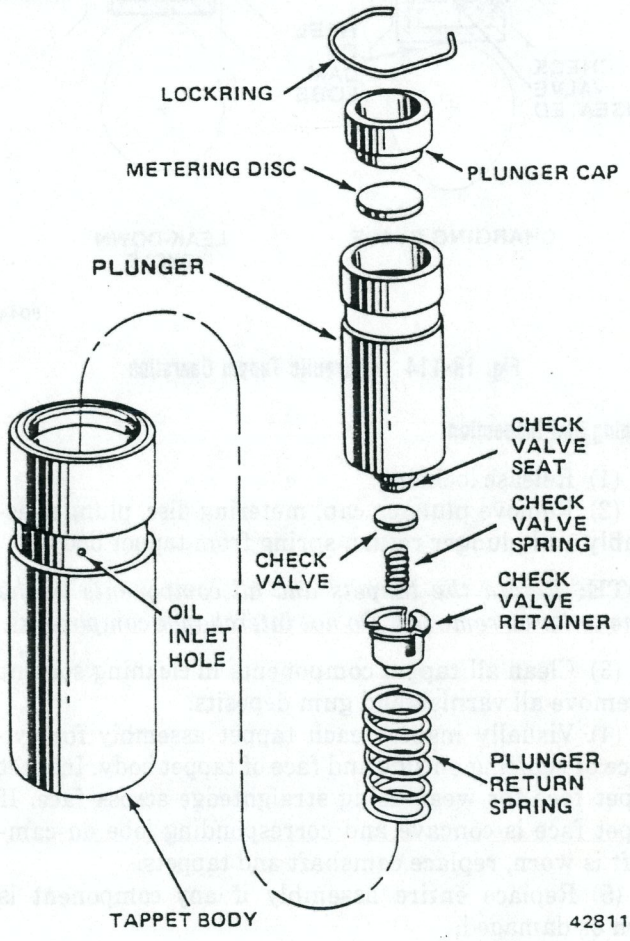

Fig. 1B-113 Hydraulic Tappet Assembly

Removal

(1) Remove cylinder head cover.

(2) Remove bridge and pivot assemblies and rocker arms. Alternately loosen capscrews, one turn at a time, to avoid damaging bridge.

(3) Remove push rods.

NOTE: *Retain bridge and pivot assemblies, rocker arms and push rods in the same order as removed.*

(4) Remove intake manifold.

(5) Remove tappet from guide bore in engine block with Tool J-21884.

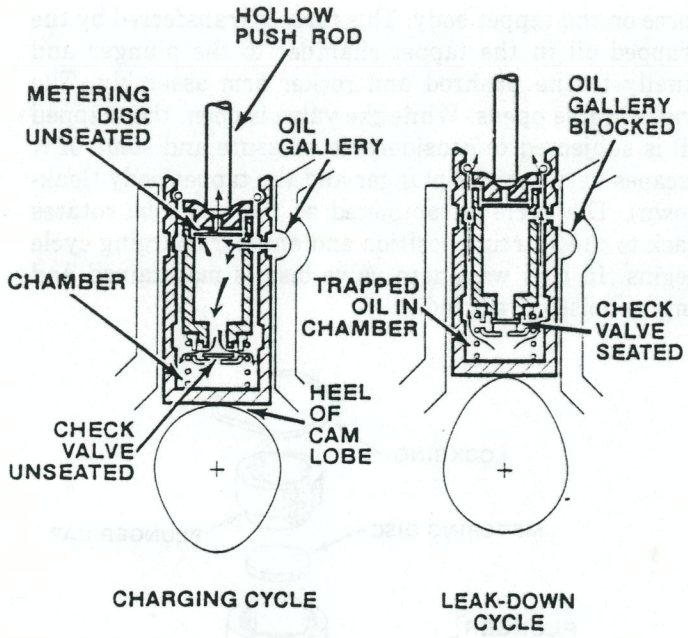

Fig. 1B-114 Hydraulic Tappet Operation

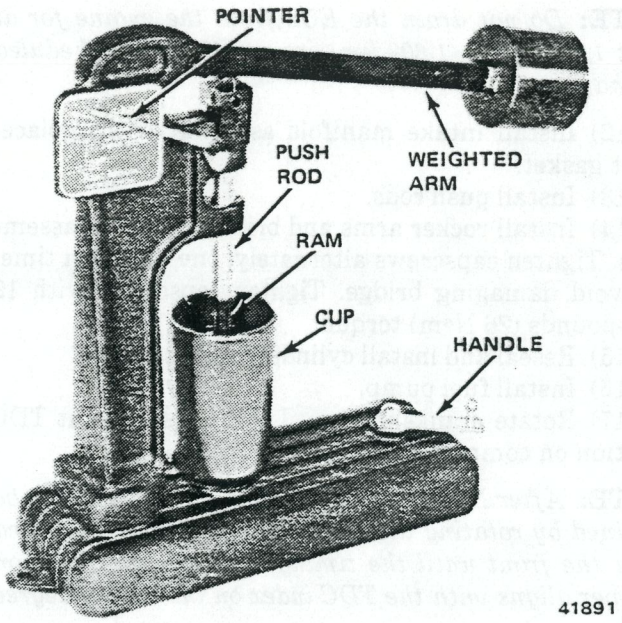

Fig. 1B-115 Hydraulic Tappet Leak-Down Rate Tester J-5790

Cleaning and Inspection

(1) Release lockring.

(2) Remove plunger cap, metering disc, plunger assembly and plunger return spring from tappet body.

NOTE: *Retain the tappets and all components in the same order as removed. Do not interchange components.*

(3) Clean all tappet components in cleaning solvent to remove all varnish and gum deposits.

(4) Visually inspect each tappet assembly for evidence of scuffing on side and face of tappet body. Inspect tappet face for wear using straightedge across face. If tappet face is concave and corresponding lobe on camshaft is worn, replace camshaft and tappets.

(5) Replace entire assembly if any component is worn or damaged.

(6) Install plunger return spring, check valve assembly, plunger, metering disc and plunger cap in tappet body.

(7) Use push rod on plunger cap to compress plunger assembly and install lockring.

Hydraulic Tappet Leak-Down Rate Test

After cleaning, inspection and assembly, use Tester J-5790 to test tappet leak-down rate and to ensure zero-lash operating condition (fig. 1B-115).

(1) Swing weighted arm of tester away from ram of tester.

(2) Place 0.312- to 0.313-inch (7.92 to 7.95 mm) diameter ball bearing on plunger cap of tappet.

(3) Lift ram and place tappet with ball bearing inside tester cup.

(4) Lower ram, then adjust nose of ram until it contacts ball bearing.

(5) Fill tester cup with valve tappet test oil J-5268, or equivalent, until tappet is completely covered.

(6) Swing weighted arm onto ram and pump up and down on tappet to remove air. When air bubbles cease, swing weighted arm away and allow plunger to rise to normal position.

(7) Adjust nose of ram to align pointer with SET mark on scale of tester and tighten hex nut.

(8) Slowly swing weighted arm onto ram. Rotate cup by turning handle at base of tester clockwise one revolution every two seconds.

(9) Time leak-down interval from instant pointer aligns with START mark on scale until pointer aligns with 0.125 mark.

(10) Acceptable tappet will require 20 to 110 seconds interval to leak down. Replace tappets with leak-down rate outside this range.

NOTE: *Do not charge the tappet assemblies with engine oil because they will charge themselves within three to eight minutes of engine operation.*

Installation

(1) Dip each tappet assembly in Jeep Engine Oil Supplement (EOS), or equivalent. Install tappet in same bore from where it was originally removed.

(2) Install push rods in same position as removed.

(3) Install rocker arm and bridge and pivot assemblies in same position as removed. Tighten capscrews alternately, one turn at a time, to avoid damaging bridge. Tighten with 19 foot-pounds (26 N•m) torque.

(4) Pour remaining EOS over entire valve train mechanism.

NOTE: *Do not drain the EOS from the engine for at least 1,000 miles (1 609 km) or until the next scheduled oil change.*

(5) Reseal and install cylinder head cover. Tighten retaining screws with 50 inch-pounds (6 N•m) torque.

(6) Install intake manifold using replacement gasket and end seals. Tighten manifold retaining screws with 43 foot-pounds (58 N•m) torque.

(7) Install all pipes, hoses, linkage and wires disconnected from intake manifold.

TIMING CASE COVER

The timing case cover is die-cast aluminum. A crankshaft oil seal is used to prevent oil leakage at the vibration damper hub (fig. 1B-116). The oil seal may be installed from either side of the timing case cover. It is not necessary to remove the cover whenever oil seal replacement is required.

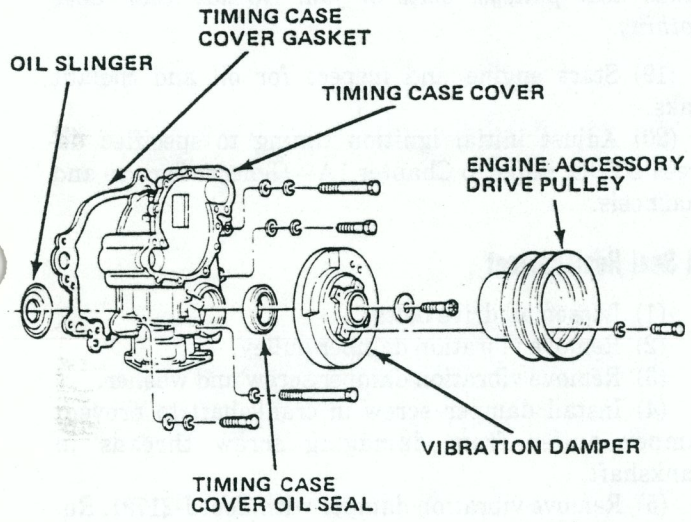

Fig. 1B-116 Timing Case Cover Assembly

A graduated timing degree scale cast in the cover is used for ignition timing. A socket is also provided for timing the ignition with a magnetic timing probe.

The engine oil pump, oil passages and coolant passages are incorporated within the timing case cover casting. The timing case cover casting is also used to mount the fuel pump, distributor and water pump.

Removal

WARNING: *If engine has been recently operated, use care to prevent scalding by hot coolant. System is pressurized.*

(1) Drain radiator and cylinder block.

NOTE: *If coolant is reusable, drain into a clean container.*

(2) Disconnect radiator hoses and bypass hose.

(3) Remove all drive belts.

(4) Remove fan and hub assembly.

(5) If equipped with air conditioner, remove compressor and bracket assembly from engine and move aside. Do not disconnect air conditioner hoses.

(6) Remove alternator, alternator mounting bracket and back idler pulley.

(7) Disconnect heater hose at water pump.

(8) Remove power steering pump and bracket assembly, if equipped. Remove air pump and mounting bracket as assembly. Do not disconnect power steering pump hoses.

(9) Remove distributor cap. Note rotor and housing position.

(10) Remove distributor.

(11) Remove fuel pump.

(12) Remove vibration damper pulley.

(13) Remove vibration damper using tool J-21791.

(14) Remove two front oil pan screws.

(15) Remove screws that secure timing case cover to engine block.

NOTE: *The cover retaining screws are of various lengths and must be installed in the same location as removed.*

(16) Remove cover by pulling forward until clear of locating dowel pins.

(17) Clean gasket contact surface of cover.

(18) Remove oil seal.

NOTE: *Always replace the oil seal whenever the timing case cover is removed. Refer to Oil Seal Replacement for procedure.*

Installation

(1) Remove lower locating dowel pin from engine block.

NOTE: *The dowel pin is required for correct cover alignment. Dowel must be installed after the cover is in position.*

(2) Use sharp knife or razor blade to cut both sides of oil pan gasket flush with engine block.

(3) Apply Permatex No. 2, or equivalent, to both sides of replacement timing case cover gasket. Install gasket on timing case cover.

(4) Install replacement front oil pan seal to bottom of timing case cover.

NOTE: *There are two methods of sealing timing case cover to oil pan where oil pan gaskets were cut off. If replacement oil pan gaskets are used, perform step (5). If room temperature vulcanizing (RTV) silicone is used, perform step (6).*

(5) If oil pan gaskets are used:

(a) Using original gasket pieces as guide, trim replacement gaskets to correspond to amount cut off in step (2) above.

(b) Align tongues of replacement oil pan gasket pieces with oil pan seal and cement into place on cover (fig. 1B-117).

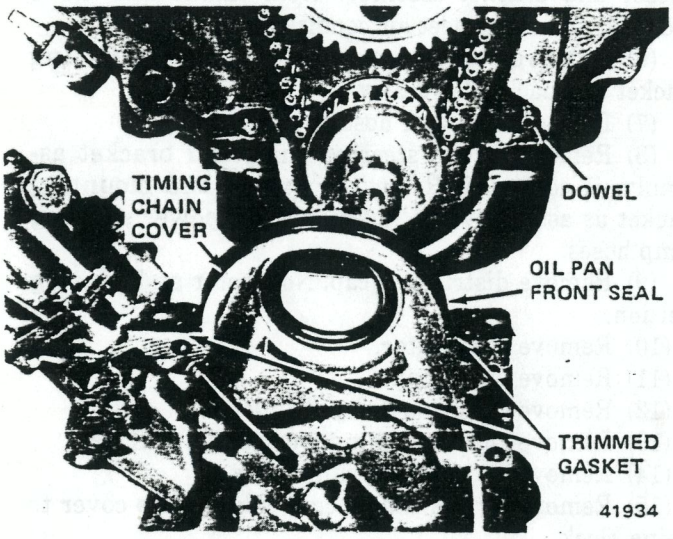

Fig. 1B-117 Oil Pan Front Seal Installation

(c) Apply Permatex No. 2, or equivalent, to cut off edges of original oil pan gaskets.

(d) Place timing case cover in position and install front oil pan screws.

(e) Tighten screws slowly and evenly until cover aligns with upper locating dowel.

(f) Insert lower dowel through cover and drive into corresponding hole in engine block.

(g) Install remaining cover retaining screws in same location as removed. Tighten all screws with 25 foot-pounds (34 N•m) torque.

(h) Proceed to step (7).

(6) If RTV is used:

(a) Apply coating of RTV silicone 1/8-inch (3.175 mm) thick on timing case cover flanges (fig. 1B-117). Use Jeep Gasket-in-a-Tube, or equivalent. Flanges must be clean and dry.

(b) Place cover in position. Align with top dowel.

(c) Loosely install front cover retaining screws in same locations as removed.

(d) Insert lower dowel through cover and drive into corresponding hole in engine block.

(e) Install remaining cover retaining screws and tighten all screws with 25 foot-pounds (34 N•m) torque.

(f) Apply small bead of RTV to joint between pan and cover and force into place with finger.

(g) Apply drop of Loctite, or equivalent, to oil pan screws and tighten until snug. *Do not over-tighten* because oil pan will distort.

(h) Proceed to step (7).

(7) Install vibration damper. Tighten retaining screw with 90 foot-pounds (122 N•m) torque.

(8) Install damper pulley. Tighten retaining bolts with 30 foot-pounds (41 N•m) torque.

(9) Install fuel pump.

(10) Install distributor with rotor and housing in same position as it was prior to removal.

(11) Install distributor cap and connect heater hose.

(12) Install power steering pump, air pump and mount bracket, if removed.

(13) Install alternator, alternator mounting bracket, and back idler pulley assembly.

(14) Install air conditioner compressor and bracket assembly, if removed.

(15) Install fan and hub assembly.

(16) Install all drive belts and adjust to specified tension. Refer to Chapter 1C—Cooling Systems.

(17) Connect radiator hoses and bypass hose.

(18) Fill cooling system to specified level.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(19) Start engine and inspect for oil and coolant leaks.

(20) Adjust initial ignition timing to specified degrees BTDC. Refer to Chapter 1A—General Service and Diagnosis.

Oil Seal Replacement

(1) Loosen all drive belts.

(2) Remove vibration damper pulley.

(3) Remove vibration damper screw and washer.

(4) Install damper screw in crankshaft to prevent damper puller from damaging screw threads in crankshaft.

(5) Remove vibration damper with Tool J-21791. Remove damper screw.

(6) Remove oil seal using Remover J-9256 (fig. 1B-118).

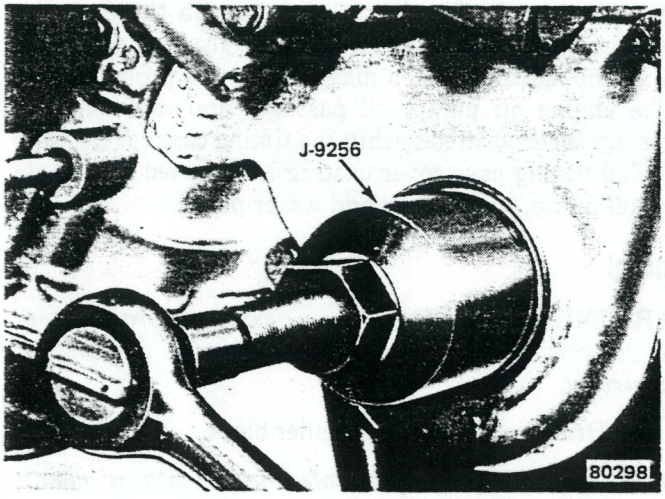

Fig. 1B-118 Removing Timing Case Cover Oil Seal

(7) Wipe crankshaft sealing area clean.

(8) Apply Permatex No. 2, or equivalent, to outer metal surface of replacement seal.

(9) Install seal using Installer Tool J-26562 (fig. 1B-119).

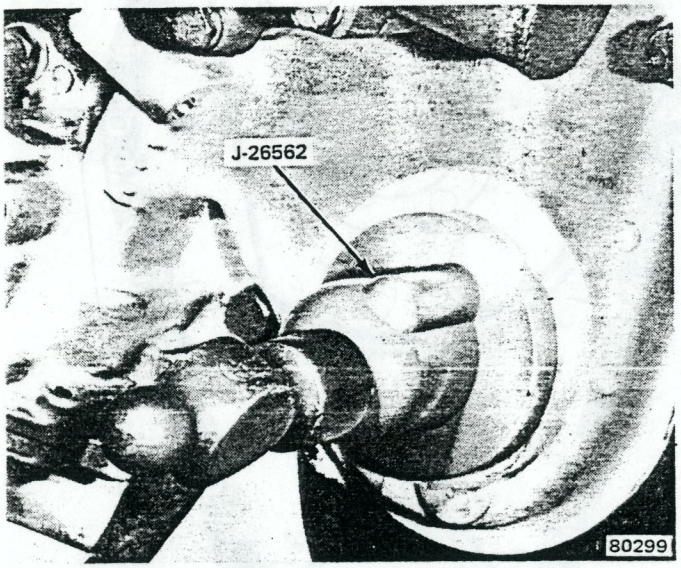

Fig. 1B-119 Installing Timing Case Cover Oil Seal

(10) Apply light coating of engine oil to seal contact surface of damper.

(11) Install damper, flat washer and screw. Tighten with 90 foot-pounds (122 N•m) torque.

(12) Install pulley and belts. Adjust belts to specifications. Refer to Chapter 1C—Cooling Systems.

TIMING CHAIN

To ensure correct valve timing, install the timing chain with the timing marks of the crankshaft and camshaft sprockets correctly positioned.

Timing Chain Wear Measurement

(1) Remove timing case cover. Refer to Timing Case Cover Removal for procedure.

(2) Rotate camshaft or crankshaft sprocket until all slack is removed from right side of chain.

(3) Determine reference point for deflection measurement according to following:

(a) Measure up from dowel on right side of engine 3/4 inch (19 mm) and mark location (fig. 1B-120).

(b) Position straightedge across timing chain from point at lowest root of camshaft sprocket to point marked in step (a) above (fig. 1B-120).

(c) Grasp chain where straightedge dissects chain and use as reference.

(d) Move chain inward toward centerline of engine and mark engine block at point of maximum inward chain deflection (fig. 1B-120).

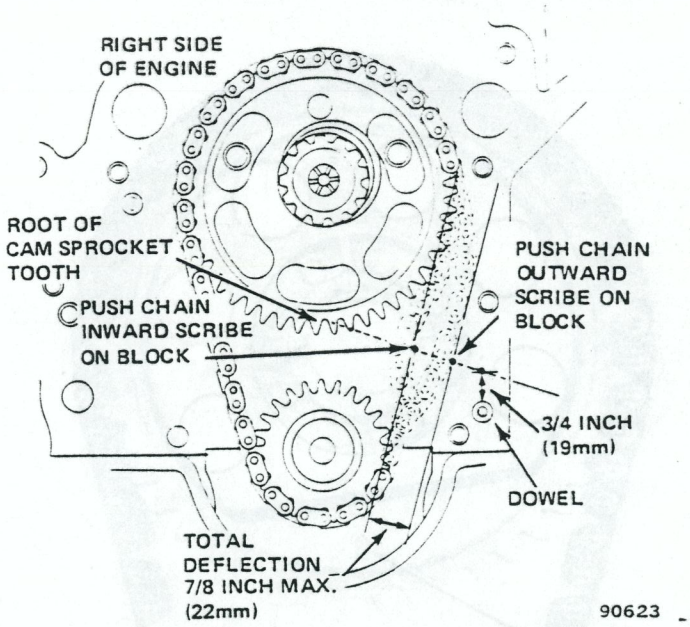

Fig. 1B-120 Timing Chain Wear Measurement

(e) Move chain outward from centerline of engine and mark engine block at point of maximum outward chain deflection (fig. 1B-120).

(f) Measure distance between two marks to determine total deflection.

(g) Replace chain assembly if deflection (wear) exceeds 7/8 inch (22 mm). Refer to Timing Chain Removal and Installation for procedure.

(h) Install timing case cover. Refer to Timing Case Cover Installation for procedure.

Removal

(1) Remove vibration damper pulley, damper, timing case cover and gasket.

(2) Remove crankshaft oil slinger.

(3) Remove camshaft sprocket retaining screw and washer.

(4) Remove distributor drive gear and fuel pump eccentric (fig. 1B-112).

(5) Rotate crankshaft until zero timing mark on crankshaft sprocket is closest to and on centerline with zero timing mark on camshaft sprocket (fig. 1B-121).

(6) Remove crankshaft sprocket, camshaft sprocket and timing chain as assembly.

Installation

(1) Assemble timing chain, crankshaft sprocket and camshaft sprocket with timing marks positioned as depicted in figure 1B-121.

(2) Install chain and sprocket assembly on crankshaft and camshaft.

NOTE: *Install the fuel pump eccentric with the stamped word REAR facing the camshaft sprocket.*

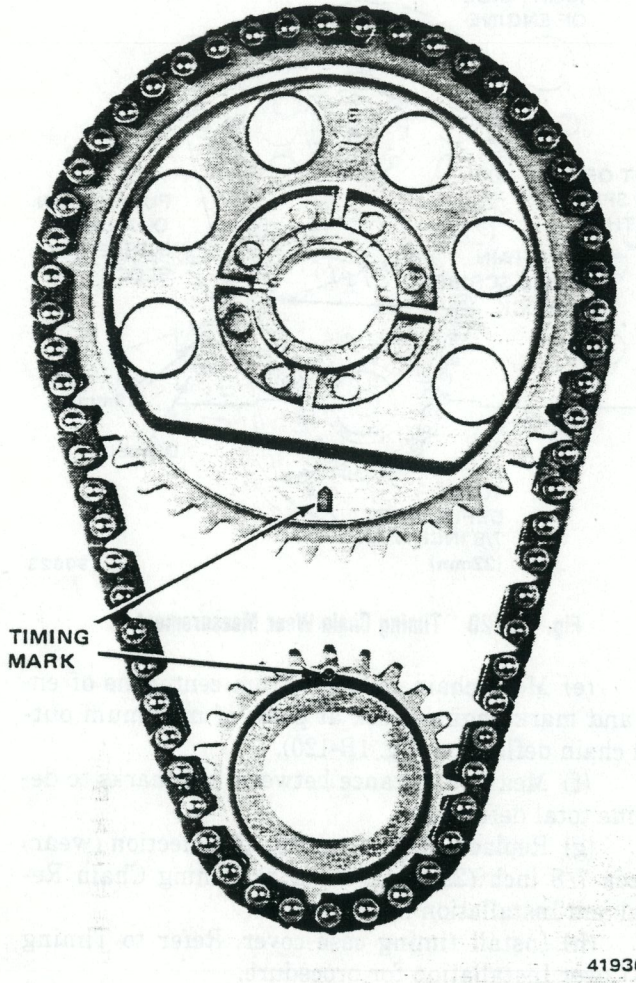

Fig. 1B-121 Timing Chain and Sprocket Alignment

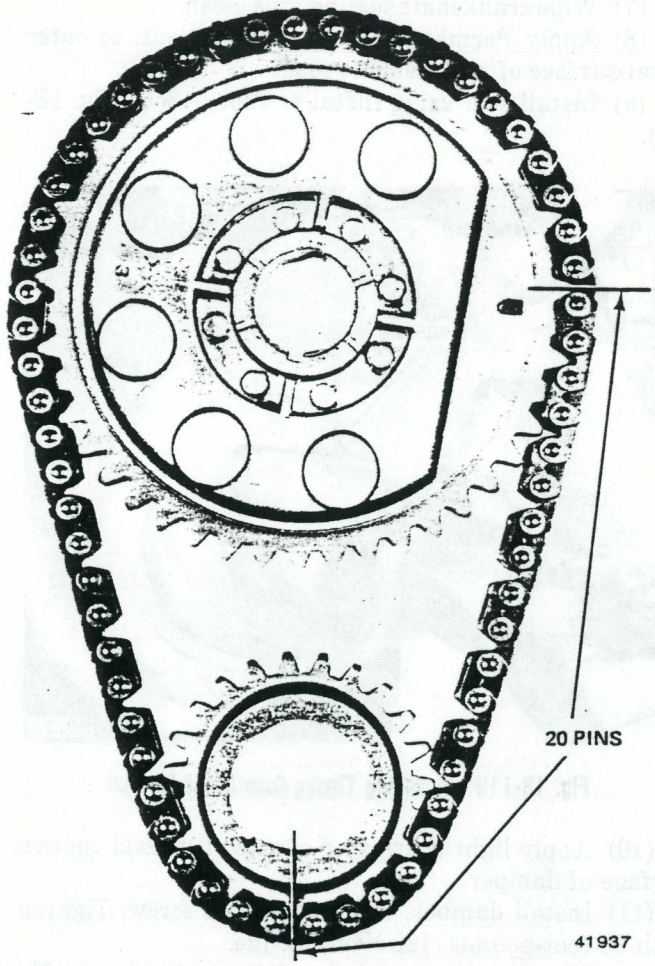

Fig. 1B-122 Correct Timing Chain Installation Verification

(3) Install fuel pump eccentric and distributor drive gear.

(4) Install camshaft washer and retaining screw. Tighten screw with 30 foot-pounds (41 N•m) torque.

(5) To verify correct installation of timing chain:

(a) Rotate crankshaft until timing mark on camshaft sprocket is on horizontal line at 3 o'clock position (fig. 1B-122).

(b) Beginning with pin directly adjacent to camshaft sprocket timing mark, count number of pins downward to timing mark on crankshaft sprocket.

(c) There must be 20 pins between these two points. **The crankshaft sprocket timing mark must be between pins 20 and 21 (fig. 1B-122).**

(6) Install crankshaft oil slinger.

(7) Remove original oil seal from timing case cover.

(8) Install replacement oil seal in timing case cover.

(9) Install timing case cover using replacement gasket. Tighten retaining screws with 25 foot-pounds (34 N•m) torque.

(10) Install vibration damper and pulley.

INTAKE AND EXHAUST MANIFOLDS

Intake Manifold

The cast iron intake manifold is designed to enclose and seal the tappet area between the cylinder heads. A one-piece metal gasket, used to seal the intake manifold to the cylinder heads and block, also serves as an oil splash baffle.

The intake manifold contains coolant passages, a crankcase ventilator passage and an exhaust crossover passage. Passages are also incorporated within the intake manifold for the Exhaust Gas Recirculation (EGR) system.

Induction system passages distribute a uniform fuel and air mixture to the combustion chamber of each cylinder. The left side of the carburetor supplies the fuel/air mixture through passages in the intake manifold to numbers 1, 7, 4 and 6 cylinder intake ports. The right side supplies numbers 3, 5, 2, and 8 cylinder intake ports.

Removal

WARNING: *If engine has been recently operated, use care to prevent scalding by hot coolant. System is pressurized.*

(1) Drain coolant from radiator and cylinder block.

NOTE: *If coolant is reusable, drain into clean container.*

(2) Remove air cleaner assembly.
(3) Disconnect ignition wires.
(4) Remove ignition wire plastic separators from cylinder head cover brackets.
(5) Disconnect radiator upper hose and bypass hose from intake manifold.
(6) Disconnect and move aside wire from coolant temperature gauge sending unit.
(7) Disconnect ignition coil bracket and move coil and bracket assembly aside.
(8) Disconnect heater hose from rear of manifold.
(9) Identify and disconnect all hoses, pipes and wire connectors from carburetor assembly.
(10) Disconnect throttle and throttle valve linkage from carburetor and intake manifold.
(11) Disconnect air hoses from air injection manifolds.
(12) Disconnect diverter valve from air pump output hose and move valve and air hoses aside.
(13) Remove carburetor.
(14) Remove intake manifold, metal gasket and end seals.
(15) Clean gasket mating surfaces of engine block, cylinder head and intake manifold.

Installation

NOTE: *When installing replacement intake manifold, transfer all components (i.e., EGR valve and back-pressure sensor, EGR CTO valve, thermostat housing and coolant temperature gauge sending unit) from original manifold. Clean and tighten as required.*

(1) Apply nonhardening sealer or RTV silicone sealant such as Jeep Gasket-in-a-Tube, or equivalent, to both sides of replacement manifold gasket.
(2) Position gasket by aligning locators at rear of cylinder head. While holding rear of gasket in place, align front locators.
(3) Install two end seals. Apply Permatex No. 2, Jeep Gasket-in-a-Tube, or equivalent, to seal ends.
(4) Install intake manifold and retaining screws. Ensure all screws are properly started before tightening. Tighten with 43 foot-pounds (58 N•m) torque.
(5) Install diverter valve and connect air pump output hose.
(6) Connect air hoses to air injection manifolds.
(7) Identify and connect all disconnected hoses, pipes, linkages and wires to intake manifold and carburetor.
(8) Install ignition coil and bracket assembly.
(9) Connect radiator upper hose and bypass hose.
(10) Install ignition wire plastic separators on cylinder head cover brackets.
(11) Connect ignition wires.
(12) Install air cleaner assembly.
(13) Add coolant as necessary.

Exhaust Manifold

The swept-flow designed cast iron manifold provides efficient removal of exhaust gases and minimizes back pressure. The mating surface of the exhaust manifold and the cylinder head are machined smooth to eliminate the need for a gasket.

All eight-cylinder engines are equipped with an air injection system and have air injection manifolds attached at number 1, 3 and 5 exhaust ports of the left exhaust manifold and numbers 2, 4, 6 and 8 of the right exhaust manifold. Refer to Chapter 1K—Exhaust Systems for description of the air injection system.

Removal

(1) Disconnect ignition wires.
(2) Disconnect air hose at injection manifold.
(3) Disconnect exhaust pipe at exhaust manifold.
(4) Remove exhaust manifold retaining screws.
(5) Separate exhaust manifold from cylinder head.
(6) Remove air injection manifold, fittings and washers.

Installation

(1) Clean mating surfaces of exhaust manifold and cylinder head. **Do not nick or scratch.**
(2) Install air injection manifold on exhaust manifold.

CAUTION: *The correct screws and washers must be used to allow the manifold to expand and prevent cracking.*

(3) Install exhaust manifold and retaining screws. Tighten two center screws with 25 foot-pounds (34 N•m) torque. Tighten four outer screws with 15 foot-pounds (20 N•m) torque.
(4) Connect exhaust pipe using replacement seal, if required. Tighten nuts with 20 foot-pounds (27 N•m) torque.
(5) Connect air hose to air injection manifold.
(6) Connect ignition wires.

CYLINDER HEADS AND COVERS

Cylinder Head Covers

The cylinder head covers are installed with a formed-in-place RTV (room temperature vulcanizing) silicone gasket.

Removal

(1) Remove air cleaner assembly.
(2) Disconnect air hose from air injection manifold.
(3) Left side:
(a) Disconnect power brake vacuum hose at intake manifold, if equipped.
(b) Disconnect throttle stop solenoid wire, if equipped.
(4) Right side:
(a) Remove thermostatically controlled air cleaner (TAC) hot air hose.
(b) Remove heater hose from choke cover clamp.
(5) Disconnect ignition wires and remove plastic wire separator from cylinder head cover bracket.
(6) Remove retaining screws and washers. Strike cover with rubber mallet to break loose from cylinder head. Remove cover and gasket.

Installation

(1) Inspect for bent or cracked cover and repair or replace as required.
(2) Remove gasket material from cylinder head cover and cylinder head gasket surface area.
(3) Apply bead of Jeep Gasket-in-a-Tube, or equivalent, to cylinder head and cylinder head cover gasket surface area.
(4) Position cylinder head cover on engine.
(5) Install retaining screws and tighten with 50 inch-pounds (6 N•m) torque.
(6) Connect ignition wires and install plastic wire separator on cylinder head cover bracket.
(7) Right side:
(a) Install heater hose on choke cover clamp.
(b) Install TAC hot air hose.
(8) Left side:
(a) Connect power brake vacuum hose at intake manifold.
(b) Connect throttle stop solenoid wire.
(9) Connect air hose to air injection manifold.
(10) Install air cleaner assembly.

Cylinder Heads

Removal

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(1) Drain cooling system and cylinder block.

NOTE: *If coolant is reuseable, drain into clean container.*

(2) Remove ignition wires and spark plugs.
(3) Remove cylinder head cover and gasket.
(4) Remove bridge and pivot assemblies and rocker arms. Alternately loosen capscrews, one turn at a time, to avoid damaging bridge.
(5) Remove push rods.

NOTE: *Retain rocker arms, bridges, pivots and push rods in the same order as removed to facilitate installation in original locations.*

(6) Remove intake manifold.
(7) Disconnect exhaust manifold from head. It is not necessary to remove exhaust pipe from manifold.
(8) Loosen all drive belts.
(9) Right side:
(a) If equipped with air conditioning, remove compressor mount bracket and battery negative cable from cylinder head.
(b) Disconnect alternator support brace from cylinder head.
(10) Left side: Disconnect air pump and power steering mount bracket, if equipped, from cylinder head.
(11) Remove cylinder head retaining screws.
(12) Remove cylinder head and gasket.

Cleaning and Inspection

Thoroughly clean the gasket surfaces of the cylinder head and block to remove all foreign material and gasket cement. Remove carbon deposits from the combustion chambers and the top of each piston.

Use a straightedge and feeler gauge to determine the flatness of the cylinder head and block mating surfaces. Refer to Specifications for tolerances.

If the cylinder head is to be replaced and the original valves reused, remove the valves and measure the stem diameters.

NOTE: *Service replacement heads have standard-size valve guide bores. If valves with oversize stems from original head are to be installed in replacement head, ream valve guide bores to appropriate oversize diameter.*

If the original valves are used, remove all carbon deposits and reface the valves as outlined within Valve Refacing. Install the valves in the cylinder head using replacement valve stem oil deflectors. If valves with oversize stems are used, oversize deflectors are also required. Transfer all components from the original head that are not included with the replacement head.

Installation

NOTE: *Wire brush the threads of screws prior to installation. Unclean threads will affect the tightening torque indications. Blow coolant from screw holes to prevent trapping coolant.*

NOTE: *The 304 CID engine uses an aluminum coated embossed steel gasket and the 360 CID engine uses an aluminum coated laminated steel and asbestos gasket. Retightening head bolts after engine has been operated is not necessary for either gasket.*

(1) Apply even coat of nonhardening sealing compound to both sides of replacement head gasket.

NOTE: *Do not apply sealing compound to head and block surfaces. Do not allow sealer to enter cylinder bores.*

(2) Position gasket flush on block with stamped word TOP facing upward.

(3) Install cylinder head over gasket.

(4) Tighten cylinder head capscrews evenly with 80 foot-pounds (108 N•m) torque following sequence outlined in figure 1B-123. Then repeat sequence and tighten screws with 110 foot-pounds (149 N•m) torque.

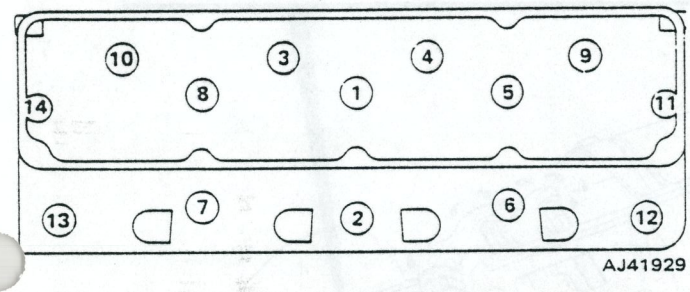

Fig. 1B-123 Cylinder Head Tightening Sequence

(5) Left side: connect air pump mount bracket and power steering pump, if removed, to cylinder head.

(6) Right side:

(a) Connect alternator support bracket to cylinder head.

(b) Install air conditioner compressor mounting bracket, if removed, and battery negative cable on cylinder head.

(7) Adjust all drive belts to specified tension. Refer to Chapter 1C—Cooling Systems.

(8) Install exhaust manifold and tighten retaining screws with 25 foot-pounds (34 N•m) torque.

(9) Install intake manifold. Tighten retaining screws with 43 foot-pounds (58 N•m) torque.

(10) Install all disconnected pipes, hoses, linkage and wires.

(11) Install push rods, rocker arms and bridge and pivot assemblies in original position. Loosely install capscrews through bridges. Tighten capscrews alternately, one turn at a time, to avoid damaging bridges. Tighten capscrews with 19 foot-pounds (26 N•m) torque.

(12) Reseal and install cylinder head cover. Tighten retaining screws with 50 inch-pounds (6 N•m) torque.

(13) Install spark plugs and connect ignition wires.

(14) Fill cooling system to specified level.

LUBRICATION SYSTEM

Oil is pumped from the sump of the oil pan through a pick-up tube and screen assembly to a horizontal oil gallery located at the lower right side of the engine block (fig. 1B-124). A passage in the timing case cover channels oil into the oil pump. Pressure is developed when oil is driven between the gears and pump body.

The oil is forced from the pump through a passage in the oil pump cover to the oil filter (fig. 1B-125).

The oil passes through the filtering element and on to an outlet passage in the oil pump cover. From the oil pump cover passage, the oil enters an adjoining passage in the timing case cover and is channeled into a gallery that extends up the left front of the cylinder block. This gallery channels oil directly to the right main oil gallery, which intersects with a short passage that channels oil to the left main oil gallery.

The left and right main oil galleries extend the length of the cylinder block. The left oil gallery channels oil to each hydraulic tappet on the left bank. The right oil gallery channels oil to each hydraulic tappet on the right bank. In addition, passages extend down from the right oil gallery to the five camshaft bearings and on to the five upper main bearing inserts. The crankshaft is drilled to allow oil to flow from each main journal to adjacent connecting rod journals. A squirt hole in each connecting rod bearing cap distributes oil to the cylinder walls, pistons and piston pins as the crankshaft rotates.

A small passage within the front camshaft bearing journal channels oil through the camshaft sprocket to the timing case cover area where the case and sprockets throw off oil to lubricate the distributor drive gear and fuel pump eccentric (see insert, fig. 1B-124). The oil returns to the oil pan by passing under the front main bearing cap.

Oil for the rocker arm assemblies is metered through the hydraulic valve tappets and routed through hollow push rods to a hole in the corresponding rocker arm. This oil lubricates the valve train, then returns to the oil pan through channels at both ends of the cylinder head.

Oil Filter

A full flow oil filter mounted on the oil pump at the lower right-hand side of the engine is accessible from below the chassis.

A bypass valve in the filter mounting base provides a safety factor in the event the filter should become inoperative as a result of restriction from sludge or foreign material accumulation (fig. 1B-126). Oil Filter Remover Tool J-22700 will facilitate removal.

Before installation, apply a thin film of oil to the filter gasket. **Do not use grease.** Rotate filter until the gasket contacts the seat of the filter base. Tighten by hand only, following instructions on replacement filter. If instructions are not printed on filter, tighten filter until gasket contacts seat and then tighten an additional 3/4 turn. Operate engine at fast idle and inspect for leaks.

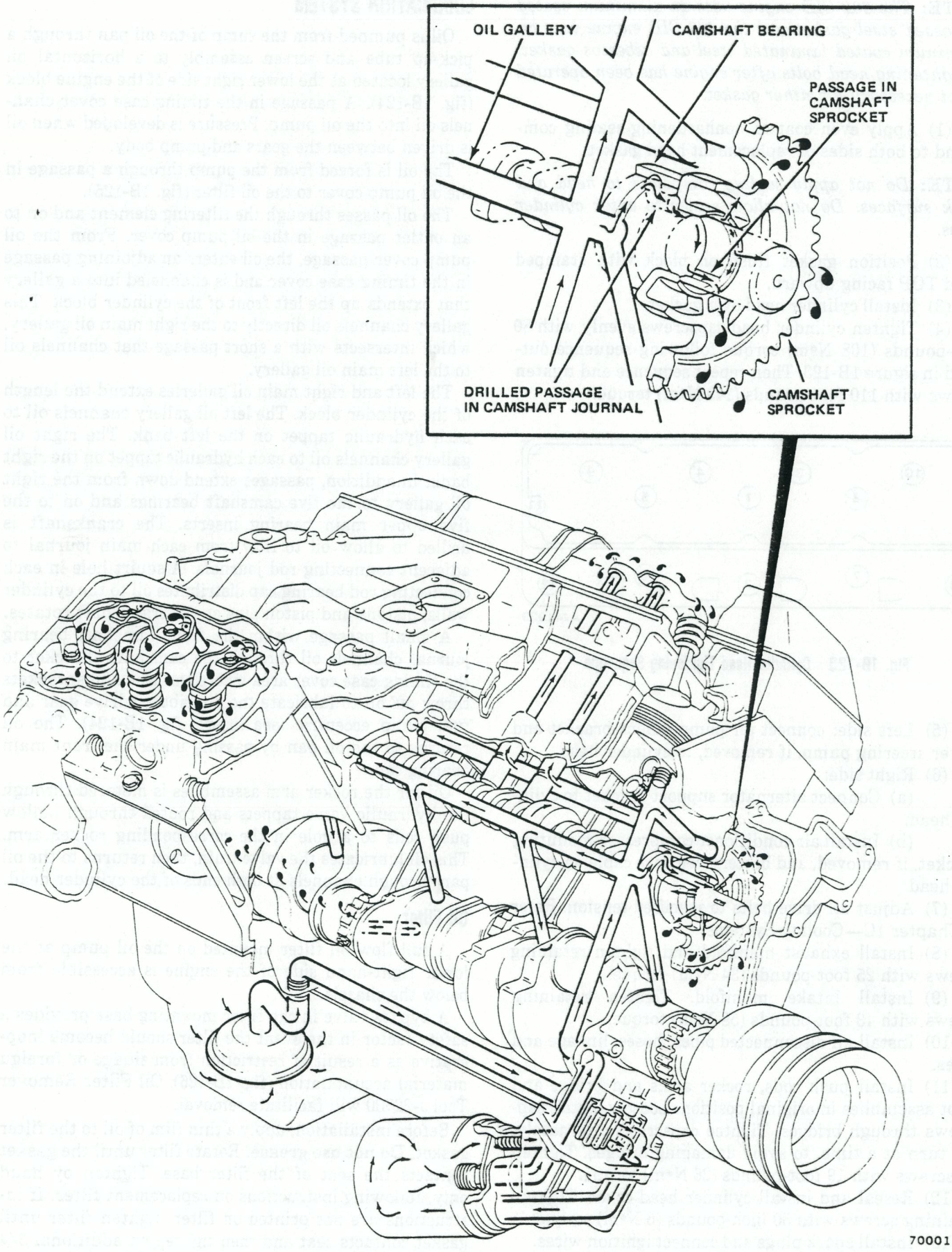

Fig. 1B-124 Lubrication System

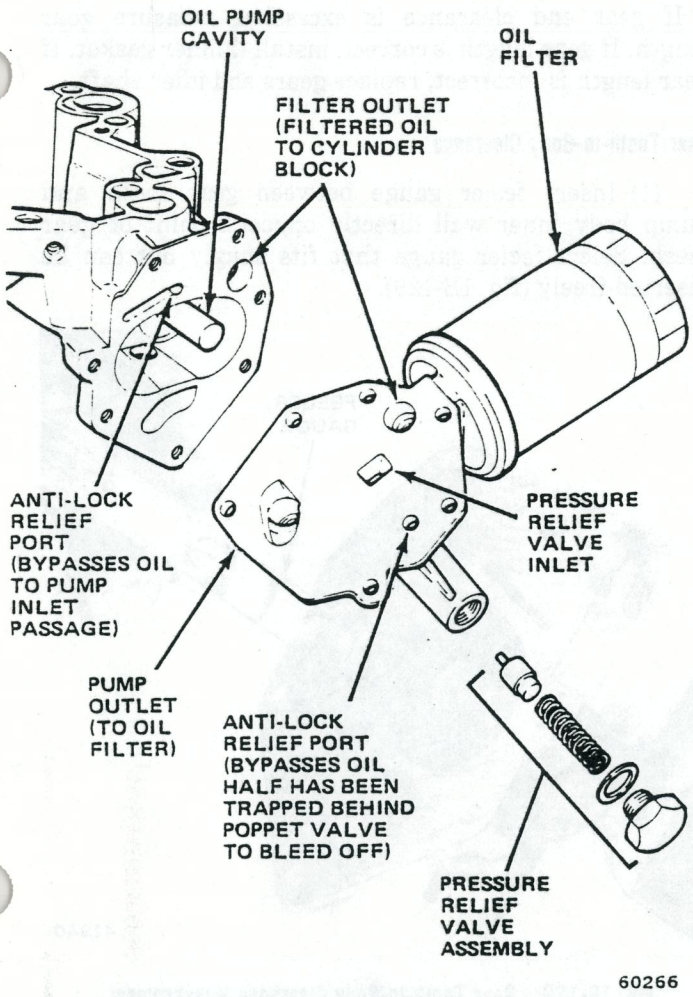

Fig. 1B-125 Oil Pump Cover

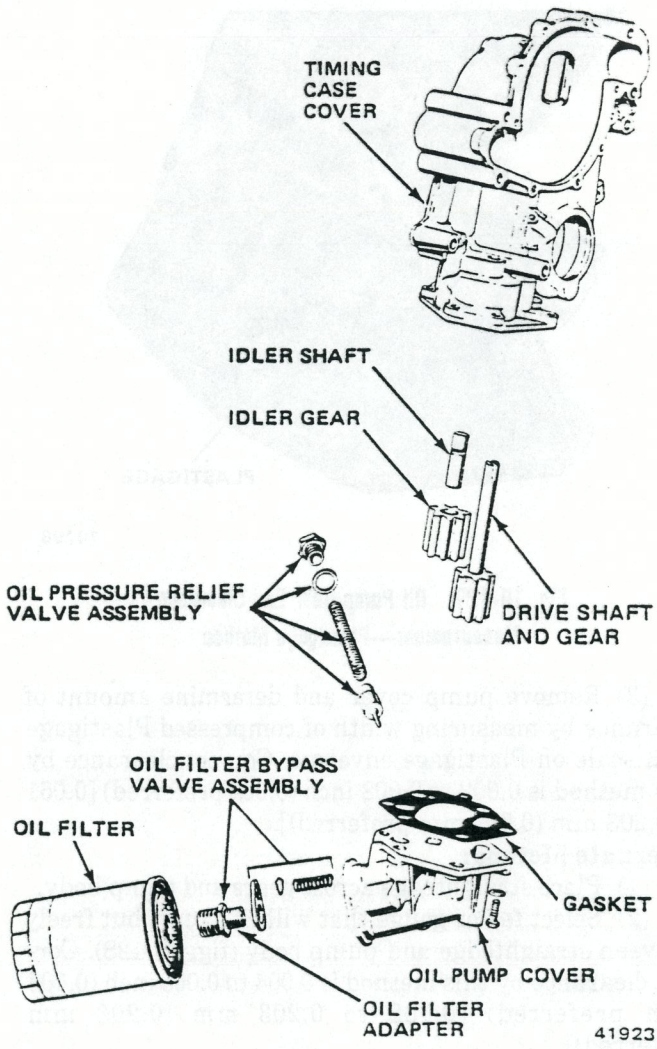

Fig. 1B-126 Oil Pump and Filter Assembly

Oil Pump

The positive-displacement gear-type oil pump is driven by the distributor shaft, which is driven by a gear on the camshaft (fig. 1B-126). The pump is integral with the timing case cover. A cavity in the cover forms the body of the pump. A pressure relief valve regulates maximum oil pressure.

Oil pump removal or replacement will not affect the distributor timing because the distributor drive gear will remain in mesh with the camshaft drive gear.

Oil Pressure Relief Valve

The oil pressure relief valve is not adjustable. The spring tension is calibrated for 75 psi (517 kPa) maximum pressure.

In the relief position, the valve permits oil to bypass through a passage in the pump cover to the inlet side of the pump (fig. 1B-126).

Removal

(1) Remove retaining screws and separate oil pump cover, gasket and oil filter as an assembly from pump body (timing case cover).

(2) Remove drive gear assembly and idler gear by sliding them out of body.

(3) Remove oil pressure relief valve from pump cover for cleaning by removing retaining cap and spring. Clean cover thoroughly. Test operation of relief valve by inserting poppet valve and determining if it slides back and forth freely. If not, replace pump cover and poppet valve.

Gear End Clearance Measurement

This measurement determines the distance between the end of the pump gear and the pump cover. The ideal clearance is as close as possible without binding gears. The pump cover gasket is 0.009- to 0.011-inch (0.229 to 0.279 mm) thick. Symptoms of excessive pump clearance are fair to good pressure when the oil is cold and low or no pressure when the oil is hot.

Preferred Method:

(1) Place strip of Plastigage across full width of each gear (fig. 1B-127).

(2) Install pump cover and gasket. Tighten screws with 55 inch-pounds (6 N•m) torque.

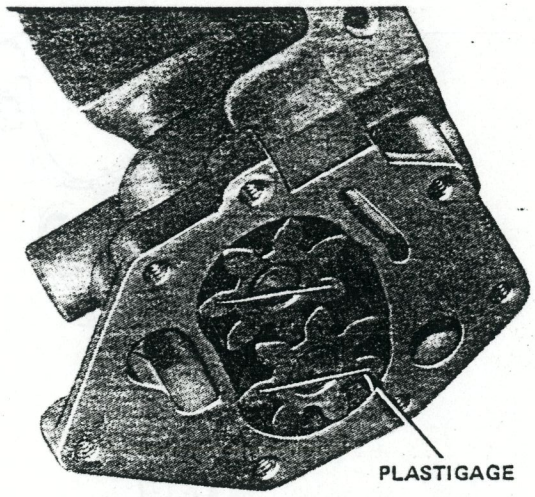

Fig. 1B-127 Oil Pump Gear End Clearance Measurement—Plastigage Method

(3) Remove pump cover and determine amount of clearance by measuring width of compressed Plastigage with scale on Plastigage envelope. Correct clearance by this method is 0.002 to 0.008 inch (0.002 preferred) [0.051 to 0.203 mm (0.051 mm preferred)].

Alternate Method:

(1) Place straightedge across gears and pump body.

(2) Select feeler gauge that will fit snugly but freely between straightedge and pump body (fig. 1B-128). Correct clearance by this method is 0.004 to 0.008 inch (0.008 inch preferred) [0.102 to 0.203 mm (0.203 mm preferred)].

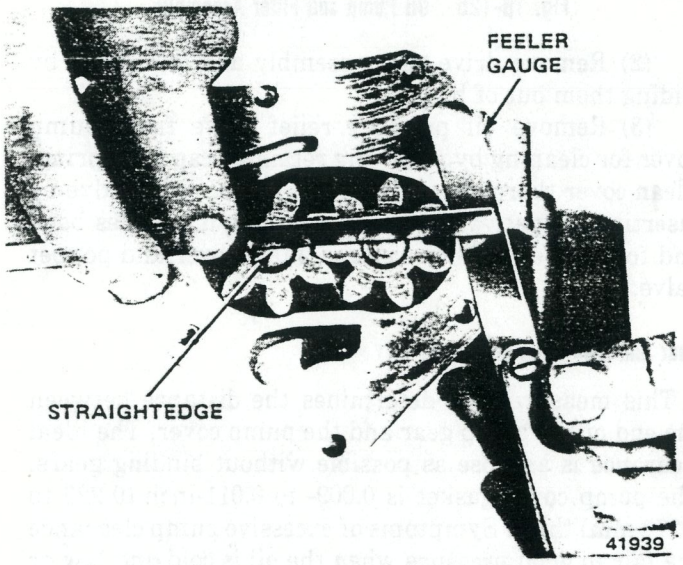

Fig. 1B-128 Oil Pump Gear End Clearance Measurement—Feeler Gauge Method

NOTE: *Ensure gears are up into body as far as possible for measurement.*

If gear end clearance is excessive, measure gear length. If gear length is correct, install thinner gasket. If gear length is incorrect, replace gears and idler shaft.

Gear Tooth-to-Body Clearance

(1) Insert feeler gauge between gear tooth and pump body inner wall directly opposite point of gear mesh. Select feeler gauge that fits snugly but can be inserted freely (fig. 1B-129).

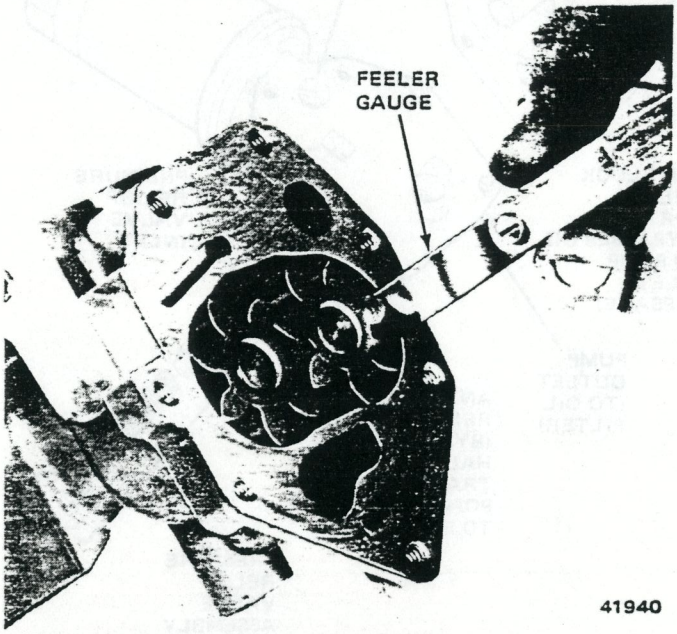

Fig. 1B-129 Gear Tooth-to-Body Clearance Measurement

(2) Rotate gears and measure clearance of each tooth and body in this manner. Correct clearance is 0.0005 to 0.0025 inch (0.0005 inch preferred) or 0.013 to 0.064 mm (0.013 mm preferred).

(3) If gear tooth-to-body clearance is more than specified, measure gear diameter with micrometer. If gear diameter is correct and gear end clearance is correct and relief valve is functioning properly, replace timing case cover. If gear diameter is incorrect, replace gears and idler shaft.

NOTE: *If the oil pump shaft or distributor drive shaft is broken, inspect for loose oil pump gear-to-shaft fit or worn front cover. Oversize pump shafts are not available.*

Installation

(1) Install oil pressure relief valve in pump cover with spring and retaining cap.

(2) Install idler shaft, idler gear and drive gear assembly.

NOTE: *To ensure self-priming of the oil pump, fill pump with petroleum jelly prior to the installation of the oil pump cover.* **Do not use grease of any type.**

(3) Install pump cover and oil filter assembly with replacement gasket. Tighten retaining screws with 55 inch-pounds (6 N•m) torque.

Oil Pan

Removal

(1) Drain engine oil.
(2) Remove starter motor.
(3) On CJ vehicles:
(a) Remove frame cross bar.
(b) Remove automatic transmission fluid cooler tubing, if equipped.
(c) Cut corner of engine mount on right side with hacksaw to provide clearance for pan removal, if required.
(4) On all vehicles, bend tabs down on dust shield, if equipped with manual transmission.
(5) Remove oil pan attaching screws. Remove oil pan.
(6) Remove oil pan front and rear neoprene oil seals.
(7) Thoroughly clean gasket surfaces of oil pan and engine block. Remove all sludge and residue from oil pan sump.

Installation

(1) Install replacement oil pan front seal for timing case cover. Apply generous amount of Jeep Gasket-in-a-Tube (RTV silicone sealant), or equivalent, to end tabs.
(2) Coat inside curved surface of replacement oil pan rear seal with soap or RTV silicone sealant. Apply generous amount of RTV silicone sealant to gasket contacting surface of seal end tabs.
(3) Install seal in recess of rear main bearing cap, ensuring it is fully seated.
(4) Apply RTV silicone sealant to oil pan contacting surface of front and rear oil pan seals.
(5) Cement replacement oil pan side gaskets into position on engine block. Apply generous amount of RTV silicone sealant to gasket ends.
(6) Install oil pan. Tighten 1/4-20 oil pan screws with 7 foot-pounds (9 N•m) torque and 5/16-18 oil pan screws with 11 foot-pounds (15 N•m) torque.
(7) Tighten drain plug securely.
(8) Install starter motor and connect cable.
(9) On CJ vehicles:
(a) Install frame cross bar.
(b) Install automatic transmission fluid cooler tubing, if removed.
(10) Fill crankcase to specified level with clean lube oil.

Oil Pressure Gauge

Refer to Chapter 1L—Power Plant Instrumentation for a description of operation, diagnosis and replacement procedure.

CONNECTING ROD AND PISTON ASSEMBLIES

Use the following procedures to service connecting rods and pistons with the engine installed in the vehicle.

Removal

(1) Remove cylinder head cover(s).
(2) Alternately loosen bridge and pivot assembly capscrews one turn at a time to avoid damaging bridges. Remove bridges, pivots and rocker arms.
(3) Remove push rods.

NOTE: *Retain bridges, pivots, rocker arms and push rods in same order as removed to facilitate installation in original locations.*

(4) Remove intake manifold assembly.
(5) Remove exhaust manifold(s). It is not necessary to disconnect exhaust pipe from manifold.
(6) Remove cylinder head(s) and gasket(s).
(7) Position pistons, one at a time, near bottom of stroke. Use ridge reamer to remove any ridge from top end of cylinder walls.
(8) Drain engine oil.
(9) Remove oil pan.
(10) Remove connecting rod bearing caps and inserts. Retain in same order as removed.

NOTE: *Connecting rods and caps are stamped with the number of the associated cylinder.*

(11) Remove connecting rod and piston assemblies through top of cylinder bores. Ensure that connecting rod bolts do not scratch connecting rod journals or cylinder walls. Short pieces of rubber hose slipped onto rod bolts will provide protection during removal.

Installation

(1) Thoroughly clean cylinder bores. Apply light film of clean engine oil to bores with clean, lint-free cloth.
(2) Arrange spacing of piston ring gaps. Refer to Piston Rings for procedure.
(3) Lubricate piston and ring surfaces with clean engine oil.
(4) Use piston ring compressor tool to install connecting rod and piston assemblies through top of cylinder bores. Ensure that connecting rod bolts do not scratch connecting rod journals or cylinder walls. Short lengths of rubber hose slipped over connecting rod bolts will provide protection during installation.

NOTE: *Squirt holes in connecting rods must face inward (fig. 1B-130).*

(5) Install connecting rod bearing caps and inserts in original positions. Tighten retaining nuts with 33 foot-pounds (45 N•m) torque.
(6) Install engine oil pan using replacement gaskets and seals.

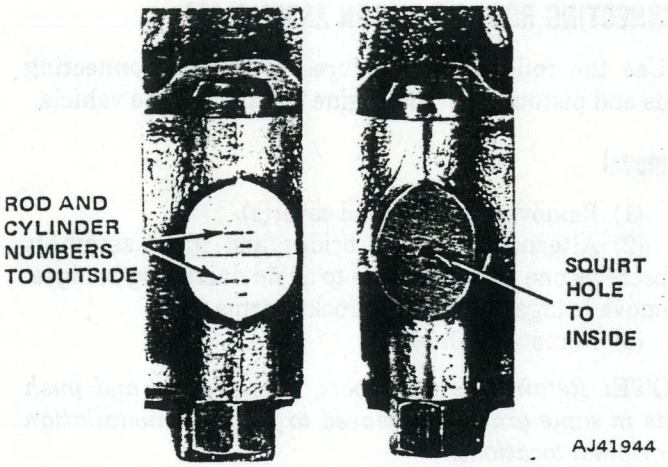

Fig. 1B-130 Rod Number and Squirt Hole Location

(7) Install cylinder head(s) and replacement gasket(s).

(8) Install push rods.

(9) Install rocker arms and bridge and pivot assemblies. Loosely install capscrews through each bridge and alternately tighten, one turn at a time, to avoid damaging bridge. Tighten capscrews with 19 foot-pounds (26 N•m) torque.

(10) Install intake manifold gasket and manifold assembly.

(11) Install exhaust manifold(s).

(12) Reseal and install cylinder head cover(s).

(13) Fill crankcase with clean oil to specified level.

WARNING: *Use extreme caution when engine is operating. Do no stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(14) Start engine inspect for leaks.

CONNECTING RODS

The connecting rods are malleable iron and are independently balanced. The crankshaft end of the connecting rod incorporates a two-piece bearing insert. The number stamped onto the removeable bearing cap and onto the adjacent machined surface of the rod corresponds to the associated cylinder (fig. 1B-130). The piston end of the rod is connected to the piston with a 2000 pound (8.9 kN) press-fitted piston pin.

Have the connecting rod alignment checked by a competent machine shop whenever engine wear patterns or damage indicates probable rod misalignment. Always replace bent connecting rods.

Connecting Rod Side Clearance Measurement

(1) Rotate crankshaft to position where connecting rod journal is at bottom of stroke.

(2) Insert snug fitting feeler gauge between connecting rods (fig. 1B-131).

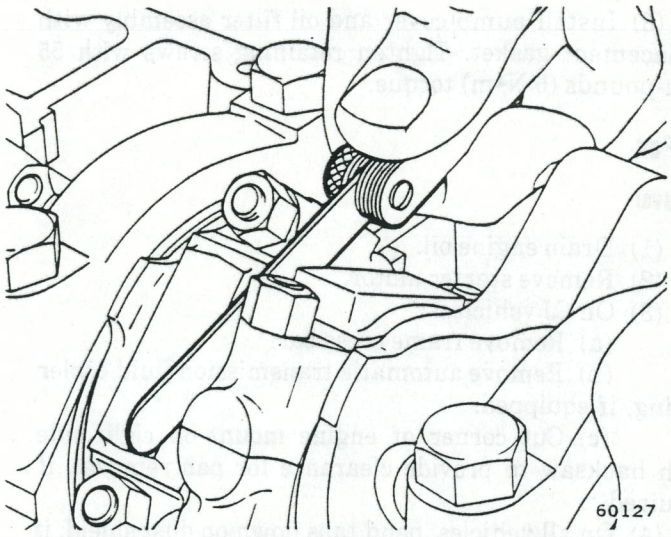

Fig. 1B-131 Connecting Rod Side Clearance Measurement

(3) Compare feeler gauge measurement to specified clearance. Replace rods that are not within specifications.

Connecting Rod Bearings

The connecting rod bearings are precision-type steel-backed aluminum alloy inserts. The connecting rod bearing inserts are selectively fitted to their respective journals to obtain the desired operating clearance. **In production,** the select fit is obtained by using various sized color coded bearing inserts as listed in the Bearing Fitting Chart. The bearing color code appears on the edge of the insert.

NOTE: *Bearing size is not stamped on production inserts.*

The rod journal size is identified **in production** by a color coded paint mark on the adjacent cheek or counterweight toward the flanged (rear) end of the crankshaft. Refer to color codes listed in the Bearing Fitting Chart to identify journal size and select the correct bearing inserts to obtain correct clearances.

CAUTION: *Never use a pair of bearing inserts that are greater than 0.001-inch (0.025 mm) difference in size.*

When required, different sized upper and lower bearing inserts may be used as a pair. A standard size insert is sometimes used in combination with a 0.001-inch (0.025 mm) undersize insert to reduce clearance by 0.0005 inch or 1/2 thousandth of an inch (0.013 mm). Example:

Insert	Correct	Incorrect
Upper	Standard	Standard
Lower	0.001-inch (0.025mm) undersize	0.002-inch (0.051mm) undersize

70242

Connecting Rod Bearing Fitting Chart

304 - 360 CID Engines

Crankshaft Connecting Rod Journal Color Code and Diameter in Inches (Journal Size)	Bearing Color Code	
	Upper Insert Size	Lower Insert Size
Yellow —2.0955 to 2.0948 (53.2257 - 53.2079 mm) (Standard)	Yellow — Standard	Yellow — Standard
Orange —2.0948 to 2.0941 (53.2079 - 53.1901 mm) (0.0007 Undersize)	Yellow — Standard	Black —0.001-inch (0.025mm)Undersize
Black —2.0941 to 2.0934 (53.1901 - 53.1723 mm) (0.0014 Undersize)	Black —0.010-Inch (0.025mm)Undersize	Black —0.001-inch (0.025mm)Undersize
Red —2.0855 to 2.0848 (52.9717 - 52.9535 mm) (0.010 Undersize)	Red —0.010-Inch (0.254mm)Undersize	Red —0.010-inch (0.254mm)Undersize

Service replacement bearing inserts are available in pairs in the following sizes: standard, 0.001-inch (0.025 mm) undersize, 0.002-inch (0.051 mm) undersize, 0.010-inch (0.250 mm) undersize and 0.012-inch (0.305 mm) undersize. The size is stamped on the back of service replacement inserts.

NOTE: *The 0.002-inch (0.051 mm) and 0.012-inch (0.305 mm) undersize inserts are not used for production engine assembly.*

Removal

Use the following procedure to service connecting rod bearings with the engine installed in the vehicle.

(1) Drain engine oil.

(2) Remove oil pan.

(3) Rotate crankshaft as required to position two connecting rods at a time at bottom of their stroke.

(4) Remove bearing caps and lower inserts.

(5) Remove upper insert by rotating insert out of connecting rod.

NOTE: *Do not interchange bearing caps. Connecting rod and corresponding cap are stamped with the associated cylinder number (fig. 1B-130). The numbers are located on a machined surface opposite the squirt holes.*

Inspection

(1) Clean inserts

(2) Inspect linings and backs of inserts for irregular wear pattern. Note any scraping, stress cracks or distortion (fig. 1B-132). If bearing has spun in rod, replace bearing and connecting rod and inspect crankshaft journal for scoring.

(3) Inspect for material imbedded in linings that may indicate abnormal piston, timing gear, distributor gear or oil pump gear wear. Figures 1B-133 and 1B-134 depict common score problems.

(4) Inspect fit of insert locking tab in rod cap. If result of inspection indicates that insert tab may have been pinched between rod and rod cap, replace upper and lower bearing inserts.

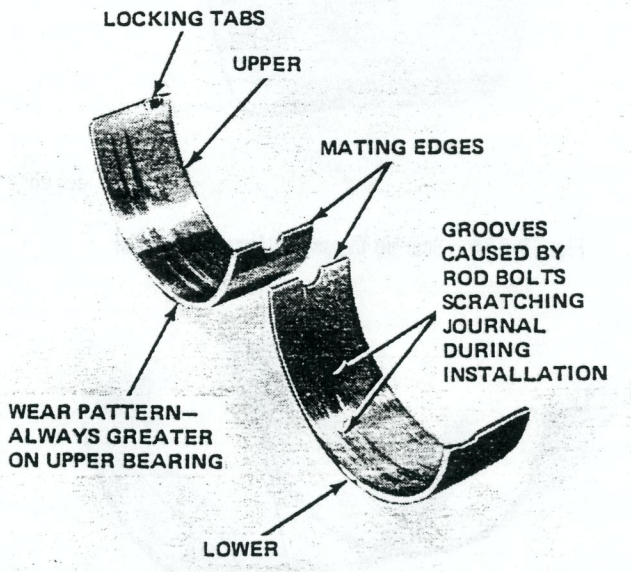

Fig. 1B-132 Connecting Rod Bearing Inspection

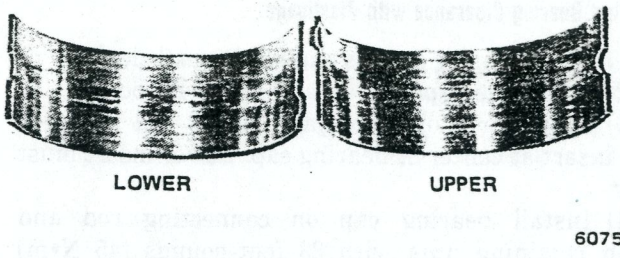

Fig. 1B-133 Scoring Caused by Insufficient Lubrication

(5) Inspect contact area of locking tab. Abnormal wear indicates bent tabs or improper installation of inserts (fig. 1B-135).

(6) Replace bearing inserts that are damaged or worn.

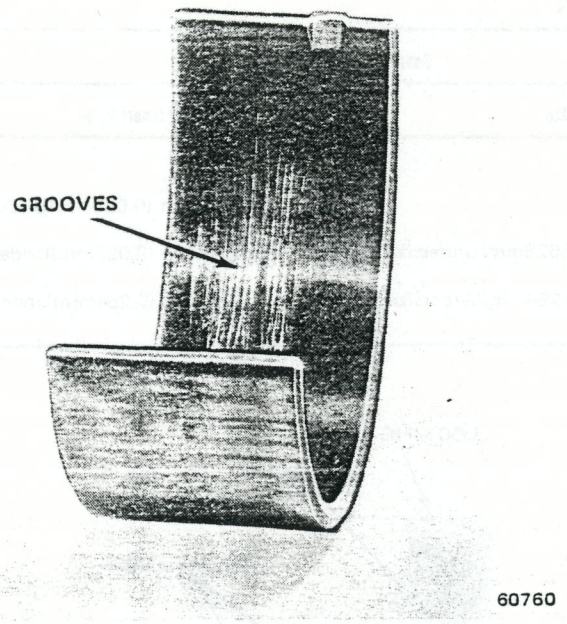

Fig. 1B-134 Scoring Caused by Foreign Material

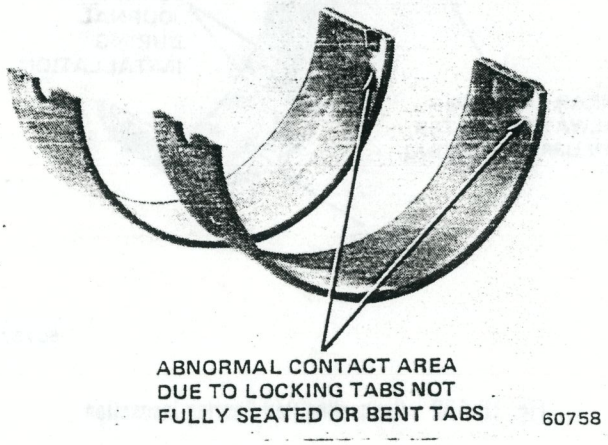

Fig. 1B-135 Locking Tab Inspection

Measuring Bearing Clearance with Plastigage

(1) Wipe bearing inserts and rod journal clean.

(2) Lubricate upper insert and install in rod.

(3) Place strip of Plastigage across full width of lower insert at center of bearing cap. Lower insert must be dry.

(4) Install bearing cap on connecting rod and tighten retaining nuts with 33 foot-pounds (45 N•m) torque.

NOTE: *Do not rotate crankshaft. Plastigage will shift, resulting in inaccurate indication. Plastigage must not crumble. If brittle, obtain fresh stock.*

(5) Remove bearing cap and determine amount of clearance by measuring width of compressed Plastigage with scale on Plastigage envelope (fig. 1B-136).

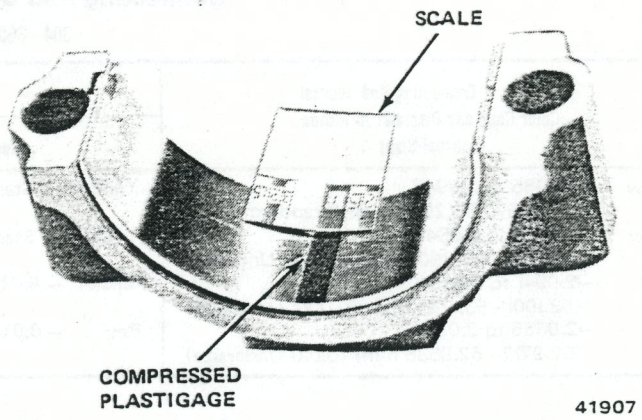

Fig. 1B-136 Connecting Rod Bearing Clearance Measurement with Plastigage

(6) If correct clearance is indicated, bearing fitting is not necessary. Remove Plastigage from crankshaft journal and bearing and proceed to Installation.

NOTE: *Traces of Plastigage left on bearing surfaces will dissolve in hot engine oil after engine is operating.*

(7) If oil clearance exceeds specification, install 0.001-inch (0.025 mm) undersize bearing inserts and measure clearance as described in steps (1) through (5) above.

NOTE: *The measured clearance with 0.001-inch (0.025 mm) undersize bearing inserts installed will determine if a pair of 0.001-inch (0.025 mm) undersize inserts or some other combination are needed to provide the correct clearance. For example, if the initial clearance was 0.003 inch (0.076 mm), 0.001-inch (0.025 mm) undersize inserts will reduce the clearance by 0.001 inch (0.025 mm). The oil clearance will be 0.002 inch (0.051 mm) and within specification. A combination of a 0.002-inch (0.051 mm) undersize insert and a 0.001-inch (0.025 mm) undersize insert will reduce the clearance an additional 0.0005 inch (0.013 mm). The oil clearance will then be 0.0015 inch (0.038 mm).*

CAUTION: *Never use a combination of inserts that differ more than one bearing size as a pair. For example, do not use a standard upper and a 0.002-inch (0.051 mm) undersize lower insert.*

(8) If oil clearance exceeds specification when 0.002-inch (0.051 mm) undersize inserts are installed, measure diameter of connecting rod journal with micrometer. If journal diameter is correct, inside diameter of connecting rod is incorrect and rod must be replaced.

Measuring Connecting Rod Journal with Micrometer

NOTE: *If the journal diameter does not conform to the specification, it may have been ground 0.010-inch (0.254 mm) or more undersize.*

If journal diameter is incorrect, replace crankshaft or grind journal to accept the appropriate undersized bearing insert pair.

(1) Wipe connecting rod journal clean.

(2) Use micrometer to measure journal diameter at two locations 90 degrees apart at each end of journal. Note difference between maximum and minimum diameters.

(3) Refer to Specifications for maximum allowable taper and out-of-roundness. If any rod journal dimension is not within specification, replace crankshaft or recondition crankshaft journals and fit with appropriate undersize bearing inserts.

(4) Compare largest diameter measurement with journal diameters listed in Bearing Fitting Chart.

(5) Select bearing insert pair required to provide specified bearing clearance.

NOTE: *Always measure clearance with Plastigage after installing replacement bearing inserts. Also, measure the clearance of each journal after installing a crankshaft kit (crankshaft supplied with bearings).*

Installation

CAUTION: *Use care when rotating the crankshaft with bearing caps removed. Ensure the connecting rod bolts do not accidentally come in contact with the rod journals and scratch the surface finish, which can cause bearing failure. Short pieces of rubber hose slipped over the rod bolts will provide protection during installation.*

(1) Rotate crankshaft to position connecting rod journal at bottom of stroke.

(2) Lubricate bearing surface of each insert with clean engine oil.

(3) Install bearing inserts, cap and retaining nuts. Tighten with 33 foot-pounds (45 N•m) torque.

(4) Install oil pan using replacement gaskets and seals. Tighten drain plug securely.

(5) Fill crankcase to specified level with clean engine lube oil.

PISTONS

The pistons used with all eight-cylinder engines are aluminum alloy Autothermic pistons. They are steel reinforced for strength and to control expansion.

The pistons are cam-ground and are elliptical in shape. The ring belt area contains three piston rings: two compression rings and one oil control ring located above the piston pin.

The piston pin boss is offset from the piston centerline so that it is nearer the thrust side of the piston. This minimizes piston slap.

To ensure correct installation of the pistons in the bore, two notches are cast in the top perimeter of the pistons for both the 304 (5 liter) and 360 (6 liter) CID engines. The notches must face forward when installed (fig. 1B-137).

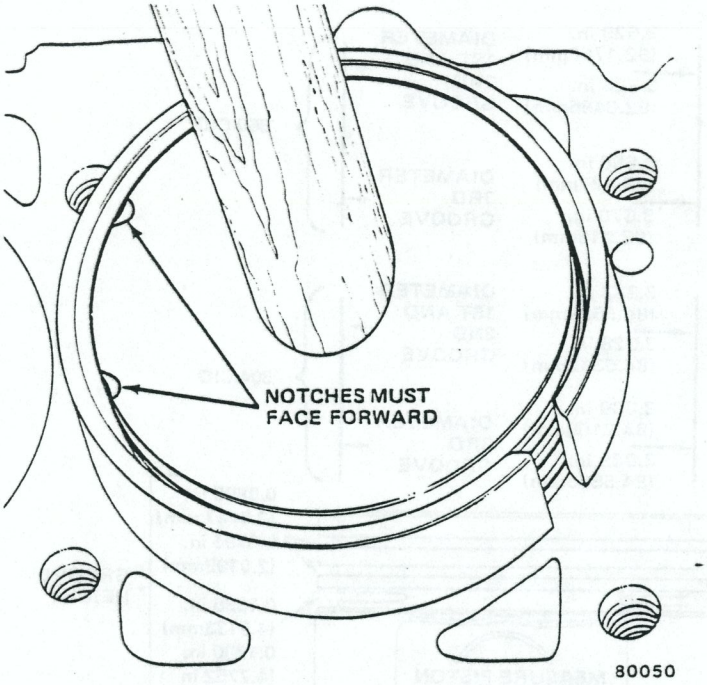

Fig. 1B-137 Installing Piston Assembly Into Cylinder Bore

Piston Measurements

Micrometer Method

(1) Use inside micrometer to measure cylinder bore inside diameter at location 2 5/16 inches (59 mm) below top of bore and crosswise to block.

(2) Measure outside diameter of piston.

NOTE: *Pistons are cam ground and must be measured at a right angle (90 degrees) to piston pin at centerline of pin (fig. 1B-138).*

(3) Difference between cylinder bore diameter and piston diameter dimensions is piston-to-bore clearance. Refer to Specifications.

Feeler Gauge Method

(1) Remove rings from piston.

(2) Insert long 0.0005-inch (0.013 mm) feeler gauge into cylinder bore.

(3) Insert piston (top first) into cylinder bore alongside feeler gauge. With entire piston inserted in cylinder bore, piston should not bind against feeler gauge.

(4) Repeat steps (2) and (3) above with long 0.002-inch (0.051 mm) feeler gauge. Piston should bind.

If the piston binds on the 0.0005-inch (0.013 mm) feeler gauge, either the piston is too large or the cylinder bore is too small. If the piston does not bind on the 0.002-inch (0.051 mm) feeler gauge, the piston may be enlarged by knurling or shot-peening. Replace any piston that is 0.004-inch (0.102 mm) or more undersize.

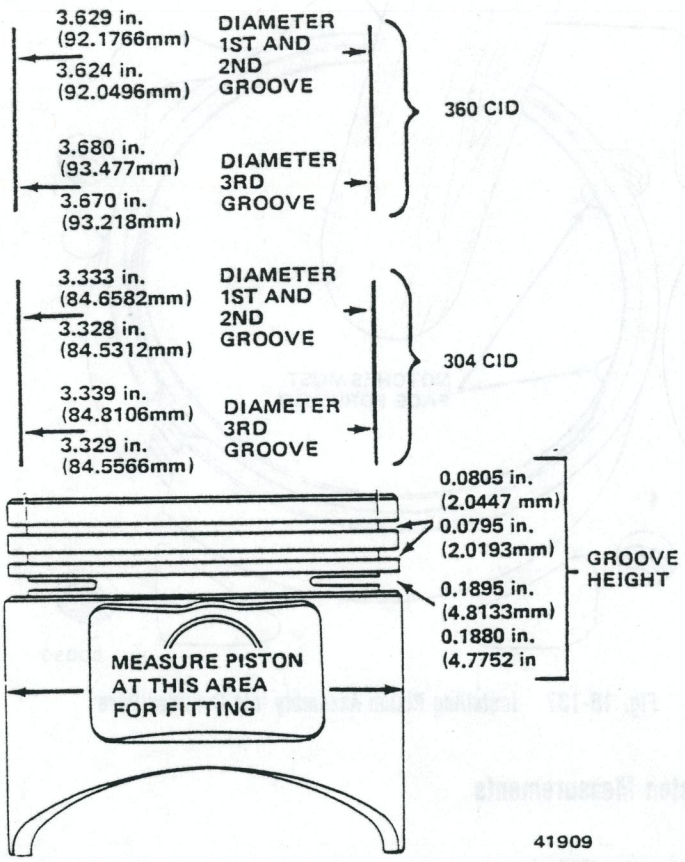

Fig. 1B-138 Piston Measurements

Piston Rings

The top compression ring is constructed of moly-filled iron. The second compression ring is constructed of cast-iron. The oil control ring has a three-piece steel design.

Ring Measurements

CAUTION: *Do not remove metal from grooves or lands. This will change ring groove clearances and will destroy ring-to-land seating.*

(1) Clean carbon deposits from all ring grooves. Ensure oil drain openings in oil ring grooves and pin boss are open.

(2) Measure ring side clearance with correct size feeler gauge that fits snugly between ring land and ring. Slide ring around groove. It must slide freely around circumference of groove (fig. 1B-139). Refer to Specifications for correct ring side clearance.

(3) Place ring in cylinder bore. Use inverted piston to push ring down near lower end of ring travel area. Measure ring gap (clearance) with feeler gauge fitted snugly in ring opening (fig. 1B-140). Refer to Specifications.

NOTE: *Insert each compression ring (not oil control rings) in its respective cylinder bore and measure end gap.*

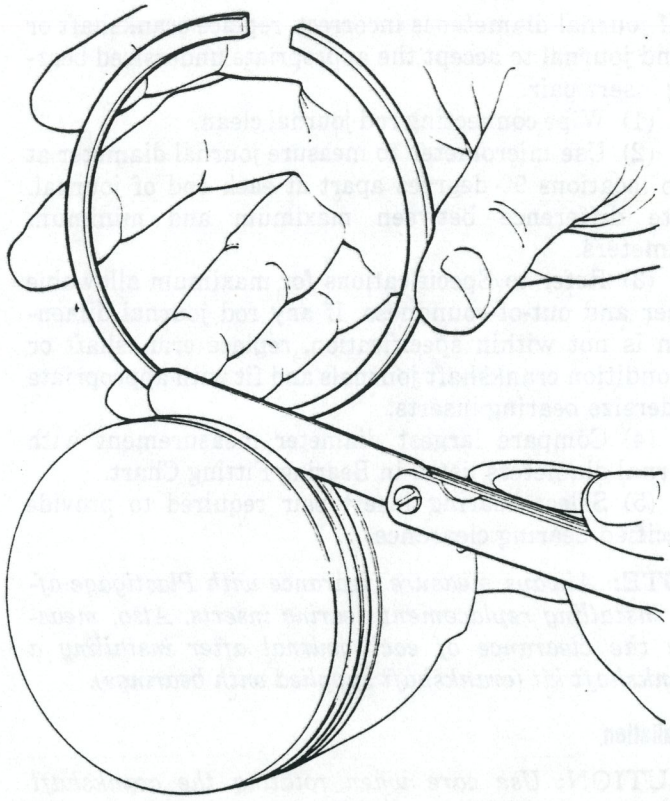

Fig. 1B-139 Ring Side Clearance Measurement

Installation

NOTE: *Ensure top and bottom compression rings are installed properly. Ideally, ring gaps should be spaced 180 degrees from each other. Correct ring gap spacing is depicted in figure 1B-141.*

(1) Install oil control rings according to instructions in package. Roll upper and lower rails into place without use of tool (fig. 1B-142).

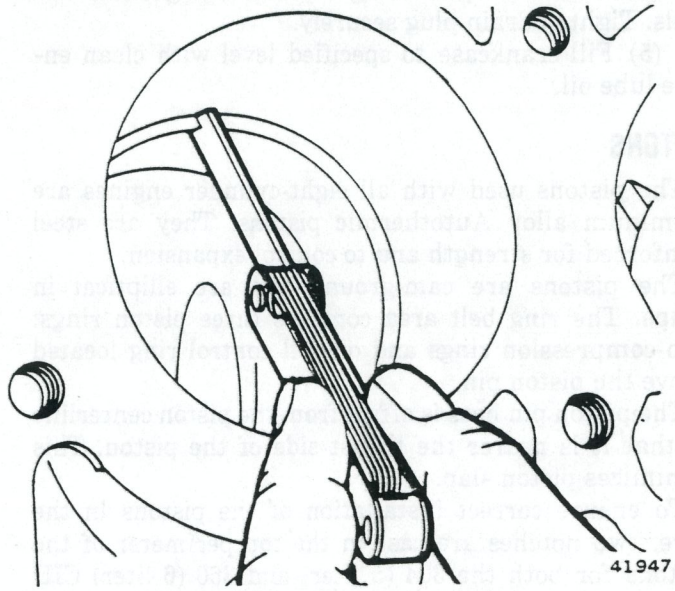

Fig. 1B-140 Compression Ring Gap Measurement

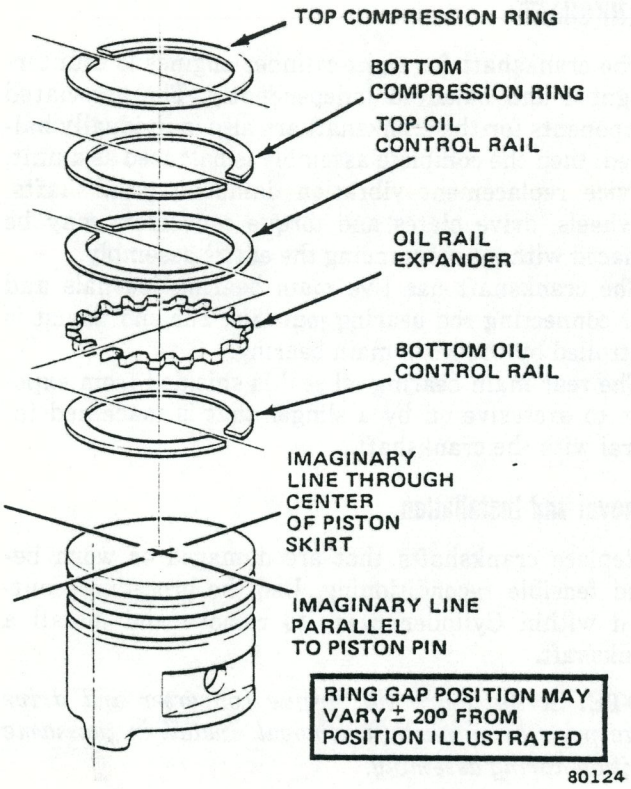

Fig. 1B-141 Ring Gap Spacing

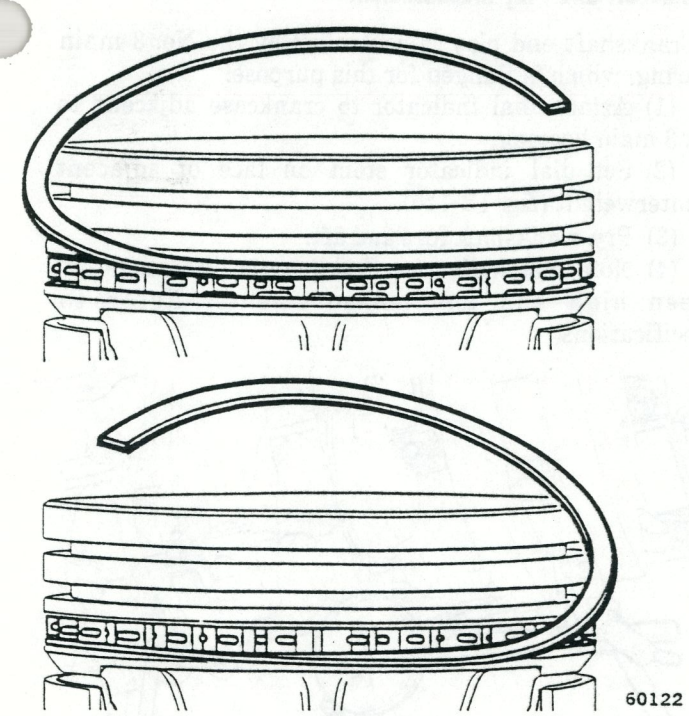

Fig. 1B-142 Installing Oil Control Ring Upper and Lower Rails

(2) Install bottom compression ring using ring installer to expand ring around piston (fig. 1B-143).

NOTE: *Ensure top and bottom compression rings are installed with* ***top*** *side up. Figure 1B-144 illustrates typical ring marks that indicate the* ***top*** *side of the ring.*

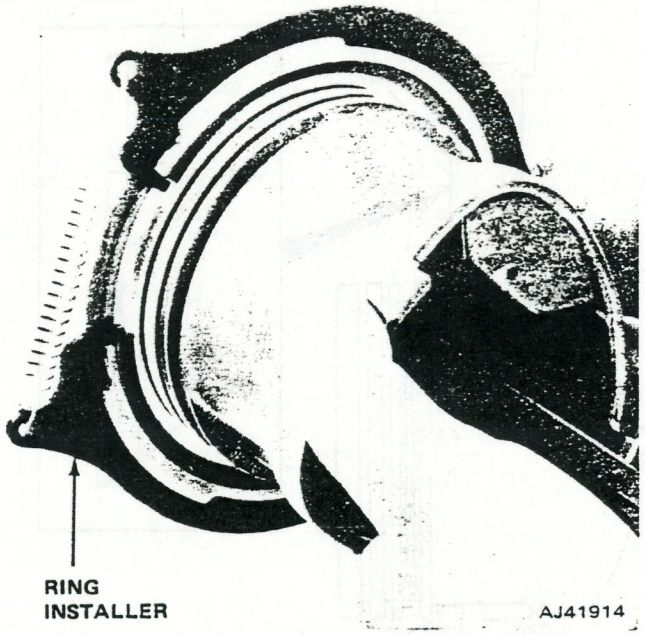

Fig. 1B-143 Compression Ring Installation

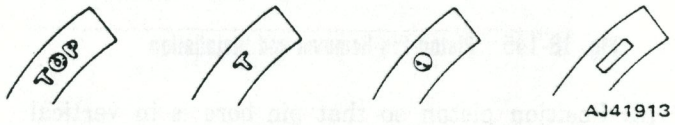

Fig. 1B-144 Typical Compression Ring Marks

(3) Install top compression ring using ring installer to expand ring around piston (fig. 1B-143).

Piston Pins

The piston pins are pressed into the rods with 2000 pounds force (8900 N) and do not require a retaining device.

Removal

(1) Using Piston Pin Remover Tool J-21872 and arbor press, place piston on Remover Support Tool J-21872-1 (fig. 1B-145).

(2) Use Piloted Driver Tool J-21872-3 to press pin completely out of piston and connecting rod. Note position of pin through gauge window of remover support tool.

Pin Fitting

(1) Inspect piston and connecting rod bores for nicks and burrs. Replace rod and piston if necessary.

NOTE: *Never reuse a piston pin after it has been pressed in and out of a connecting rod.*

(2) With pin removed from piston and connecting rod, clean and dry piston pin bores.

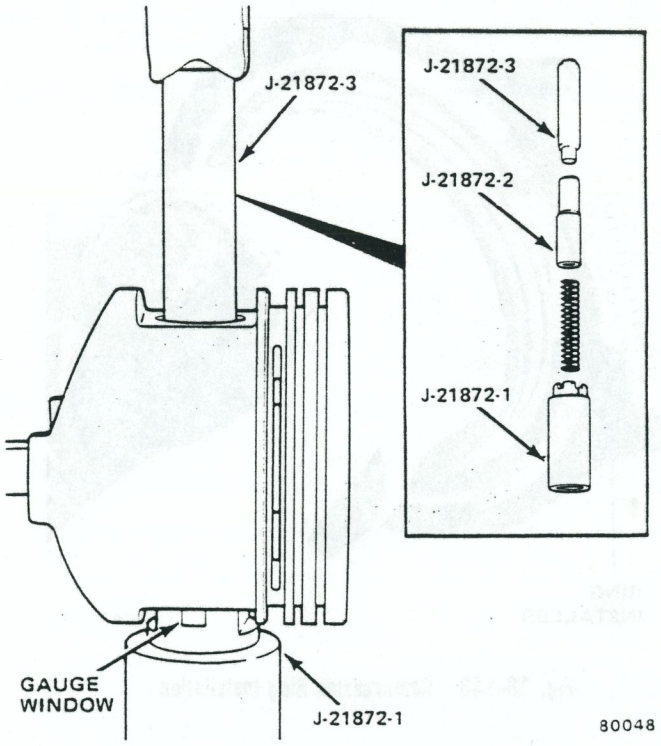

Fig. 1B-145 Piston Pin Removal and Installation

(3) Position piston so that pin bore is in vertical position. Insert replacement pin in bore. At room temperature, replacement pin should slide completely through piston bore without forcing.

(4) Replace piston if pin jams in bore.

Installation

(1) Position piston and connecting rod so that piston notches will face forward and rod squirt hole will face inward when assembly is installed in engine.

(2) Place Pin Pilot Tool J-21872-2 through piston and connecting rod pin bores (fig. 1B-145).

(3) Place pin pilot, piston and connecting rod on Support Tool J-21872-1.

(4) Insert piston pin into piston pin bore and into connecting rod pin bore.

(5) Insert Piloted Driver Tool J-21872-3 into piston pin.

(6) Use arbor press to press piston pin through connecting rod and piston bores until pin pilot indexes with mark on support.

NOTE: *The piston pin requires 2000 pounds force (8900 N) for installation. If insufficient force is required to press piston pin into connecting rod, or if rod slides along pin, replace connecting rod.*

(7) Remove piston and connecting rod assembly from press. Pin should be centered in rod ±1/32 inch (0.787 mm).

CRANKSHAFT

The crankshaft for eight-cylinder engines is counterweighted and balanced independently. The associated components for the crankshaft are also individually balanced, then the complete assembly is balanced as a unit. Service replacement vibration dampers, crankshafts, flywheels, drive plates and torque converters may be replaced without rebalancing the entire assembly.

The crankshaft has five main bearing journals and four connecting rod bearing journals. The end thrust is controlled by the No. 3 main bearing.

The rear main bearing oil seal is shielded from exposure to excessive oil by a slinger that is machined integral with the crankshaft.

Removal and Installation

Replace crankshafts that are damaged or worn beyond feasible reconditioning. Use the procedures outlined within Cylinder Block to remove and install a crankshaft.

NOTE: *Scribe mark the torque converter and drive plate prior to crankshaft removal. Install in the same position during assembly.*

Crankshaft End Play Measurement

Crankshaft end play is controlled by the No. 3 main bearing, which is flanged for this purpose.

(1) Attach dial indicator to crankcase adjacent to No. 3 main bearing.

(2) Set dial indicator stem on face of adjacent counterweight (fig. 1B-146).

(3) Pry crankshaft fore and aft.

(4) Note dial indicator. End play is difference between high and low measurements. Refer to Specifications

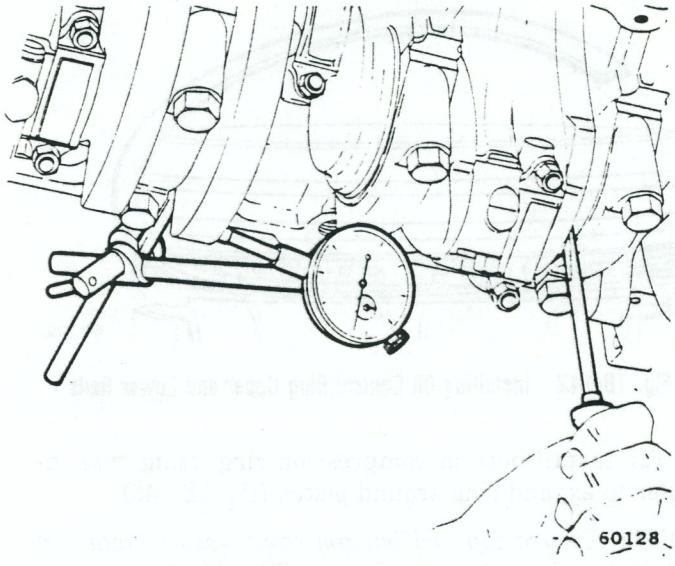

Fig. 1B-146 Crankshaft End Play Measurement

(5) If end play is not within specification, inspect crankshaft thrust faces for wear. If no wear is apparent, replace No. 3 (thrust) main bearing inserts and measure end play. If end play is not within specification, replace crankshaft.

NOTE: *When installing the No. 3 (thrust) main bearing inserts, pry the crankshaft fore and aft to align the thrust faces of the bearing inserts before final tightening.*

Crankshaft Main Bearings

The main bearing inserts are steel-backed aluminum-tin lined. Optional bearing inserts are available with overplated copper-lead linings. The main bearing caps are numbered 1 through 5, front to rear, with an arrow to indicate the forward position. The upper main bearing insert surfaces are grooved. The lower insert surfaces are smooth.

Each bearing insert pair is selectively fitted to its respective journal to obtain the desired operating oil clearance. **In production,** the select fit is obtained by using various-sized color-coded main bearing inserts as listed in the Main Bearing Fitting Chart. The bearing color code appears on the edge of the insert.

NOTE: *The bearing size is not stamped on production inserts.*

The main bearing journal diameter is identified **in production** by a color-coded paint mark on the adjacent cheek toward the flanged (rear) end of the crankshaft, except for the rear main journal. The paint mark that identifies the rear main journal diameter is on the crankshaft rear flange.

Refer to the Main Bearing Fitting Chart to select the proper bearing inserts to obtain the specified bearing clearance. The correct clearance is 0.0015 to 0.0020 inch (0.038 to 0.051 mm) for No. 1 through No. 4 main bearings and 0.0025 to 0.0030 inch (0.064 to 0.076 mm) for the rear main bearing.

When required, use different sized upper and lower bearing inserts as a pair. Use a standard size upper insert in combination with a 0.001-inch (0.025 mm) undersize lower insert to reduce the clearance by 0.0005 inch or 1/2 thousandth of an inch (0.013 mm).
Example:

Insert	Correct	Incorrect
Upper	Standard	Standard
Lower	0.002-inch (0.051 mm) undersize	0.001-inch (0.025 mm) undersize

70242

NOTE: *When installing upper and lower inserts having different sizes, install undersize inserts either all on the top (upper) or all on the bottom (lower). Never use bearing inserts in combination with greater than 0.001-inch (0.025 mm) difference in size.*

Service replacement main bearing inserts are available as pairs in the following sizes: standard, 0.001-inch (0.025 mm) undersize, 0.002-inch (0.051 mm) undersize, 0.010-inch (0.250 mm) undersize, and 0.012-inch (0.305 mm) undersize. The bearing size is stamped on the back of service replacement inserts.

NOTE: *The 0.012-inch (0.305 mm) undersize insert is not used for production engine assembly.*

Removal

The following procedure can be used when the engine is installed in the vehicle.

(1) Drain engine oil and remove oil pan.
(2) Remove main bearing cap and lower insert.
(3) Remove lower insert from bearing cap.
(4) Remove upper insert by loosening all other bearing caps and inserting tool fabricated from cotter pin approximately 1/2-inch (14 mm) into crankshaft oil hole. Fabricate cotter pin as depicted in figure 1B-147.

Main Bearing Fitting Chart

Crankshaft Main Bearing Journal Color Code and Diameter in Inches (Journal Size)	Bearing Color Code	
	Upper Insert Size	Lower Insert Size
Yellow —2.7489 to 2.7484 (69.8220-69.8093mm) (Standard)	Yellow —Standard	Yellow —Standard
Orange —2.7484 to 2.7479 (69.8093-69.7966mm) (0.0005 Undersize)	Yellow —Standard	Black 0.001-inch (0.025mm) Undersize
Black —2.7479 to 2.7474 (69.7966-69.7839mm) (0.001 Undersize)	Black 0.001-inch (.025mm) Undersize	Black 0.001-inch (0.025mm) Undersize
Green —2.7474 to 2.7469 (69.7839-69.7712mm) (0.0015 Undersize)	Black 0.001-inch (.025mm) Undersize	Green 0.002-inch (0.051mm) Undersize
Red —2.7389 to 2.7384 (69.5680-69.5553mm) (0.010 Undersize)	Red 0.010-inch (.254mm) Undersize	Red 0.010-inch (0.254mm) Undersize

60273

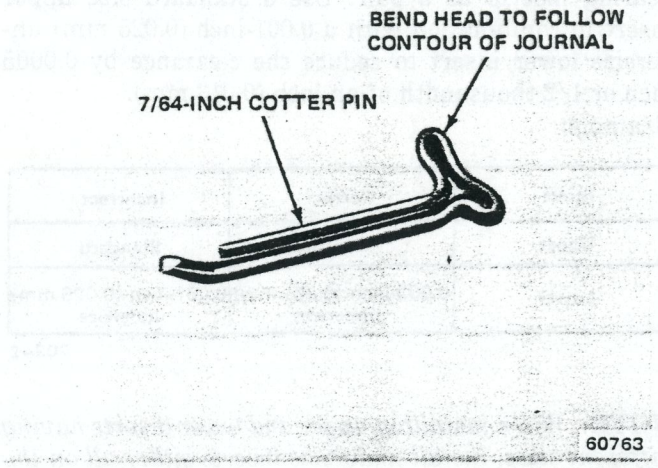

Fig. 1B-147 Fabricated Upper Main Bearing Insert Removal Tool

(5) With cotter pin in place, rotate crankshaft so that upper bearing insert is rotated in direction of its locking tab.

(6) Remove remaining bearings in same manner as outlined above.

Inspection

(1) Wipe inserts clean and inspect for abnormal wear patterns and for metal or other foreign material imbedded in lining. Normal main bearing insert wear patterns are illustrated in figure 1B-148.

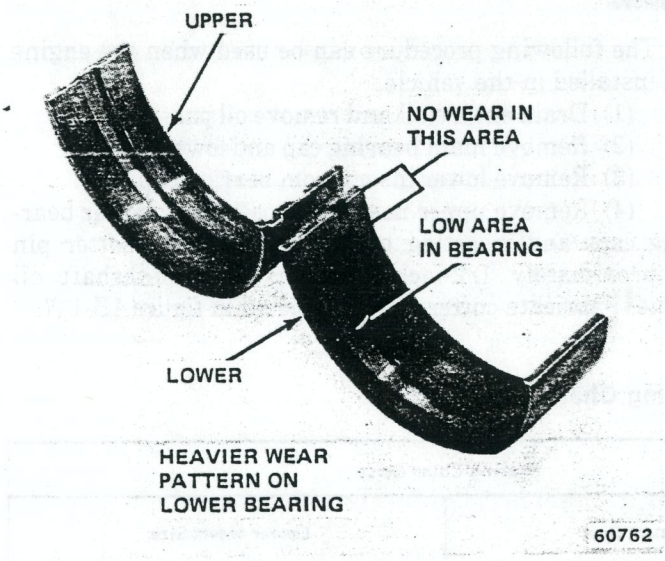

Fig. 1B-148 Normal Main Bearing Insert Wear Patterns

NOTE: *If any of the crankshaft journals are scored, remove the engine for crankshaft repair.*

(2) Inspect back of inserts for fractures, scrapings or irregular wear patterns.

(3) Inspect upper insert locking tabs for damage.

(4) Replace all damaged or worn bearing inserts.

Measuring Main Bearing Clearance with Plastigage (Crankshaft Installed)

(1) Support weight of crankshaft with jack placed under counterweight adjacent to journal being measured.

NOTE: *Measure clearance of one bearing at a time. ALL other bearing caps must remain tightened.*

(2) Remove main bearing cap and lower insert.

(3) Wipe insert and exposed portion of crankshaft journal clean.

(4) Place strip of Plastigage across full width of bearing insert.

NOTE: *Plastigage must not crumble. If brittle, obtain fresh stock.*

(5) Install bearing cap and tighten retaining screws with 100 foot-pounds (136 N•m) torque.

NOTE: *Do not rotate crankshaft. Plastigage will shift, resulting in inaccurate indication.*

(6) Remove bearing cap and determine amount of clearance by measuring width of compressed Plastigage with scale on Plastigage envelope. Correct clearance is 0.0015 to 0.0020 inch (0.038 to 0.051 mm) for No. 1 through No. 4 main bearings and 0.0025 to 0.003 inch (0.064 to 0.076 mm) for rear main bearing (fig. 1B-149).

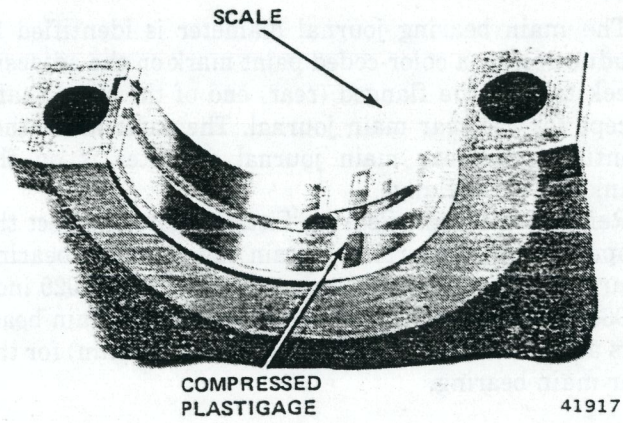

Fig. 1B-149 Measuring Main Bearing Clearance with Plastigage

NOTE: *The compressed Plastigage should maintain the same size across the entire width of the insert. If the size varies, this may indicate either a tapered journal or foreign material trapped behind the insert.*

(7) If correct clearance is indicated, bearing replacement is not necessary. Remove Plastigage from crankshaft and insert. Proceed to Installation.

NOTE: *Small pieces of Plastigage may remain on insert or journal surfaces. If so, they will dissolve in hot engine oil when the engine is operated.*

(8) If oil clearance exceeds specification, install pair of 0.001-inch (0.025 mm) undersize bearing inserts and measure clearance as described in steps (3) through (6) above.

(9) Clearance measured with 0.001-inch (0.025 mm) undersize inserts installed will determine if pair of 0.001-inch (0.025 mm) undersize inserts or some other size combination will provide correct clearance. For example, if clearance was 0.0035-inch (0.089 mm) originally, a pair of 0.001-inch (0.025 mm) undersize inserts will reduce clearance by 0.001 inch (0.025 mm). Oil clearance will be 0.0025 inch (0.064 mm) and within specification. Combination of 0.002-inch (0.051 mm) undersize insert and 0.001-inch (0.025 mm) undersize insert will reduce this clearance additional 0.0005 inch (0,013 mm) and oil clearance will be 0.002 inch (0.051 mm).

CAUTION: *Never use a combination of inserts that have a difference of more than one bearing size. For example, do not use a standard upper and 0.002-inch (0.051 mm) undersize lower insert.*

(10) If oil clearance exceeds specification with pair of 0.002-inch (0.051 mm) undersize inserts, measure crankshaft journal diameter with micrometer. Refer to Specifications. If journal diameter is correct, crankshaft bore in cylinder block may be misaligned, which requires cylinder block replacement. If journal diameter is incorrect, replace or grind crankshaft to standard undersize.

Installation

(1) Lubricate journal contact surface of each insert with clean engine oil.

(2) Loosen all main bearing caps.

(3) Install main bearing upper insert(s).

(4) Install main bearing cap(s) and lower insert(s). Tighten retaining screws evenly with 100 foot-pounds (136 N•m) torque in steps of 30, 60, 90 and 100 foot-pounds (41, 81, 122 and 136 N•m) torque. Rotate crankshaft after each tightening step to determine if it rotates freely. If it does not rotate freely, examine inserts for proper installation and size.

(5) Install oil pan using replacement gaskets and seals. Tighten drain plug securely.

(6) Fill crankcase to specified level with clean lube oil.

Measuring Main Bearing Journals with Micrometer (Crankshaft Removed)

(1) Wipe main bearing journals clean.

(2) Measure each journal diameter with micrometer. Note difference between maximum and minimum diameters of each journal.

(3) Refer to Specifications for maximum allowable taper and out-of-roundness.

(4) Compare measured largest diameter dimensions with journal diameter dimensions listed in Main Bearing Fitting Chart.

(5) Select insert pairs that will provide specified bearing clearance. Correct clearance is 0.0015 to 0.0020 inch (0.038 to 0.051 mm) for No. 1 through No. 4 main bearings and 0.0025 to 0.0030 inch (0.064 to 0.076 mm) for rear main bearing.

Rear Main Bearing Oil Seal

The rear main bearing oil seal consists of a two-piece neoprene single lip seal. Correct installation of the seal is required for leak-free engine operation.

Removal

(1) Drain engine oil.

(2) Remove starter motor.

(3) Remove oil pan.

(4) Remove oil pan front and rear neoprene oil seals.

(5) Remove oil pan side gaskets.

(6) Thoroughly clean gasket mating surfaces of oil pan and engine block. Remove all sludge and residue from oil pan sump.

(7) Remove rear main bearing cap.

(8) Remove and discard lower seal.

NOTE: *To ensure leak-free operation, always replace the upper and lower seal halves as a pair.*

(9) Clean main bearing cap thoroughly to remove all sealer.

(10) Loosen all remaining main bearing capscrews.

(11) Use brass drift and hammer to tap upper seal half until sufficient portion of seal is protruding to permit pulling seal out completely.

Installation

(1) Wipe crankshaft seal surface area clean and apply light film of oil.

(2) Coat block contact surface area of replacement upper seal half with soap and lip of seal with clean engine oil (fig. 1B-150).

(3) Insert upper seal half into engine block.

NOTE: *The lip of the seal must face the front of the engine.*

(4) Coat both sides of replacement lower seal half end tabs with Jeep Gasket-in-a-Tube (RTV silicone), or equivalent. Do not apply sealer to lip of seal.

(5) Coat outer curved surface of lower seal half with soap and lip of seal with clean engine oil.

(6) Insert seal into cap recess and seat firmly.

(7) Apply Jeep Gasket-in-a-Tube (RTV silicone), or equivalent, to both chamfered edges of rear main bearing cap.

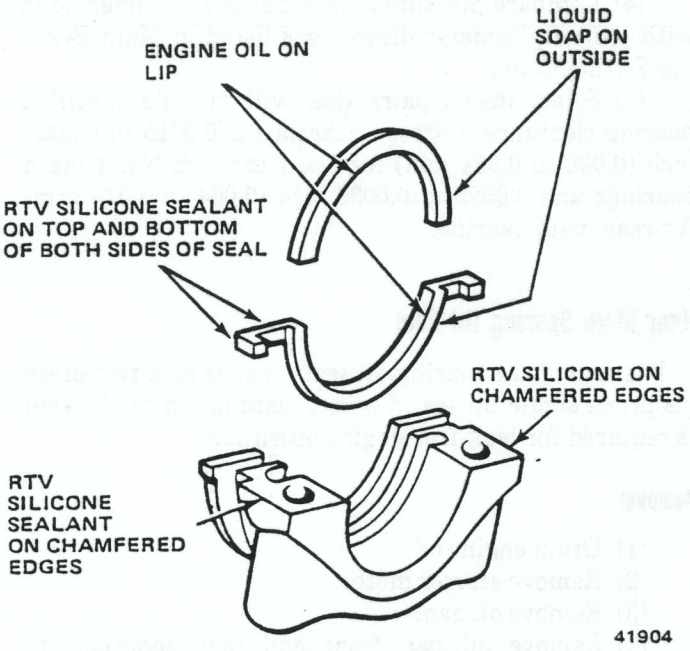

Fig. 1B-150 Rear Main Oil Seal Installation

CAUTION: *Do not apply sealer to the cylinder block mating surface of the rear main cap because bearing clearance could be affected.*

(8) Tighten all main bearing capscrews with 100 foot-pounds (136 N•m) torque.

(9) Install oil pan using replacement gaskets and seals. Tighten drain plug securely.

(10) Install starter motor.

(11) Fill crankcase to specified level with clean engine lube oil.

VIBRATION DAMPER AND PULLEY

The vibration damper is balanced independently and then rebalanced as part of the complete crankshaft assembly.

Do not attempt to duplicate original vibration damper balance holes when installing a service replacement damper. The vibration damper is not repairable and is serviced only as a complete assembly.

Removal

(1) Loosen damper retaining screw.

(2) Loosen alternator drive belt.

(3) Loosen air conditioner compressor drive belt, if equipped, and move aside.

(4) Loosen power steering pump drive belt, if equipped, and move aside.

(5) Remove damper pulley retaining bolts. Remove damper pulley from damper.

(6) Remove damper retaining screw and washer and loosely install screw to prevent damage to screw threads when removal tool is used.

(7) Use Vibration Damper Removal Tool J-21791 to remove damper from crankshaft (fig. 1B-151).

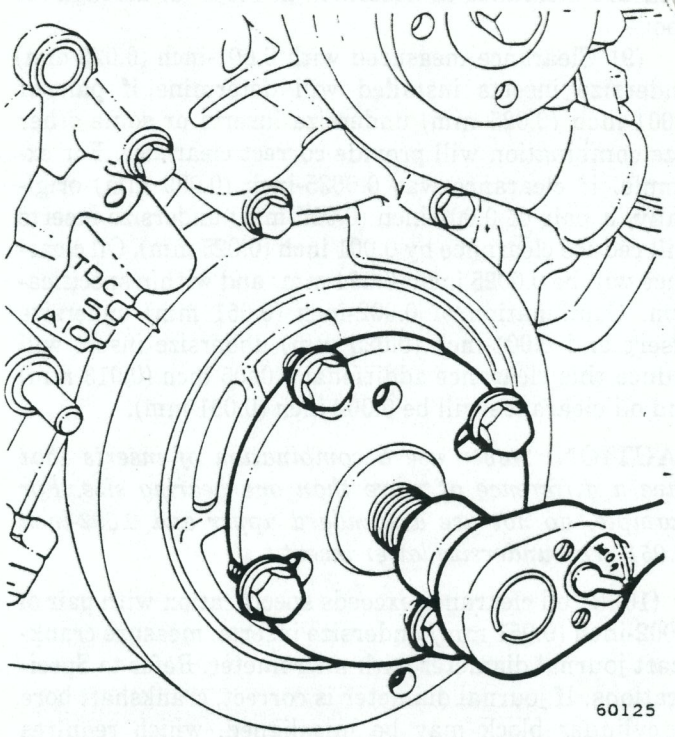

Fig. 1B-151 Vibration Damper Removal

Installation

(1) Polish damper hub with crocus cloth to prevent seal damage.

(2) Apply light film of engine oil to seal contact surface area of damper.

(3) Align key slot in damper hub with crankshaft key way.

(4) Position damper on end of crankshaft.

(5) Lubricate screw threads and washer with engine oil.

(6) Install damper retaining screw and washer and tighten with 90 foot-pounds (122 N•m) torque.

NOTE: *If crankshaft turns before specified torque is attained, proceed with belt installation. With belts installed, tighten damper retaining screw with 90 foot-pounds (122 N•m) torque.*

(7) Install damper pulley and retaining bolts. Tighten bolts with 30 foot-pounds (41 N•m) torque.

(8) Install drive belts and adjust to specified tension. Refer to Chapter 1C—Cooling Systems.

FLYWHEEL/DRIVE PLATE AND RING GEAR ASSEMBLY

The ring gear can be removed only from engines used with manual transmissions. With automatic transmissions, the ring gear is welded to and balanced as part of the drive plate and is not removeable.

Ring Gear Replacement—Manual Transmission (Flywheel Removed)

(1) Place flywheel on arbor press with steel blocks equally spaced around perimeter and under ring gear.
(2) Press flywheel down through ring gear.

NOTE: *The ring gear can also be removed by breaking it with a chisel.*

(3) Apply heat to expand inside perimeter of replacement ring gear.
(4) Press replacement ring gear onto flywheel.

NOTE: *The flywheel is balanced as an individual component and also as part of the crankshaft assembly. Do not attempt to duplicate original flywheel balance holes when installing a service replacement.*

CYLINDER BLOCK

Disassembly

(1) Drain engine oil.
(2) Remove engine assembly from vehicle as outlined in Engine Removal.
(3) Use engine stand to support engine assembly.
(4) Remove distributor.
(5) Remove cylinder head covers and gaskets.
(6) Remove bridge and pivot assemblies and rocker arms. Alternately loosen capscrews, one turn at a time, to avoid damaging bridge.
(7) Remove push rods.

NOTE: *Retain bridges, pivots, rocker arms, push rods and tappets in cylinder sets to facilitate installation in original locations.*

(8) Remove intake manifold assembly.
(9) Remove valve tappets.
(10) Remove cylinder heads and gaskets.
(11) Position pistons, one at a time, near bottom of stroke. Use ridge reamer to remove ridge, if any, from top end of cylinder walls.
(12) Loosen all drive belts. Remove power steering pump, air pump and air conditioner compressor, if equipped.
(13) Remove damper pulley and vibration damper.
(14) Remove timing case cover.
(15) Remove oil pan.
(16) Remove camshaft.
(17) Remove connecting rod bearing caps and inserts and retain in same order as removed.

NOTE: *Connecting rods and caps are stamped with the number of the associated cylinder.*

(18) Remove connecting rod and piston assemblies through top of cylinder bores. Ensure that connecting rod bolts do not scratch connecting rod journals or cylinder walls. Short pieces of rubber hose slipped over rod bolts will provide protection during removal.
(19) Remove oil pickup tube and screen assembly.
(20) Remove main bearing caps and inserts.
(21) Remove crankshaft.

Cylinder Bore Reconditioning

Cylinder Bore Measurement

Use a bore gauge to measure the cylinder bores (fig. 1B-152). If a bore gauge is not available, use an inside micrometer.

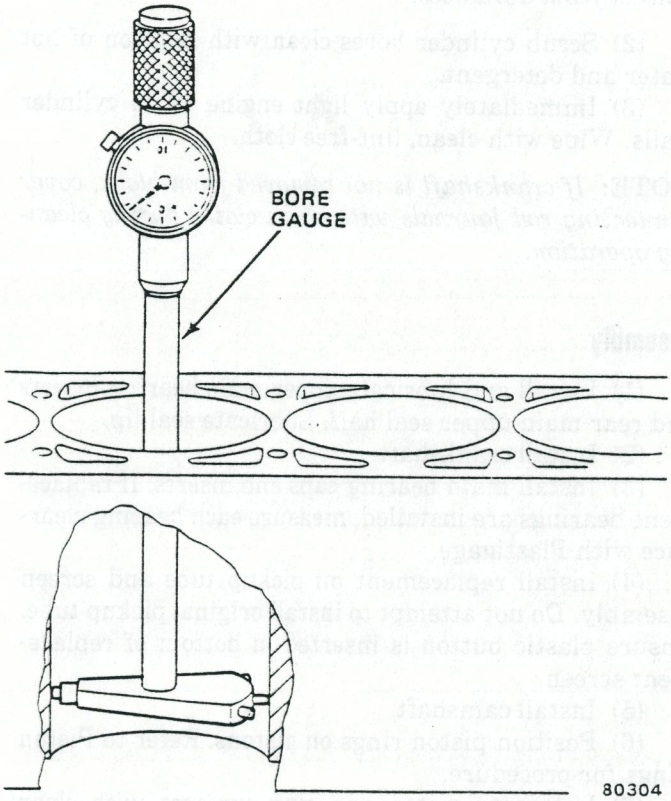

Fig. 1B-152 Measuring Cylinder Bore with Bore Gauge

(1) Measure cylinder bore crosswise to block near top of bore. Repeat measurement at bottom of bore.
(2) Determine taper by subtracting smaller dimension from larger dimension.
(3) Turn measuring device 120° and repeat step (1). Then turn another 120° and repeat measurements.
(4) Determine out-of-roundness by comparing difference between measurements taken 120° apart.

If the cylinder taper does not exceed 0.005 inch (0.127 mm) and the out-of-roundness does not exceed 0.003 inch (0.076 mm), true the cylinder bore by honing. If the cylinder taper or out-of-round condition exceeds these limits, bore and then hone cylinder for an oversize piston.

Resurfacing Cylinder Bore

CAUTION: *Do not use rigid type hones to remove cylinder glaze. A slight amount of taper always exists in cylinder walls after the engine has been in service for a period of time.*

(1) Use expanding hone to true cylinder bore and to remove glaze for faster ring seating. Move hone up and down at sufficient speed to produce uniform 60° angle crosshatch pattern on the cylinder walls. Do not use more than ten strokes per cylinder. A stroke is one down-and-up motion.

CAUTION: *Protect engine bearings and lubrication system from abrasives.*

(2) Scrub cylinder bores clean with solution of hot water and detergent.

(3) Immediately apply light engine oil to cylinder walls. Wipe with clean, lint-free cloth.

NOTE: *If crankshaft is not removed from block, cover connecting rod journals with clean cloths during cleaning operation.*

Assembly

(1) Install and lubricate upper main bearing inserts and rear main upper seal half. Lubricate seal lip.

(2) Install crankshaft.

(3) Install main bearing caps and inserts. If replacement bearings are installed, measure each bearing clearance with Plastigage.

(4) Install replacement oil pickup tube and screen assembly. Do not attempt to install original pickup tube. Ensure plastic button is inserted in bottom of replacement screen.

(5) Install camshaft.

(6) Position piston rings on pistons. Refer to Piston Rings for procedure.

(7) Lubricate piston and ring surfaces with clean engine oil.

(8) Use piston ring compressor tool to install connecting rod and piston assemblies through top of cylinder bores. Ensure that connecting rod bolts do not scratch connecting rod journals or cylinder walls. Short lengths of rubber hose slipped over connecting rod bolts will provide protection during installation.

(9) Install connecting rod bearing caps and inserts in same location as removed. Tighten nuts with 33 foot-pounds (45 N•m) torque.

(10) Install camshaft and crankshaft sprockets and timing chain as an assembly.

(11) Install timing case cover and gaskets. Refer to Timing Case Cover for procedure.

(12) Install engine oil pan using replacement gaskets and seals. Tighten drain plug securely.

(13) Install vibration damper and damper pulley.

(14) Install cylinder heads with replacement gaskets.

(15) Install valve tappets.

(16) Install intake manifold with replacement gasket.

(17) Install push rods.

(18) Install rocker arms and bridge and pivot assemblies. Loosely install capscrews through each bridge and then alternately tighten capscrews, one turn at a time, to avoid damaging bridge. Tighten capscrews with 19 foot-pounds (26 N•m) torque.

(19) Turn crankshaft to position No. 1 piston at TDC on compression stroke.

(20) Reseal and install cylinder head covers.

(21) Install power steering pump, air pump and air conditioner compressor.

(22) Install distributor.

(a) Point rotor at No. 1 spark plug firing position.

(b) Turn oil pump drive shaft with long screw driver to engage with distributor shaft.

(c) With rotor pointing at No. 1 spark plug firing position, rotate distributor housing counterclockwise until leading edge of trigger wheel segment is aligned with center of sensor. Tighten distributor hold-down clamp.

NOTE: *When engine is installed and operating, check ignition timing as outlined in Chapter 1A—General Service and Diagnosis.*

(23) Remove engine from stand.

(24) Install engine assembly as outlined in Engine Installation.

SPECIFICATIONS

Eight-Cylinder Engine Specifications

	(USA) Inches Unless Otherwise Specified	(METRIC) Millimeters Unless Otherwise Specified
Bore		
304	3.75	95.25
360	4.08	103.63
Stroke		
304	3.44	87.38
360	3.44	87.38
Displacement		
304	304 cu.in.	5 liter
360	360 cu.in.	6 liter
Compression Ratio		
304	8.40:1	
360	8.25:1	
Compression Pressure		
304	120 - 140 psi (min)	827-1034 kPa
360	120 - 140 psi (min)	827-1034 kPa
Maximum Variation Between Cylinders	30 psi	206 kPa
Taxable Horsepower		
304	45.00	33.56 kW
360	53.27	39.72 kW
Fuel	unleaded	
Camshaft		
Fuel Pump Eccentric Diameter	2.182-2.192	55.423-55.677
Tappet Clearance	Zero lash (hydraulic tappets)	
End Play	Zero (engine operating)	
Bearing Clearance	0.001-0.003 (0.0017-0.0020 preferred)	0.0254-0.0762 (0.0432-0.0508 preferred)
Bearing Journal Diameter		
No. 1	2.1195-2.1205	53.835-53.861
No. 2	2.0895-2.0905	53.073-53.099
No. 3	2.0595-2.0605	52.311-52.337
No. 4	2.0295-2.0305	51.549-51.575
No. 5	1.9995-2.0005	50.787-50.813
Maximum Base Circle Runout	0.001	0.0254
Cam Lobe Lift		
304/360	0.266	6.7564
Intake Valve Timing		
Opens 304/360	14.75° BTDC	
Closes 304/360	68.75° BTDC	
Exhaust Valve Timing		
Opens 304/360	56.75° BBDC	
Closes 304/360	26.75° ATDC	
Valve Overlap		
304/360	41.50°	
Intake Duration		
304/360	263.50°	
Exhaust Duration		
304/360	263.50°	

	(USA) Inches Unless Otherwise Specified	(METRIC) Millimeters Unless Otherwise Specified
Connecting Rods		
Total Weight (Less Bearings)		
304/360	681-689 grams	
Total Length (Center-to-Center)		
304/360	5.873-5.877	149.17-149.28
Bearing Clearance	0.001-0.003 (0.0020-0.0025 preferred)	0.03-0.08 (0.051-0.064 preferred)
Side Clearance	0.006-0.018	0.15-0.46
Maximum Twist	0.0005 per inch	0.013 per 25.4 mm
Maximum Bend	0.001 per inch	0.03 per 25.4 mm
Crankshaft		
End Play	0.003-0.008	0.08-0.20
Main Bearing Journal Diameter		
No. 1, 2, 3, 4	2.7474-2.7489	69.784-69.822
Rear Main	2.7464-2.7479	69.759-69.797
Main Bearing Journal Width		
304/360		
No. 1	1.2635-1.2695	32.093-32.25
No. 2	1.246-1.248	31.65-31.70
No. 3	1.273-1.275	32.33-32.39
No. 4	1.246-1.248	31.65-31.70
No. 5	1.215-1.217	30.86-30.91
Main Bearing Clearance		
No. 1, 2, 3, 4	0.001-0.003 (0.0017-0.0020 preferred)	0.03-0.08 (0.04-0.05 preferred)
Rear Main		
No. 5	0.002-0.004 (0.0025-0.003 preferred)	0.05-0.10 (0.06-0.08 preferred)
Connecting Rod Journal Diameter		
304/360	2.0934-2.0955	53.172-53.266
Connecting Rod Journal Width		
304/360	1.998-2.004	50.75-50.90
Connecting Rod Bearing		
Clearance	0.001-0.003 (0.0020-0.0025 preferred)	0.03-0.08 (0.051-0.064 preferred)
Maximum Taper (All Journals)	0.0005	0.013
Maximum Out-of-Round (All Journals)	0.0005	0.013
Cylinder Block		
Deck Height	9.205-9.211	233.81-233.96
Deck Clearance		
304/360	0.0145 (below block)	0.368 (below block)

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Eight-Cylinder Engine Specifications (Continued)

	(USA) Inches Unless Otherwise Specified	(METRIC) Millimeters Unless Otherwise Specified
Maximum Cylinder Taper	0.005	0.13
Maximum Cylinder Out-of-Round	0.003	0.08
Tappet Bore Diameter	0.9055-0.9065	22.999-23.025
Cylinder Block Flatness	0.001/1-0.002/6 0.008 (max)	0.03/25-0.05/152 0.20 (max)
Cylinder Head		
Combustion Chamber Volume		
304	57.42-60.42 cc	
360	58.62-61.62 cc	
Valve Arrangement	EI-IE-EI-IE	
Valve Guide ID (Integral)	0.3735-0.3745	9.487-9.512
Valve Stem-to-Guide Clearance	0.001-0.003	0.03-0.08
Intake Valve Seat Angle	30°	
Exhaust Valve Seat Angle	44.5°	
Valve Seat Width	0.040-0.060	1.02-1.52
Valve Seat Runout	0.0025 (max)	0.064 (max)
Cylinder Head Flatness	0.001/1-0.002/6 0.008 (max)	0.03/25-0.05/152 0.20 (max)
Lubrication System		
Engine Oil Capacity	4 quarts (add 1 quart with filter change)	3.8 liters (add 0.9 liters with filter change)
Normal Operating Pressure	13 psi at 600 rpm 37-75 psi at 1600+ rpm	90 kPa at 600 rpm 255-517 kPa at 1600+ rpm
Oil Pressure Relief	75 psi (max)	517 kPa (max)
Gear-to-Body Clearance	0.0005-0.0025 (0.0005 preferred)	0.013-0.064 (0.013 preferred)
Gear End Clearance, Feeler Gauge	0.004-0.008 (0.008 preferred)	0.010-0.2 (0.10 preferred)
Gear End Clearance, Plastigage	0.002-0.008 (0.002 preferred)	
Pistons		
Weight (Less Pin)		
304	1.1-1.12 lbs	506-510 grams
360	1.32-1.33 lbs	601-605 grams
Piston Pin Bore CL-to Piston Top		
304/360	1.599-1.603	40.62-40.72
Piston-to-Bore Clearance		
304	0.0010-0.0018 (0.0014 preferred)	0.025-0.46 (0.035 preferred)
360	0.0012-0.0020 (0.0016 preferred)	0.030-0.051 (0.041 preferred)
Piston Ring Gap Clearance		
No. 1 and No. 2	0.010-0.020 (0.010-0.012 preferred)	0.25-0.51 (0.25-0.305 preferred)
Oil Control Steel Rail		
304	0.010-0.025	0.25-0.64
360	0.015-0.045 (0.010-0.020 preferred)	0.38-1.14 (0.25-0.51 preferred)
Piston Ring Side Clearance		
340		
No. 1	0.0015-0.0035 (0.0015 preferred)	0.038-0.089 (0.038 preferred)
No. 2	0.0015-0.003 (0.0015 preferred)	0.038-0.076 (0.038 preferred)
Oil Control	0.0011-0.008	0.028-0.203
360		
No. 1	0.0015-0.003 (0.0015 preferred)	0.038-0.076 (0.038 preferred)
No. 2	0.0015-0.0035 (0.0015 preferred)	0.038-0.089 (0.038 preferred)
Oil Control	0.000-0.007	0.000-0.18
Piston Ring Groove Height		
No. 1 and No. 2	0.0795-0.0805	2.019-2.045
Oil Control	0.1880-0.1895	4.775-4.813
Piston Ring Groove Diameter		
304		
No. 1 and No. 2	3.328-3.333	84.53-84.66
Oil Control	3.329-3.339	84.56-84.81
360		
No. 1 and No. 2	3.624-3.629	92.05-92.18
Oil Control	3.624-3.635	92.05-92.33
Piston Pin Diameter		
304/360	0.9308-0.9313	23.649-23.655
Piston Pin Bore Diameter		
304/360	0.9288-0.9298	23.592-23.617
Piston-to-Pin Clearance	0.0003-0.0005 (0.005 preferred) loose	0.008-0.013 (0.013 preferred) loose
Piston Pin-to-Connecting Rod Fit	2000 lbf Press-Fit	8900 N Press-Fit
Rocker Arms, Push Rods, and Tappets		
Rocker Arm Ratio	1.6:1	
Push Rod Length	7.790-7.810	197.87-198.37
Push Rod Diameter	0.312-0.315	7.93-8.00
Hydraulic Tappet Diameter	0.9040-0.9045	22.962-22.974
Tappet-to-Bore Clearance	0.001-0.0025	0.025-0.064
Valves		
Valve Length		
(Tip-to-Gauge Dim. Line)	4.7895-4.8045	121.653-122.034
Valve Stem Diameter	0.3715-0.3725	9.436-9.462
Stem-to-Guide Clearance	0.001-0.003	0.03-0.08
Intake Valve Head Diameter		
304	1.782-1.792	45.26-45.52
360	2.020-2.030	51.31-51.56
Intake Valve Face Angle	29°	
Exhaust Valve Head Diameter		
304	1.401-1.411	35.59-35.84
360	1.675-1.685	42.55-42.80
Exhaust Valve Face Angle	44°	
Valve Springs		
Free Length	1.99	50.55
Spring Tension		
Valve Closed	64-72 lbf at 1.786	282-317 N at 45.36
Valve Open	202-220 lbf at 1.356	889-968 N at 34.44
Inside Diameter (All)	0.948-0.968	24.08-24.59

602718

Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft-lbs)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Air Injection Tube-to-Manifold	38	30-45	52	41-61
Air Pump-to-Bracket Pivot Screw	20	15-22	27	20-30
Air Pump Brackets-to-Engine—AC Compressor or Pedestals	25	18-28	34	24-38
Air Pump Adjusting Strap-to-Pump	20	15-22	27	20-30
Alternator Pivot Bolt or Nut	28	20-35	38	27-47
Alternator Adjusting Bolt	18	15-20	24	20-27
Alternator Mounting Bracket Bolt-to-Engine	28	23-30	38	31-41
Alternator Pivot Mounting Bolt-to-Head	33	30-35	45	41-47
Block Heater Nut, T-Screw Type	20 in-lbs	17-25 in-lbs	2	2-3
Camshaft Gear Retainer Screw	30	25-35	41	34-47
Carburetor Adapter-to-Manifold Screws—2V	14	12-15	19	16-20
Carburetor Holddown Nuts	14	12-15	19	16-20
Connecting Rod Bolt Nuts	33	30-35	45	41-47
Crankshaft Pulley-to-Damper	23	18-28	31	24-38
Cylinder Head Capscrews	110	100-120	149	136-163
Cylinder Head Cover Screws	50 in-lbs	42-58 in-lbs	6	5-7
Distributor Clamp Screw	20	18-24	18	14-24
Drive Plate-to-Converter Screw	22	20-25	30	27-34
EGR Valve-to-Manifold	13	9-18	18	12-24
Exhaust Manifold Screws				
Center (2)	25	20-30	34	27-41
Outer (4)	15	12-18	20	16-24
Exhaust Pipe-to-Manifold Nuts	20	15-25	27	20-34
Fan and Hub Assembly Bolts	18	12-25	24	16-34
Flywheel or Drive Plate-to-Crankshaft	105	95-115	142	129-156
Front Support Cushion Bracket-to-Block Screw	35	25-40	47	34-54
Front Support Cushion-to-Bracket-to-Frame	37	30-45	50	41-61
Fuel Pump Screws	16	13-19	22	18-26
Idler Pulley Bearing Shaft-to-Bracket Nut	33	28-38	45	38-52
Idler Pulley Bracket-to-Front Cover Nut	7	4-9	9	5-12
Intake Manifold Screws	43	37-47	58	50-64
Main Bearing Capscrews	100	90-105	136	122-142
Oil Pump Cover Screws	55 in-lbs	45-65 in-lbs	6	5-7
Oil Pan Screws				
1/4 inch - 20	7	5-9	9	7-12
5/16 inch - 18	11	9-13	15	12-18
Oil Relief Valve Cap	28	22-35	38	30-47
Power Steering Pump Adapter Screw	23	18-28	31	24-38
Power Steering Pump Bracket Screw	43	37-47	58	50-64
Power Steering Pump Mounting Screw	28	25-35	38	34-47
Rear Crossmember-to-Side Sill Nut	30	20-35	41	27-47
Rear Insulator Bracket-to-Trans. Screw	33	27-38	45	37-52
Rear Support Insulator-to-Bracket Nut	48	40-55	65	54-75
Rear Support Cushion-to-Crossmember Screw Nut	18	12-25	24	16-34
Rocker Arm Capscrew	19	16-26	26	22-35
Spark Plugs	28	22-33	38	30-45
Starter Motor to Converter Housing Screws	18	13-25	24	18-34
Thermostat Housing Screw	13	10-18	18	14-24
Throttle Valve Rod Adjusting Screw	40 in-lbs	30-50 in-lbs	5	3-6
Timing Case Cover-to-Block	25	18-33	34	24-45
Vibration Damper Screw (Lubricated)	90	80-100	122	108-136
Water Pump Screws	48 in-lbs	40-55 in-lbs	5	5-6

All Torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.
Refer to the Standard Torque Specifications and Capscrew Markings Chart in Chapter A of this manual for any torque specifications not listed above.

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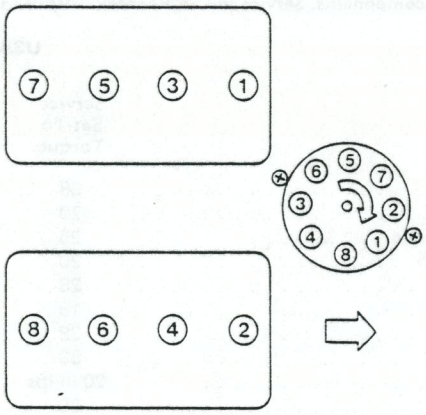
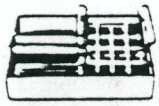
Eight-Cylinder Engine
Firing Order

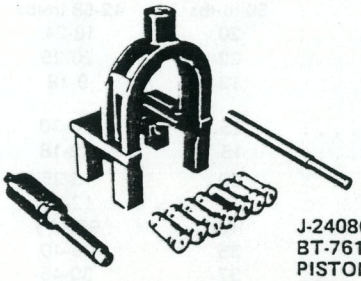


Tools

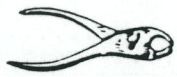
Four-Cylinder Engine



J-5821
VALVE LIFTER
CLEANING TANK



J-24086
BT-7612
PISTON PIN
TOOL

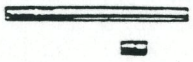


J-3049
VALVE LIFTER
REMOVER

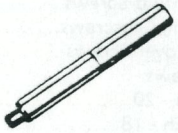
J-8087
CYLINDER BORE
CHECKING GAUGE
(RANGE 2-1/2"–9")

J-5830
VALVE GUIDE
REAMER SET

J-21473-1
CAMSHAFT BUSHING
REMOVER & INSTALLER
ADAPTER (USE WITH
J-21054-1)



J-6305-11
CONNECTING ROD
BOLT GUIDE SET



J-21054-1
HANDLE (CAMSHAFT
BUSHING REMOVER
& INSTALLER) (USE
WITH J-21473-1)

J-22330
VALVE SEAL
INSTALLER &
TESTER

J-8101
VALVE GUIDE
CLEANING TOOL

J-23042
TIME COVER
SEAL ALIGNER
& INSTALLER

J-22794
AIR LINE
ADAPTER

J-4160
HYDRAULIC VALVE
LIFTER PLUNGER
REMOVER

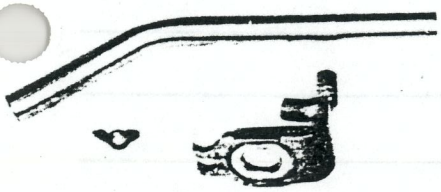
J-5569
PISTON RING
COMPRESSOR
(4")

J-5892-1
VALVE SPRING
COMPRESSOR

50428B

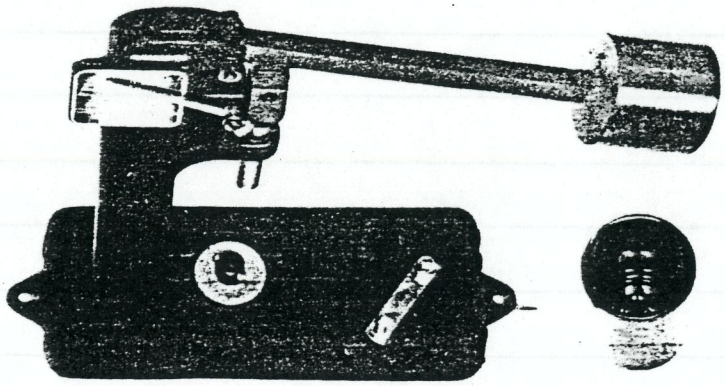
Tools

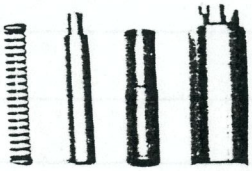
Six- and Eight-Cylinder Engine



J-22534-1
VALVE SPRING
REMOVER AND
INSTALLER

J-21791
VIBRATION DAMPER
REMOVER

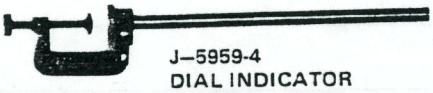




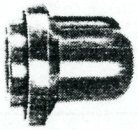
J-21872
PISTON PIN REMOVER AND INSTALLER

J-26562
TIMING CASE COVER
OIL SEAL INSTALLER

J-5790
HYDRAULIC VALVE LIFTER TESTER

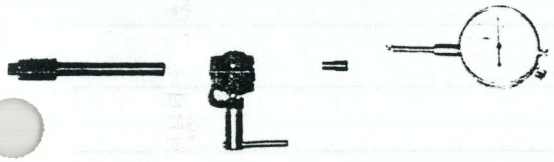


J–5959-4
DIAL INDICATOR
CLAMP AND ROD

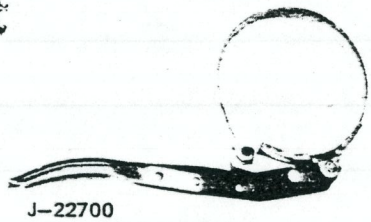


J-26562
OIL SEAL INSTALLER

J–6042-1, 4, 5
VALVE GUIDE REAMERS



J–8520
DIAL INDICATOR SET
(0-1 INCH -.001 INCH GRADUATION)



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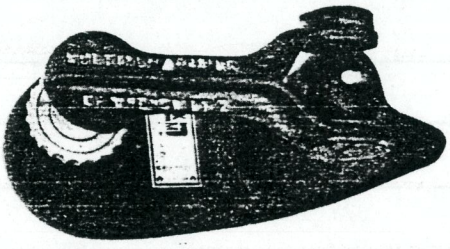


J–8056
VALVE AND CLUTCH
SPRING TESTER

J-22248
TIMING CASE COVER
ALIGNMENT TOOL AND
SEAL INSTALLER

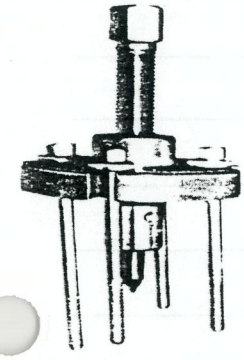
SCREW, TIMING CASE
COVER CRANKSHAFT
SEAL INSTALLER
PART OF TOOL J-9163

J-21882
OIL PUMP INLET
TUBE INSTALLER

J-9256 TIMING CASE COVER
OIL SEAL REMOVER

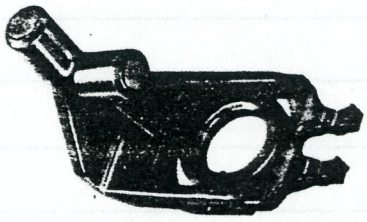
J-5601
PISTON RING
COMPRESSOR 3-3/4"

J-6042-1,4,5
VALVE GUIDE REAMERS



J-21791 VIBRATION
DAMPER REMOVER

J-21884 HYDRAULIC VALVE TAPPET
REMOVER AND INSTALLER



TOOL J-22534-1
VALVE SPRING REMOVER
AND INSTALLATION TOOL

TOOL
J-22534-4

TOOL
J-22534-5

J-22534 VALVE SPRING REMOVER AND INSTALLATION TOOL

90197

NOTES

COOLING SYSTEMS 1C

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GENERAL

The cooling system regulates engine operating temperature by allowing the engine to reach normal operating temperature as quickly as possible, maintaining normal operating temperature and preventing overheating (figs. 1C-1, 1C-2 and 1C-3). The cooling system also provides a means of heating the passenger compartment and cooling the automatic transmission fluid.

The cooling system is pressurized and uses a centrifugal water pump to circulate coolant throughout the system.

COOLING SYSTEM OPERATION

On four-cylinder engines (with the engine operating), the belt-driven water pump forces coolant into the front of the cylinder block where water jackets route it around all the cylinders. The coolant then passes upwards through holes in the cylinder head gasket and into the head. Coolant flows out the rear of the intake manifold to the heater core. The coolant returns to the water pump from the heater core.

Below 195°F (90°C) coolant does not flow through the thermostat but flows to the front of the intake manifold and returns to the cylinder head. Above 195°F (90°C) part of the coolant flows through the thermostat to the radiator and returns to the pump inlet.

Heat from the coolant is used to warm the intake manifold to prevent fuel condensation.

NOTE: *The EGR CTO valve and spark CTO valve are located in the intake manifold coolant passages.*

On six-cylinder engines, coolant is forced directly into the cylinder block water jackets surrounding the cylinders. It travels up through passages in the head gasket and cylinder head, around the combustion chambers and valves, through intake manifold and forward to the front of the cylinder head. Below 195°F (90°C), the thermostat is closed and coolant flows through the bypass port in the cylinder head, down through the block and back to the water pump where it is recirculated. A bypass port in the thermostat housing allows coolant flow to the heater core.

On eight-cylinder engines, coolant is forced from center of the engine timing case cover through side outlets into both banks of the cylinder block. It flows through the water jackets around all cylinders and up through holes in the block and head gaskets into the cylinder heads to cool the combustion chambers and valves. Coolant then flows through the heads to passages at the front of the heads and through the intake manifold to the thermostat. In the right head, coolant is forced into an intake manifold passage at the rear corner and out to the heater core, through the heater core, and back to the water pump. Below 195°F (91°C), the thermostat is closed and coolant flows out the bypass port through the hose to the water pump, where it is recirculated.

On all engines, the recirculation cycle continues until the coolant temperature reaches the thermostat calibration temperature and the thermostat begins to open. Some coolant then flows to the radiator inlet tank, through the cooling tubes and into the outlet tank. The radiator fan and vehicle motion cause air to flow past

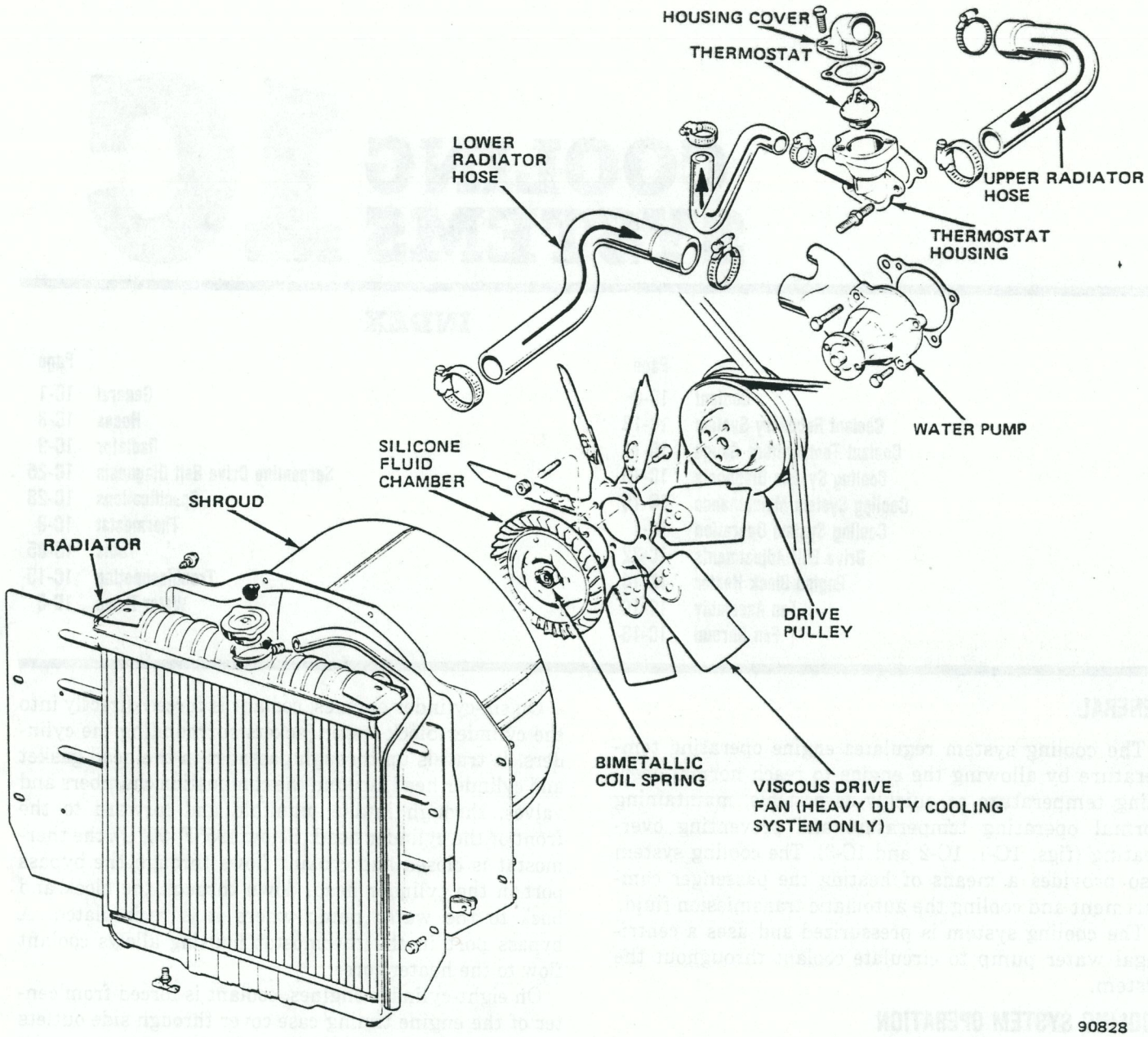

Fig. 1C-1 Four-Cylinder Engine Cooling System Components

the cooling fins to remove heat from the coolant. As the coolant flows through the outlet tank, it passes the automatic transmission fluid cooler, if equipped, and cools the automatic transmission fluid. Coolant is then drawn through the lower radiator hose into the water pump inlet to restart the cycle.

As the thermostat continues to open, it allows more coolant flow to the radiator. When it reaches its maximum open position, maximum coolant flows through the radiator.

Heat causes the coolant to expand and increase the system pressure, which raises the boiling point of the coolant. The pressure cap maintains pressure up to 15 psi (103 kPa). Above 15 psi (103 kPa), the relief valve in the cap allows pressurized coolant to escape through the filler neck overflow tube to the coolant recovery system bottle or to the road.

NOTE: *Immediately after shutdown, the engine enters a condition known as heat soak. This is when the coolant is no longer circulating but engine temperature is still high. If coolant temperature rises above the boiling point, expansion and pressure may force some coolant out of the radiator overflow tube. Normal engine operation will not usually cause this to happen.*

As engine temperature drops, the coolant loses heat and contracts, forming a partial vacuum in the system.

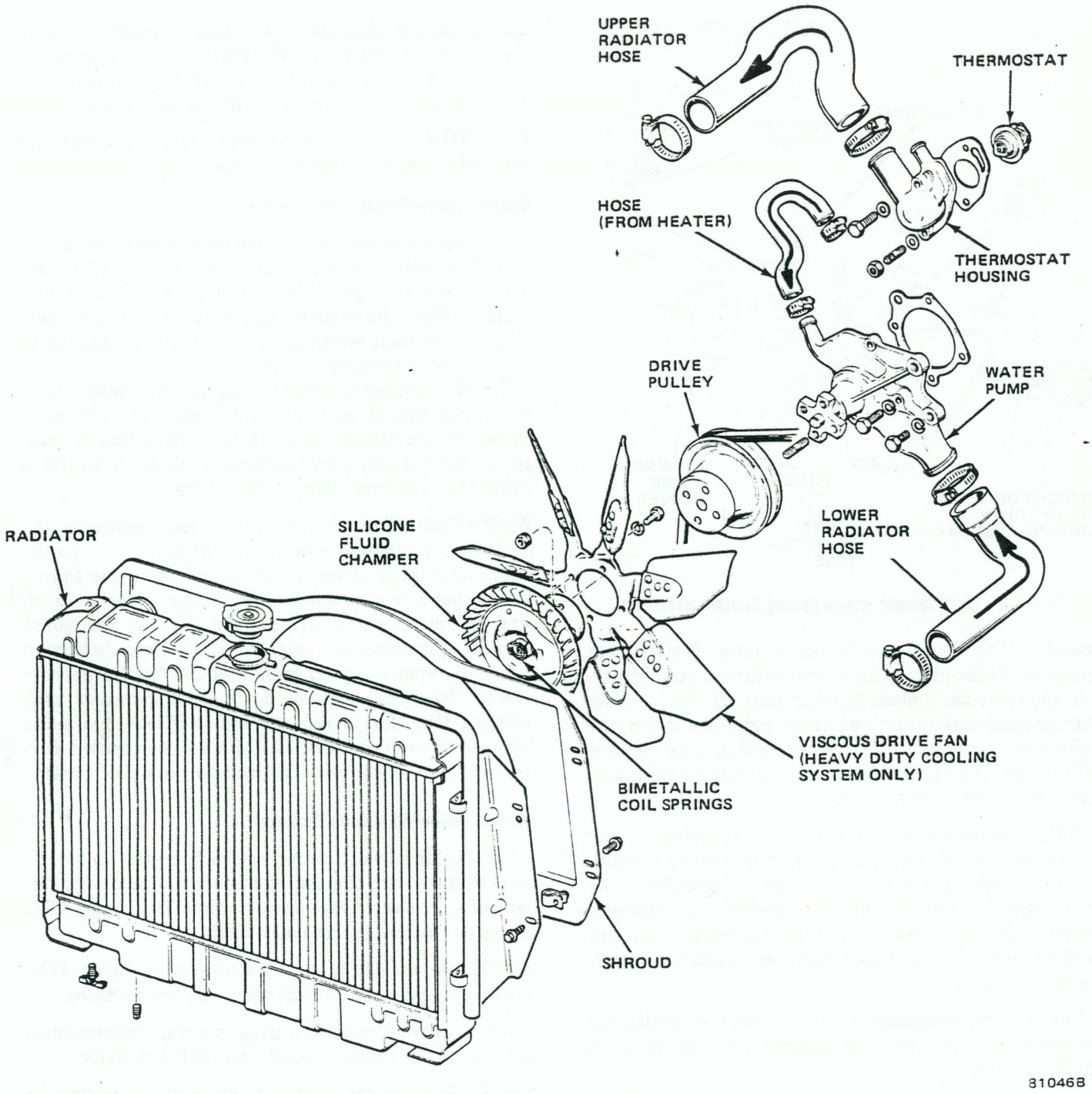

Fig. 1C-2 Six-Cylinder Engine Cooling System Components

The radiator cap vacuum valve allows atmospheric pressure to enter the system to equalize the pressure.

During operation, the coolant temperature is detected by the temperature sending unit. The sending unit electrical resistance varies as temperature changes, causing the temperature gauge to indicate accordingly.

The sender responds to temperature changes and with heavy load operation or on hot days, the coolant will be hotter and the gauge will indicate a higher engine temperature. Unless the gauge pointer moves past the high end of the band or coolant loss occurs, this is normal.

COOLANT

The coolant is a mixture of low mineral content water and ethylene glycol-based antifreeze. The addition of antifreeze to water alters several physical characteristics of water that are important to cooling system performance. The freezing point is lowered, the boiling point is raised and tendencies for corrosion and foaming are reduced. The lowered freezing point protects the engine and cooling system components from damage caused by the expansion of water as it freezes. The

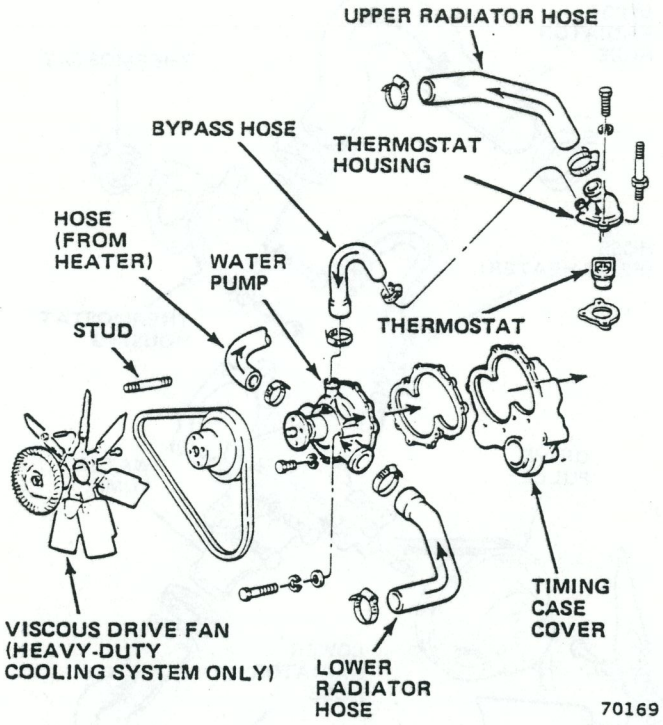

Fig. 1C-3 Eight-Cylinder Engine Cooling System Components

raised boiling point contributes to more efficient heat transfer. Reduced corrosion and reduced foaming permit unobstructed coolant flow for more efficient cooling. During heat-soak conditions after engine shutdown, the higher boiling point helps prevent coolant loss because of boilover. The higher boiling point also helps minimize damage caused by cavitation.

NOTE: *Cavitation is the formation of a partial vacuum by moving a solid body (pump impeller) swiftly through a liquid (coolant). The vacuum reduces the boiling point of the liquid and allows the formation of vapor bubbles, which burst when contacting a hard surface. If enough bubbles burst in a localized area, metal can be eroded, causing leakage.*

Vehicles manufactured at Toledo have an antifreeze concentration that protects against freezing down to -20°F (-28.9° C).

Coolant Level

Maintain the coolant level with a mixture of ethylene glycol based antifreeze and low mineral content water.

CAUTION: *The antifreeze mixture should always be maintained to satisfy local climatic requirements, or 50 percent, whichever is greater. Maximum protection against freezing is provided with a 68 percent antifreeze mixture, which prevents freezing down to -90°F (-68°C). A higher percentage will freeze at a warmer temperature. For example, pure antifreeze freezes at -8°F (-22°C). In addition, a higher percentage of antifreeze can cause the engine to overheat because the specific heat of antifreeze is lower than that of water. The antifreeze mixture MUST ALWAYS be at least 50 percent, year-round and in all climates. If the percentage is lower, engine parts may be eroded by cavitation.*

CAUTION: *Do not use coolant additives that are claimed to improve engine cooling.*

Coolant Level—Without Coolant Recovery

For four-cylinder engines, the coolant level when cold should be maintained 1 to 1-1/4 inches (25 to 32 mm) below the rear edge of the radiator filler neck sealing surface. When the engine is at normal operating temperature, the coolant level should be 1/4 to 1/2 inch (6 to 13 mm) below the sealing surface.

For six- and eight-cylinder engines the coolant level when cold should be 1-1/2 to 2 inches (38 to 51 mm) below the rear of the radiator filler neck sealing surface, and at normal operating temperature it should be 1/2 to 1 inch (13 to 25 mm) below this surface.

WARNING: *With the engine hot and removing the radiator cap, coolant can spray out and scald hands, body and face. If necessary to check level, allow engine to idle for a few moments. Use a heavy rag or towel wrapped over cap and turn cap slowly to the first notch to relieve pressure, then push down to disengage locking tabs and remove cap. If engine is overheated, operate engine above curb idle speed for a few moments with hood up, then shut engine Off and let it cool 15 minutes before removing cap. Pressure can also be reduced during cooldown by spraying the radiator with cool water.*

Coolant Level—With Coolant Recovery

The coolant level in the recovery bottle should be checked only with the engine at normal operating temperature. It should be between the FULL and ADD marks on the coolant recovery bottle.

NOTE: *Do not add coolant unless level is below ADD mark with engine at normal operating temperature.*

When adding coolant during normal maintenance, add only to the recovery bottle, not to the radiator.

NOTE: *Remove the radiator cap only for testing or when refilling the system after service. Removing the cap unnecessarily can cause loss of coolant and allow air to enter the system, which produces corrosion.*

Draining Coolant

NOTE: *DO NOT WASTE reusable coolant. If solution is clean and is being drained only to service the engine or cooling system, drain coolant into a clean container for reuse.*

WARNING: *DO NOT remove block drain plugs or loosen radiator draincock with system hot and under pressure because serious burns from coolant can occur.*

Drain the coolant from the radiator by loosening the draincock on the bottom tank.

On four-cylinder engines, drain the cylinder block by removing the drain plug at the left-rear of the cylinder block.

On six-cylinder engines, drain the coolant from the cylinder block by removing the two drain plugs located on the left side of the block (plugs may have been replaced by one or two CTO valves).

On eight-cylinder engines, drain the coolant from the cylinder block by removing the centrally located plugs on each side of the block.

Replacing Coolant

Before filling, tighten radiator draincock and all drain plugs. Add the proper mixture of coolant to satisfy local climatic requirements for freeze and cooling protection.

CAUTION: *The antifreeze mixture must always be at least 50 percent, year-round and in all climates. If percentage is lower, engine parts may be eroded by cavitation.*

Fill the radiator to the correct coolant level. On vehicles with a coolant recovery system, fill the radiator to the top and install the radiator cap. Add sufficient coolant to the recovery bottle.

After refilling the system or when air pockets are suspected, purge the cooling system of excess air.

Purging Air from Cooling System

Trapped air will hamper or stop coolant flow, or cause burping of engine coolant out of the radiator overflow tube.

Move the heater control to the HEAT position and the heater temperature control to the full WARM or HIGH position.

On vehicles without a coolant recovery system, purge air by operating the engine (with a properly filled cooling system) with the radiator cap off until coolant has completely circulated throughout the engine, or until normal operating temperature is attained. Add coolant if necessary, and install radiator cap.

On vehicles with a coolant recovery system, fill the system with coolant and operate the engine with all coolant caps in place. After coolant has reached normal operating temperature, shut engine off and allow to cool. Add coolant to recovery bottle as necessary.

NOTE: *This procedure may have to be repeated several times to maintain the correct coolant level at normal operating temperature.*

NOTE: *With some models, it may be necessary to remove a heater hose to provide an escape for trapped air when filling the system.*

Coolant Freezing Point Test

Check coolant freezing point, or freeze protection, with an antifreeze hydrometer to determine protection level.

Removing Coolant from Crankcase

If coolant leaks into the lubricating system, **it will clog the oil passages and cause the pistons to seize. Severe damage to the engine will result.** If coolant has leaked into the lubricating system, locate the source of the coolant leaks, such as a faulty head gasket or cracked block, and make the necessary repairs. After repairing the leaks, use Jeep Crankcase Cleaner, or equivalent, to flush engine.

WATER PUMP

A centrifugal water pump circulates the coolant through the water jackets, passages, radiator core, hoses of the system and heater core. The pump is driven from the engine crankshaft by a V-type belt or belts (some eight-cylinder engines). A single serpentine drive belt is used for six-cylinder engines manufactured for sale in California. The water pump impeller is pressed onto the rear of a shaft that rotates in bearings pressed into the housing. The housing has a small hole to allow seepage to escape. The water pump seals are lubricated by the antifreeze in the coolant. No additional lubrication is necessary.

Water Pump Pulley Replacement

(1) Disconnect fan shroud from radiator, if equipped.

(2) Remove fan or Tempatrol drive attaching screws.

(3) Remove fan and spacer or Tempatrol fan and drive. Remove shroud. Refer to Fan Replacement.

(4) Loosen all belts routed around water pump pulley.

(5) Remove pulley.

(6) Install pulley.

(7) Position fan, spacer and shroud.

(8) Install and tighten belts. Refer to Drive Belt Adjustments.

(9) Install fan attaching screws and tighten.

(10) Install shroud attaching screws and tighten.

Water Pump Replacement

The water pump impeller is pressed on the rear of the pump shaft and bearing assembly. The water pump is serviced only as a complete assembly.

NOTE: *DO NOT WASTE reusable coolant. If solution is clean and being drained only to service the cooling system, drain into a clean container for reuse.*

WARNING: *DO NOT remove block drain plugs or loosen radiator draincock with system hot and under pressure because serious burns from coolant can occur.*

Removal—Four-Cylinder Engine

(1) Drain coolant. Observe WARNING and NOTE stated above.

(2) Remove drive belt and fan. Refer to Fan Replacement.

(3) Disconnect lower radiator and heater hoses from pump.

(4) Remove pump attaching bolts and water pump.

Installation—Four-Cylinder Engine

(1) Scrape and clean gasket surface area on block.

(2) Position replacement gasket.

(3) Install water pump on block. Tighten bolts with 25 foot-pounds (30 N•m) torque.

(4) Connect lower radiator and heater hoses.

(5) Install coolant. Use correct mixture.

(6) Install fan and drive belt. Tighten drive belt. Refer to Drive Belt Adjustments.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

NOTE: *The fan assembly and pulley must be installed with the drive belt in position on the pulley. Tighten attaching nuts with 18 foot-pounds (34 N•m) torque.*

(7) Operate engine and check for leaks.

Removal—Six-Cylinder Engine

The following procedure applies to all vehicles with or without power steering, air injection and air conditioning.

(1) Drain cooling system. Observe WARNING and NOTE stated above.

(2) Disconnect radiator and heater hoses from pump.

(3) Remove drive belts.

(4) Remove fan shroud attaching screws from radiator, if equipped.

(5) Remove fan assembly and remove fan shroud. Refer to Fan Replacement.

NOTE: *On some models, fan removal may be easier if the fan shroud is rotated 1/2 turn.*

(6) Remove water pump and gasket.

Installation—Six-Cylinder Engine

CAUTION: *Six-cylinder engines (California) with a serpentine (single) drive belt have a reverse rotating water pump and viscous (Tempatrol) fan drive assembly. The components are identified by the words "REVERSE" stamped on the cover of the viscous drive and inner side of the fan, and "REV" cast into the water pump body. Do not install components that are intended for non-serpentine drive belts.*

Before installing pump, clean gasket mating surfaces and (if original pump) remove deposits and other foreign material from impeller cavity. Inspect block surface for erosion or other faults.

(1) Install replacement gasket and water pump. Tighten bolts with 13 foot-pounds (18 N•m) torque. Rotate shaft by hand to ensure it turns freely.

(2) Position shroud against front of engine, if removed, and install fan and hub assembly. Tighten screws with 18 foot-pounds (24 N•m) torque.

(3) Install fan shroud on radiator.

(4) Install drive belts and tighen to specified tension with Tension Gauge J-23600. Refer to Drive Belt Adjustments.

(5) Connect hoses to water pump.

(6) Fill system with coolant. Use correct mixture.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(7) Operate engine with heater control valve open and radiator cap off until thermostat opens to purge air from cooling system.

(8) Check coolant level and add as required.

Removal—Eight-Cylinder Engine

(1) Disconnect battery negative cable.

WARNING: *DO NOT remove block drain plugs with system under pressure because serious scalding from coolant can occur.*

(2) Drain radiator and disconnect upper radiator hose at radiator.

(3) Loosen all drive belts.

(4) If vehicle is equipped with radiator shroud, separate shroud from radiator.

(5) Install one radiator/shroud screw to retain radiator.

(6) Remove fan and hub from water pump. Remove fan and shroud, if equipped, from engine compartment.

(7) If vehicle is equipped with air conditioning, install double nut on air conditioning compressor bracket-to-water pump stud and remove stud (fig. 1C-4).

NOTE: *Removal of this stud eliminates the necessity of removing compressor mounting bracket.*

(8) Remove alternator and mount bracket assembly and place aside. Do not disconnect wires.

(9) If equipped with power steering, remove two nuts that attach power steering pump to rear half of pump mounting bracket.

(10) Remove two screws that attach front half of bracket to rear half.

(11) Remove remaining upper screw from inner air pump support brace, loosen lower bolt and drop brace away from power steering front bracket (fig. 1C-4).

(12) Remove front half of power steering bracket from water pump mounting stud.

(13) Disconnect heater hose, bypass hose and lower radiator hose at water pump.

(14) Remove water pump and gasket from timing case cover.

(15) Clean all gasket material from gasket mating surface of timing case cover.

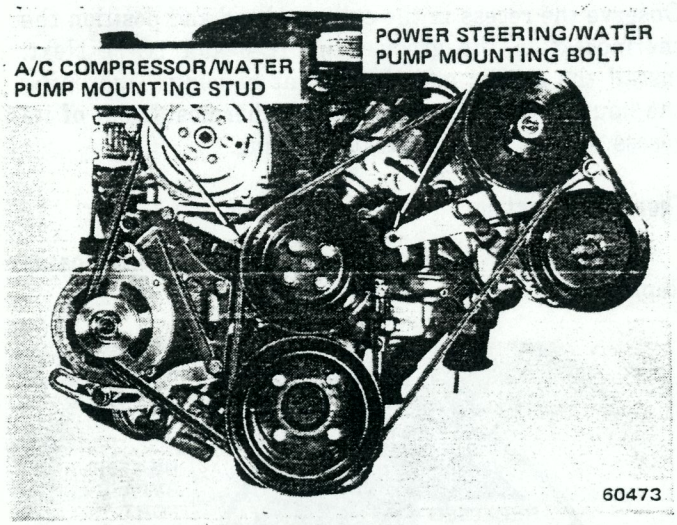

Fig. 1C-4 Water Pump Removal—Eight-Cylinder Engine

Installation—Eight-Cylinder Engine

NOTE: *Check timing case cover for erosion damage caused by cavitation.*

(1) Install water pump and replacement gasket on timing case cover.

(2) Tighten retaining screws to specified torque.

(3) If removed, install front section of power steering mount bracket, power steering pulley and drive belt.

(4) Tighten drive belt to specified tension, then tighten pulley retaining nut to 55 to 60 foot-pounds (75 to 81 N•m) torque.

(5) Install air pump drive belt, if removed, and tighten to specified tension.

(6) Install alternator and mount bracket assembly.

(7) Connect heater hose, bypass hose and lower radiator hose to water pump.

CAUTION: *Check and ensure the wire coil is installed in the lower radiator hose. Failure to install this coil will result in the hose collapsing during high engine rpm.*

(8) Position shroud against front of engine and install engine fan and hub assembly. Tighten retaining screws to specified torque.

(9) Position shroud on radiator and install with attaching screws.

(10) Install alternator drive belt and tighten to specified tension.

(11) Connect upper radiator hose to radiator.

(12) Connect battery negative cable.

(13) Fill cooling system with a mixture of 50 percent Jeep All-Season Coolant, or equivalent, and 50 percent water. Operate engine with heater control valve open until thermostat opens. Shut off engine, recheck coolant level and add as necessary.

(14) Reset clock, if equipped.

Water Pump Tests

Loose Impeller

NOTE: *DO NOT WASTE reusable coolant. If solution is clean and is being drained only to service the cooling system, drain coolant into a clean container for reuse.*

WARNING: *DO NOT remove block drain plugs or loosen radiator draincock with system hot and under pressure because serious burns from coolant can occur.*

(1) Drain cooling system.

(2) Loosen fan belt.

(3) Disconnect lower radiator hose from water pump.

(4) Bend stiff clothes hanger or welding rod (fig. 1C-5).

(5) Position rod in water pump inlet and attempt to hold impeller while turning fan blades. If impeller is loose and can be held with rod while fan blades are turning, pump is defective. If impeller turns, pump is OK.

NOTE: *If equipped with a Tempatrol fan, turn water pump shaft with socket and breaker bar attached to a mounting flange nut.*

(6) Connect hose and install coolant, or proceed with further repairs.

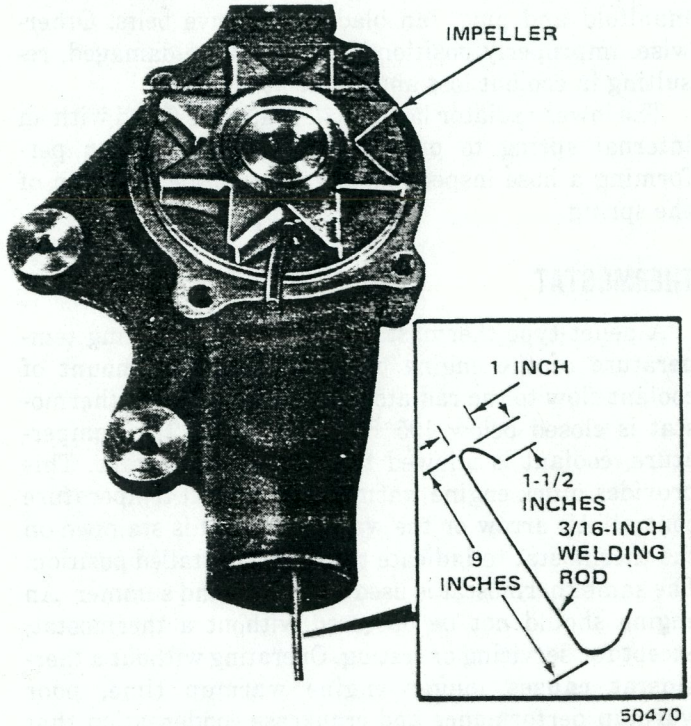

Fig. 1C-5 Testing Water Pump for Loose Impeller—Typical

Inspecting for Inlet Restrictions

With six- and eight-cylinder engines, poor heater performance may be caused by a casting restriction in the water pump heater hose inlet.

NOTE: *This procedure does not apply to the four-cylinder engine.*

(1) Drain sufficient coolant from radiator to permit removal of heater hose from water pump.
(2) Remove heater hose.
(3) Check inlet for casting flash or other restrictions.

NOTE: *Remove pump from engine before removing restriction to prevent contamination of coolant with debris. Refer to Water Pump Removal.*

HOSES

Rubber hoses route coolant to and from the radiator core and heater core. A coolant control valve is installed in the heater core inlet hose to control coolant flow to the heater core.

The lower radiator hose on all engines is spring-reinforced to prevent collapse caused by water pump suction.

Hose Inspection

Inspect hoses at regular intervals. Replace hoses that are cracked, feel brittle when squeezed or swell excessively when under pressure.

In areas where specific routing clamps are not provided, ensure hoses are positioned to clear exhaust manifold and pipe, fan blades and drive belts. Otherwise, improperly positioned hoses will be damaged, resulting in coolant loss and overheating.

The lower radiator hose on all engines is fitted with an internal spring to prevent hose collapse. When performing a hose inspection, check for proper position of the spring.

THERMOSTAT

A pellet-type thermostat controls the operating temperature of the engine by controlling the amount of coolant flow to the radiator. On all engines, the thermostat is closed below 195°F (90°C). Above this temperature, coolant is allowed to flow to the radiator. This provides quick engine warmup and overall temperature control. An arrow or the words TO RAD is stamped on the thermostat to indicate the proper installed position. The same thermostat is used for winter and summer. An engine should not be operated without a thermostat, except for servicing or testing. Operating without a thermostat causes longer engine warmup time, poor warmup performance and crankcase condensation that can result in sludge formation.

Thermostat Replacement

On four-cylinder engines, install the thermostat with the pellet inside the thermostat housing. Insert replacement gasket between thermostat and housing cover.

On six- and eight-cylinder engines, install the thermostat so that the pellet, which is encircled by a coil spring, faces the engine. All thermostats are marked on the outer flange to indicate the proper installed position. Observe the recess in the cylinder head and position the thermostat in the groove (fig. 1C-6 and 1C-7). Next, install the gasket and thermostat housing. Tightening the housing unevenly or with the thermostat out of its recess will result in a cracked housing.

Thermostat Testing

(1) Remove thermostat. Refer to Thermostat Replacement.

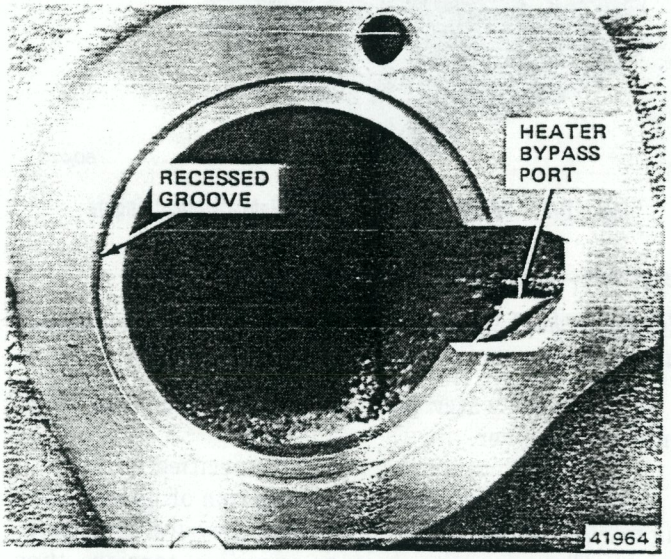

Fig. 1C-6 Thermostat Recess—Six-Cylinder Engine

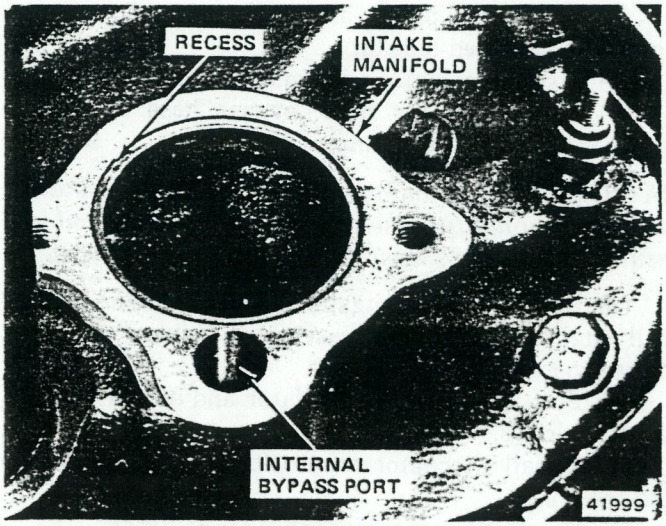

Fig. 1C-7 Thermostat Recess—Eight-Cylinder Engine

(2) Insert 0.003-inch (0.076-mm) feeler gauge, with wire or string attached, between valve and seat (fig. 1C-8).

WARNING: *Antifreeze is poisonous. Keep out of reach of children.*

(3) Submerge thermostat in container of pure antifreeze and suspend it so that it does not touch sides or bottom of container.

(4) Suspend thermometer in solution so that is does not touch container.

WARNING: *Do not breathe fumes.*

(5) Heat solution.

(6) Apply slight tension on feeler gauge while solution is heated. When valve opens 0.003-inch (0.076-mm), feeler gauge will slip free from valve. Note temperature. Refer to Thermostat Calibrations chart below. If faulty, replace thermostat.

(7) Install thermostat.

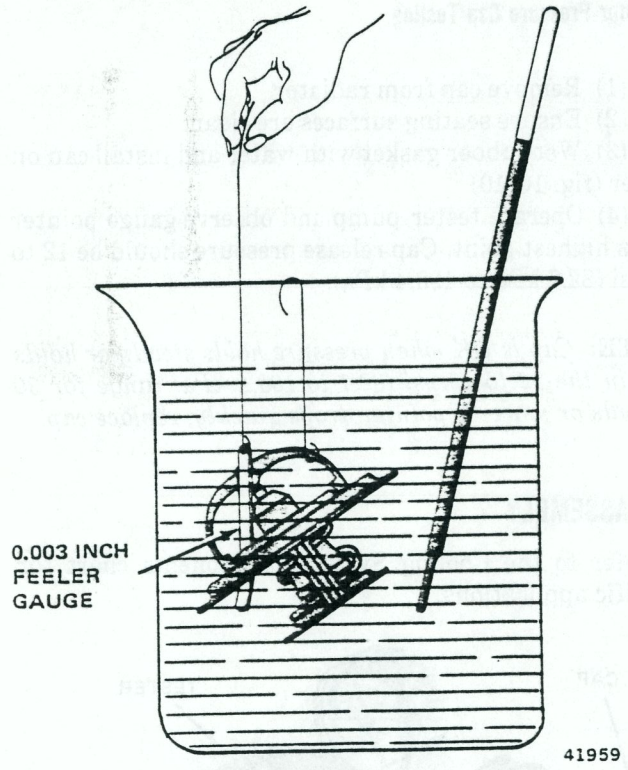

Fig. 1C-8 Testing Thermostat

Thermostat Calibrations

	4-, 6- and 8-Cyl
Must Be Open 0.003-Inch (0.076 mm)	90°C 195°F
Must Be Fully Open	103°C 218°F

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RADIATOR

The radiator, a tube and spacer type, is composed of two tanks soldered to the cooling tubes. The filler neck has an overflow tube that routes excess coolant to the road or to the coolant recovery bottle, if equipped.

All vehicles have downflow type radiators. A top tank and a bottom tank are soldered to vertical cooling tubes. The radiator cap and filler neck are located on the inlet tank. The bottom, or outlet, tank contains the draincock. It also contains the transmission fluid cooler for vehicles with an automatic transmission.

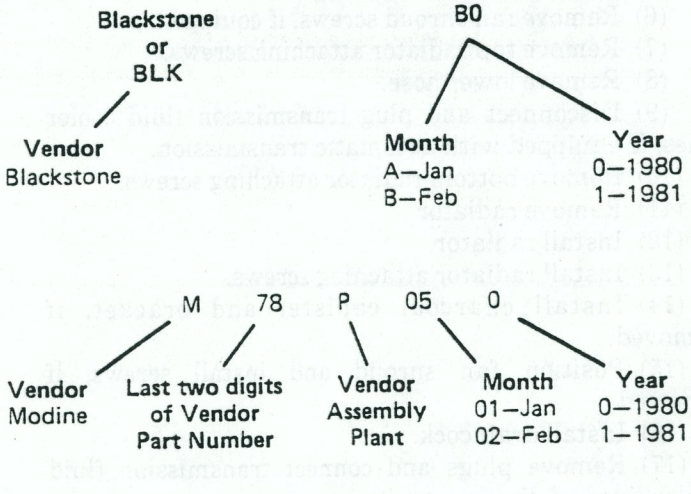
Some radiators have a plastic shroud attached to funnel air more directly through the radiator for improved engine cooling during idle and low rpm speeds.

Some vehicles are equipped with air seals between the radiator and various body structures. This prevents air from flowing forward around the radiator and recirculating through the core.

Radiator Identification

Radiators are identified by a Jeep part number and the vendor build code number embossed on the upper tank. Some Cherokees, Wagoneers and Trucks have the code located at the radiator right side support.

Radiator Identification



Radiator Maintenance

NOTE: *To test radiator for leaks or pressure loss, refer to Troubleshooting—Cooling System Leakage.*

The radiator should be free from any obstruction of airflow. This includes bugs, clogged bug screens, leaves, mud, emblems, flags, fog lamps, improperly mounted license plates, large nonproduction bumper guards or collision damage.

NOTE: *Remove dirt and other debris by blowing compressed air from the engine side of the radiator through the fins.*

Several problems may affect radiator performance:
- bent or damaged tubes,
- corrosive deposits restricting coolant flow,
- tubes blocked because of improper soldering.

Repair damaged tubes that affect proper operation. Leaks can be detected by applying 3 to 5 psi (21 to 34 kPa) air pressure to the radiator while it is submerged in water. Repair tubes with solder. Clean a clogged radiator with solvent or by reverse flushing. Refer to Cooling System Maintenance.

Replacement—All Models

NOTE: *DO NOT WASTE reusable coolant. If solution is clean and is being drained only to service the cooling system, drain into a clean container for reuse.*

WARNING: *DO NOT remove block drain plugs or loosen radiator draincock with system hot and under pressure because serious burns from coolant can occur.*

(1) Position drain pan under radiator and remove draincock. Observe WARNING above.
(2) Remove radiator cap.
(3) Disconnect upper radiator hose.
(4) Disconnect coolant recovery hose, if equipped.
(5) On air-conditioned, four-cylinder engine models, remove charcoal canister and bracket.
(6) Remove fan shroud screws, if equipped.
(7) Remove top radiator attaching screws.
(8) Remove lower hose.
(9) Disconnect and plug transmission fluid cooler lines, if equipped with automatic transmission.
(10) Remove bottom radiator attaching screws.
(11) Remove radiator.
(12) Install radiator.
(13) Install radiator attaching screws.
(14) Install charcoal canister and bracket, if removed.
(15) Position fan shroud and install screws, if removed.
(16) Install draincock.
(17) Remove plugs and connect transmission fluid cooler lines, if disconnected.
(18) Install lower radiator hose using replacement clamp.
(19) Install upper hose using replacement clamp.
(20) Install coolant. Use correct mixture.
(21) Connect coolant recovery hose, if removed.
(22) Install radiator cap.

Radiator Pressure Cap

The radiator cap consists of a pressure valve and a vacuum valve. The cap has several functions (fig. 1C-9):
- prevents coolant loss when the vehicle is in motion;
- prevents impurities from entering the system and this minimizes corrosion;
- allows atmospheric pressure to eliminate the vacuum that occurs in the system during cooldown;
- seals cooling system pressure up to 15 psi (103.4 kPa), which raises the coolant boiling point approximately 2-1/2°F per psi of pressure (0.20°C per kPa).

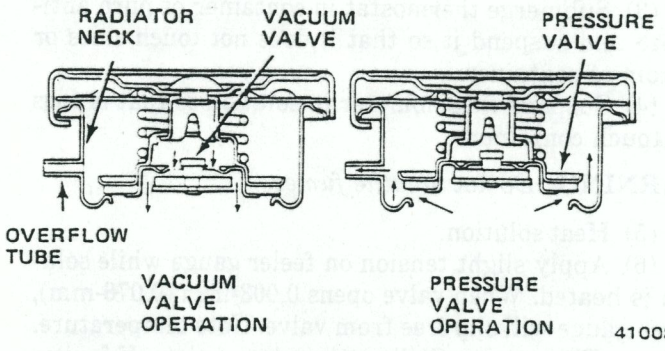


Fig. 1C-9 Radiator Cap Operation

Radiator Pressure Cap Testing

(1) Remove cap from radiator.
(2) Ensure seating surfaces are clean.
(3) Wet rubber gasket with water and install cap on tester (fig. 1C-10)
(4) Operate tester pump and observe gauge pointer at its highest point. Cap release pressure should be 12 to 15 psi (82.7 kPa to 103.4 kPa).

NOTE: *Cap is OK when pressure holds steady or holds within the 12 to 15 psi (82.7 to 103.4 kPa) range for 30 seconds or more. If pointer drops quickly, replace cap.*

FAN ASSEMBLY

Refer to the Cooling System Components chart for specific applications.

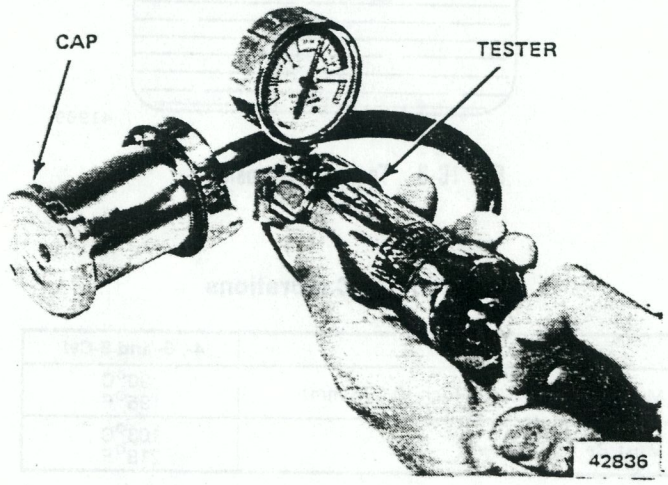


Fig. 1C-10 Radiator Cap Pressure Test

There are several types of metal fans available for all engines. Most engines with standard cooling use a seven-bladed rigid fan. Some engines are fitted with standard-equipment multi-bladed viscous fans for noise reduction. Most air-conditioned vehicles have a viscous (Tempatrol) fan (fig. 1C-11).

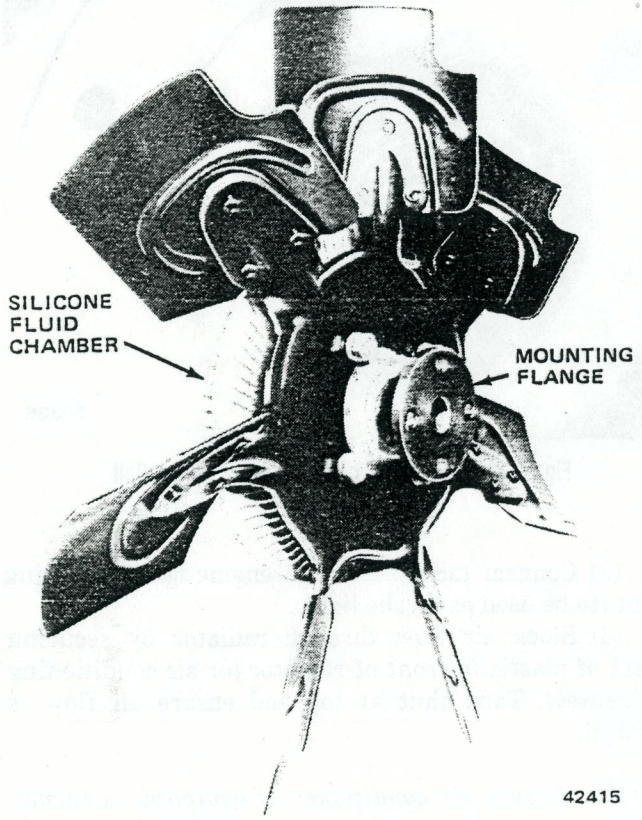


Fig. 1C-11 Tempatrol Fan—Typical

The Tempatrol fan drive is a torque- and temperature-sensitive clutch unit that automatically increases or decreases fan speed to provide proper engine cooling.

The Tempatrol fan drive clutch is essentially a silicone-fluid-filled coupling connecting the fan assembly to the fan/water pump pulley. The coupling allows the fan to be driven in a normal manner at low engine speeds while limiting the top speed of the fan to a predetermined maximum level at higher engine speeds. A bimetallic spring coil is located on the front face. This spring coil reacts to the temperature of the radiator discharge air and engages the drive clutch for higher fan speed if the air temperature from the radiator rises above a certain point. Until additional engine cooling is necessary, the fan will remain at a reduced rpm regardless of the engine speed. Only when sufficient heat is present in the air flowing through the radiator core to cause a reaction from the bimetallic coil will the Tempatrol drive clutch engage and increase fan speed to provide the necessary additional engine cooling.

Once maximum fan speed is attained, the fan will not rotate faster regardless of increased engine speed. When the necessary engine cooling has been accomplished and the degree of heat in the air flowing through the radiator core has been reduced, the bimetallic coil again reacts and the fan speed is reduced to the previous disengaged speed.

Rigid fan blades are fastened by rivets. The fan is mounted on an aluminum spacer to provide the proper distance between the fan and radiator.

WARNING: *Do not stand in direct line with the fan when the engine is operating, particularly at speeds above idle.*

Cherokees, Wagoneers and Trucks equipped with air conditioning (or heavy-duty cooling) are equipped with a Tempatrol (viscous drive) fan assembly. Six-cylinder engines not equipped with air conditioning or heavy-duty cooling have a rigid metal, four-bladed fan. All CJ vehicles with eight-cylinder engines and air conditioning are equipped with a Tempatrol (viscous drive) fan assembly.

Fan blade assemblies are balanced within 0.25 in. oz. and should not be altered in any way. Replace a damaged or bent fan. Do not attempt repair. Refer to the Cooling System Components chart for fan applications.

CAUTION: *Fans are designed to be compatible with certain applications only. DO NOT attempt to increase cooling capacity by installing a fan not intended for a given engine. Fan or water pump damage and noise may result.*

Replacement—All Models

(1) Disconnect fan shroud from radiator, if equipped.
(2) Remove fan attaching bolts.
(3) Remove fan, spacer and shroud.

NOTE: *If equipped with a Tempatrol fan assembly, remove attaching nuts and remove fan and drive as a unit.*

(4) Position fan, spacer and shroud, if equipped.
(5) Install fan attaching bolts (or nuts) and tighten.
(6) Install shroud attaching screws and tighten, if removed.

Tempatrol Fan Blade and Drive Unit Replacement

CAUTION: *Six-cylinder engines (California) with a serpentine (single) drive belt have a reverse rotating water pump and viscous (Tempatrol) fan drive assembly. The components are identified by the words "REVERSE" stamped on the cover of the viscous drive and inner side of the fan, and "REV" cast into the water pump body. Do not install components that are intended for nonserpentine drive belts.*

If it necessary to replace either the Tempatrol fan blade unit or the drive unit separately, use the following procedure.

The Tempatrol drive unit should be replaced if there is an indication of a fluid leak, noise, or if roughness is detected when turning by hand. If the drive cannot be turned by hand, or if the leading edge of the fan can be moved more than 1/4 inch (6.35 mm) front to rear, replace the drive unit.

(1) Remove fan shroud attaching screws.

(2) Remove nuts attaching fan assembly and pulley to water pump. Remove drive belt.

(3) Move shroud rearward and remove fan assembly.

CAUTION: *To prevent silicone fluid from draining into fan drive bearing and contaminating the lubricant, do not place Tempatrol fan unit on work bench with rear mounting flange pointing downward.*

(4) Remove bolts attaching fan blade unit to drive unit.

(5) Attach replacement unit. Tighten bolts with 13 foot-pounds (18 N•m) torque.

(6) Install fan assembly and pulley on water pump. Tighten nuts with 18 foot-pounds (24 N•m) torque.

NOTE: *If a four-cylinder engine, the fan assembly and pulley must be installed with the drive belt in position on pulleys.*

Tempatrol Fan Test

In an engine overheating situation, the Tempatrol drive unit can be statically tested for proper operation by observing movement of the bimetallic spring coil and shaft. To test, disconnect end of bimetallic spring coil from slot (fig. 1C-12) and rotate it counterclockwise until a stop is felt.

NOTE: *Do not force beyond stop.*

Gap between end of coil and clip on housing should be approximately 1/2 inch (13 mm). Replace unit if shaft does not rotate with coil. After test, connect end of coil in slot.

Dynamic Test

CAUTION: *Ensure there is adequate fan blade clearance before drilling.*

(1) Drill 1/8-inch (3.18-mm) diameter hole in top center of shroud.

(2) Insert dial thermometer (0° to 220°F [-18° to 105°C]) with 8-inch stem, or equivalent, through hole in shroud.

NOTE: *Ensure there is adequate clearance from fan blades.*

Fig. 1C-12 Disconnecting Tempatrol Spring Coil

(3) Connect tachometer and engine ignition timing light (to be used as strobe light).

(4) Block air flow through radiator by securing sheet of plastic in front of radiator (or air conditioning condenser). Tape shut at top and ensure air flow is blocked.

NOTE: *Ensure air conditioner, if equipped, is turned off.*

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(5) Start engine and operate at 2400 rpm with timing light aimed at fan blades (strobe light).

(6) Within ten minutes air temperature (indicated on dial thermometer) should reach 190°F (88°C). Satisfactory operation of fan drive requires that it engage before or at 200°F (93°C). Engagement is distinguishable by increase in fan roar. Timing light will also indicate increase in speed of fan.

(7) When air temperature reaches 200°F (93°C), remove plastic sheet. Satisfactory operation of Tempatrol fan requires air temperature to drop 20°F (11°C) or more. Definite decrease of audible fan air flow should be noticed. Replace defective fan assemblies.

NOTE: *The cooling system must be in good condition prior to performing the test outlined above to ensure against excessively high coolant temperature.*

FAN SHROUD

In some extreme situations, the engine fan blades may contact the shroud. An examination for proper engine mounting should isolate the problem. If not, examine the shroud position. To compensate for normal engine movement, loosen the shroud attaching screws and reposition shroud to prevent fan-to-shroud contact. Inspect the fan for bent blades and replace fan if necessary.

COOLANT RECOVERY SYSTEM

The coolant recovery system consists of a special pressure radiator cap, an overflow tube and a plastic coolant recovery bottle (fig. 1C-13). Refer to the Cooling System Components chart for specific applications.

The radiator cap used with the recovery system has a gasket to prevent air leakage at the filler neck. The cap has small finger grips (to discourage unnecessary removal) and has a mark on top that aligns with the overflow tube to indicate the proper installed position. The rubber overflow tube fits into the top of the plastic bottle and extends to the bottom. The overflow tube must always be submerged in coolant. The bottle also has a molded-in tube to allow excess coolant to escape. This same tube allows atmospheric pressure to enter the bottle during recovery operation. The bottle is fitted with a plain plastic cap.

Coolant Recovery Operation

As engine temperature increases, the coolant expands. The radiator cap pressure vent valve (normally open) slowly allows transfer of expanding coolant to the coolant recovery bottle. Any air trapped in the system will also be expelled during this period.

If ambient temperature is high, the system continues heating until vapor bubbles form. These vapor bubbles pass rapidly through the radiator cap vent valve, causing it to close. Further expansion of the coolant pressurizes the system up to 15 psi (103.4 kPa). Above 15 psi (103.4 kPa) the relief valve in the cap allows pressurized coolant to escape to the coolant recovery system.

As engine temperature drops, the coolant loses heat and contracts, forming a partial vacuum in the system. The radiator cap vacuum valve then opens and allows atmospheric pressure to force coolant from the recovery bottle into the system to equalize the pressure. Air is not admitted as long as the overflow tube remains submerged in the recovery bottle.

Coolant Recovery Bottle Replacement—All Models

(1) Remove tube from radiator filler neck.
(2) Remove bottle from radiator support panel.
(3) Pour coolant into clean container for reuse.
(4) Remove tube from bottle.
(5) Install tube in replacement bottle.

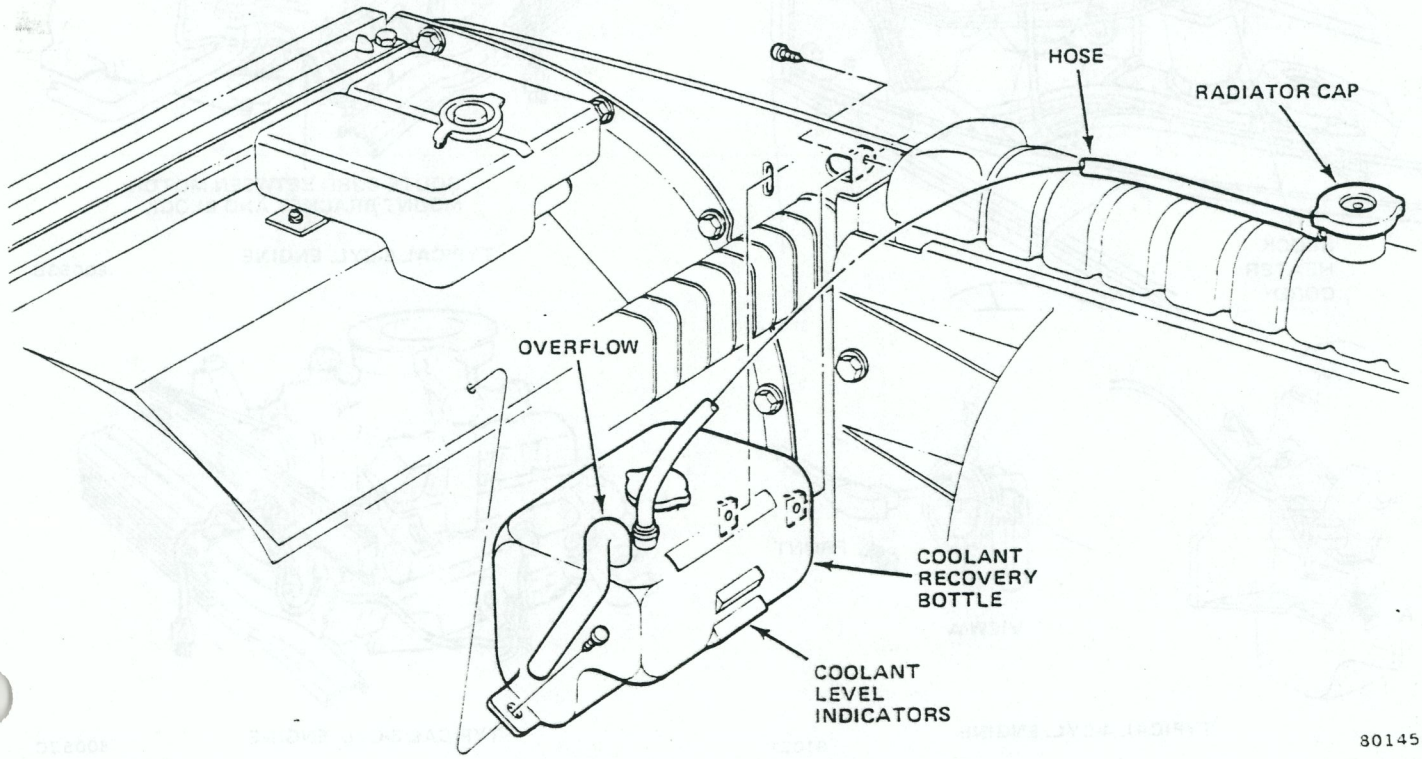


Fig. 1C-13 Coolant Recovery System—Typical

(6) Install bottle on radiator support panel.
(7) Connect tube to radiator filler neck.
(8) Install coolant in bottle. Ensure tube is submerged in coolant.

COOLANT TEMPERATURE GAUGE

All vehicles are equipped with a coolant temperature gauge. Refer to Chapter 1L—Power Plant Instrumentation for operation, diagnosis and repair of the temperature gauge system.

ENGINE BLOCK HEATER

A factory-installed engine block heater is optional. It consists of a 600W, 120V heater element fitted into a core plug hole in the block, a power cord and nylon straps are placed in the glove box for later installation.

Engine Block Heater Installation

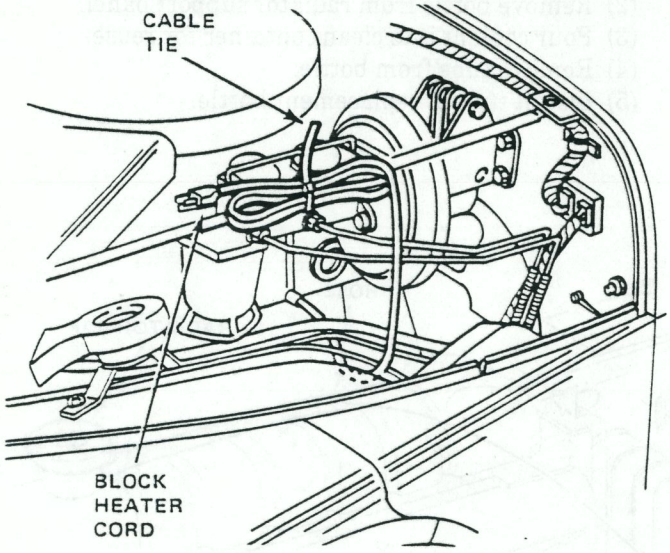
NOTE: *DO NOT WASTE reuseable coolant. If solution is clean and is being drained only to service the engine or cooling system, drain coolant into a clean container for reuse.*

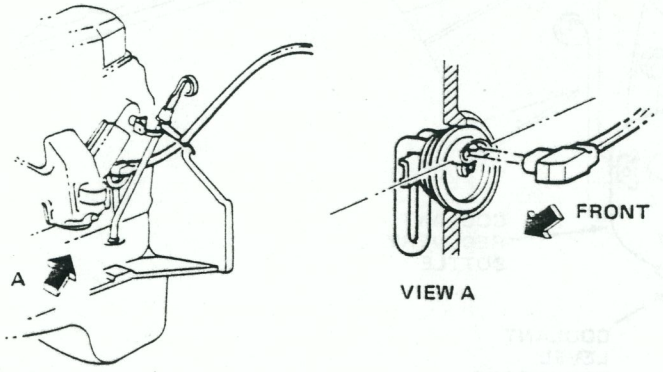
WARNING: *DO NOT remove block drain plugs or loosen radiator draincock with system hot and under pressure because serious burns from coolant can occur.*

(1) Drain coolant from engine. See NOTE and WARNING above.
(2) Remove core plug and install block heater (fig.1C-14). Tighten T-bolt type with 20 inch-pounds (2.3 N•m) torque. Tighten compression nut type with 10 foot-pounds (14 N•m) torque.

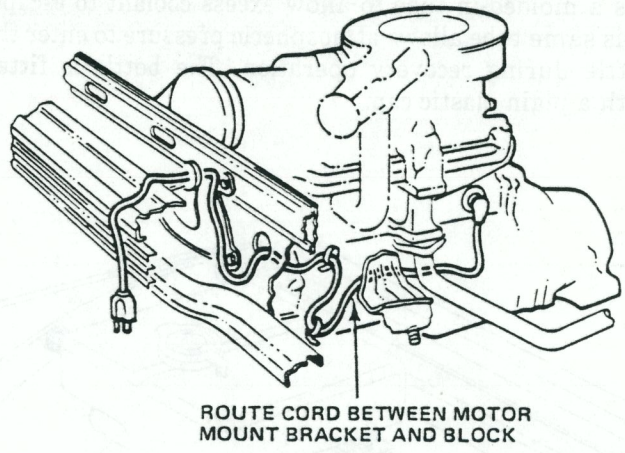
CAUTION: *Use care when tightening block heater attaching parts. Improper tightening may damage seal or allow heater to loosen, resulting in coolant loss and engine damage.*

(3) From front of vehicle, route heater (female) end of power cord through hole in front panel, along wire harness and connect to block heater.
(4) Use nylon straps furnished to tie cord to wire harness and to inside of grille. Allow cord to extend outside of grille.
(5) Install coolant in engine.

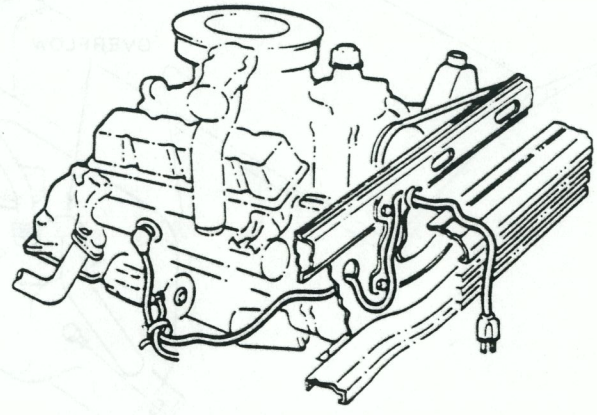




TYPICAL 4-CYL. ENGINE 81021



TYPICAL 6-CYL. ENGINE 80053B



TYPICAL 8-CYL. ENGINE 80053C

Fig. 1C-14 Engine Block Heater Installation

COOLING SYSTEM MAINTENANCE

Engine Flushing

CAUTION: *The cooling system normally operates at 12 to 15 psi (83 to 103 kPa) pressure. Exceeding this pressure may damage the radiator, heater core, or hoses.*

(1) Remove thermostat housing and thermostat. Install thermostat housing.
(2) Attach flushing gun to upper radiator hose at radiator end.
(3) Attach leadaway hose to water pump inlet.
(4) Connect water supply and air supply hoses to flushing gun.
(5) Allow engine to fill with water.
(6) When engine is filled, apply air in short blasts, allowing system to fill between air blasts. Continue until clean water flows through leadaway hose.
(7) Remove thermostat housing and install thermostat. Install thermostat housing, using a replacement gasket.
(8) Connect radiator hoses.
(9) Refill cooling system with correct antifreeze-water mixture.

Solvent Cleaning

In some instances, the use of a radiator cleaner (Jeep Radiator Kleen, or equivalent) before flushing will soften scale and deposits and aide the flushing operation.

CAUTION: *Ensure instructions on the container are followed.*

Radiator Reverse Flushing

(1) Disconnect radiator hoses.
(2) Attach piece of radiator hose to radiator bottom outlet and insert flushing gun.
(3) Connect water supply hose and air supply line to flushing gun. Note excess pressure caution above.
(4) Allow radiator to fill with water.
(5) When radiator is filled, apply air in short blasts, allowing radiator to refill between blasts.

Continue this reverse flushing until clean water flows through top radiator opening. If flushing fails to clear radiator passages, have the radiator cleaned more extensively by a radiator repair shop.

Transmission Fluid Cooler Repairs

Because of the high pressure applied to the fluid cooler, do not attempt conventional soldering to repair leaks. **All repairs must be silver soldered or brazed.**

Core Plugs

Prior to hot tanking for block boiling, remove casting flash causing hot spots or coolant flow blockage. Remove core plugs with hammer, chisel and prying tool. Apply a sealer to edges of replacement plugs and position plugs with lip to outside of block. Install with hammer and suitable tool. Refer to Core Plug Sizes chart.

Core Plug Sizes

Location	Diameter	
	inches	mm
Four-Cylinder Head (rear inside water jacket)	0.637	16
Four-Cylinder Head (rear)	1.9	48.5
Four-Cylinder Block (3 on side)	1.6	41.5
Four Cylinder Block (1 on rear)	1.9	48.3
Six-Cylinder Head (3 left side)	0.875	22
Six-Cylinder Head (rear)	2.0	51
Six-Cylinder Block (3 left, 1 rear)	2.0	51
Eight-Cylinder Heads (outer sides, 2 each)	1.0	24.4
Eight-Cylinder Blocks (3 each side)	1.5	38.1
Eight-Cylinder Heads (1 each end)	1.5	38.1

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COOLING SYSTEM DIAGNOSIS

If the cooling system requires frequent addition of coolant to maintain the correct level, inspect all units and connections in the cooling system for evidence of leakage. Perform the inspection with the cooling system cold. Small leaks, which may appear as dampness or dripping, can easily escape detection if they are rapidly evaporated by engine heat. Telltale stains of a grayish white or rusty color, or dye stains from antifreeze, may appear at connecting joints in the cooling system. These stains are almost always a sure indication of small leaks, though there may appear to be no defects.

Air may be drawn into the cooling system through incomplete sealing at the water pump seal or through incomplete sealing in the coolant recovery system. Combustion pressure may be forced into the cooling system through a leak at the cylinder head gasket, though the passage is too small to allow coolant to enter the combustion chamber.

TROUBLESHOOTING

Cooling System Leakage

NOTE: *Engine should be warm. Recheck system cold if cause of coolant loss is not located during warm engine troubleshooting.*

WARNING: *Hot, pressurized coolant can cause injury by scalding.*

Service Diagnosis

Condition	Possible Cause	Correction
HIGH TEMPERATURE INDICATION-OVERHEATING	(1) Coolant level low.	(1) Replenish coolant level.
	(2) Fan belt loose.	(2) Adjust fan belt.
	(3) Radiator hose(s) collapsed.	(3) Replace hose(s).
	(4) Radiator blocked to airflow.	(4) Remove restriction (bugs, fog lamps, etc.)
	(5) Faulty radiator cap.	(5) Replace cap.
	(6) Vehicle overloaded.	(6) Reduce load or shift to lower gear.
	(7) Ignition timing incorrect.	(7) Adjust ignition timing.
	(8) Idle speed low.	(8) Adjust idle speed.
	(9) Air trapped in cooling system.	(9) Purge air.
	(10) Vehicle in heavy traffic.	(10) Operate at fast idle intermittently in neutral gear to cool engine.
	(11) Incorrect cooling system component(s) installed.	(11) Install proper component(s).
	(12) Faulty thermostat.	(12) Replace thermostat.
	(13) Water pump shaft broken or impeller loose.	(13) Replace water pump.
	(14) Radiator tubes clogged.	(14) Flush radiator.
	(15) Cooling system clogged.	(15) Flush system.
	(16) Casting flash in cooling passages.	(16) Repair or replace as necessary. Flash may be visible by removing cooling system components or removing core plugs.
	(17) Brakes dragging.	(17) Repair brakes.
	(18) Excessive engine friction.	(18) Repair engine.
	(19) Antifreeze concentration over 68%.	(19) Lower antifreeze content.
	(20) Missing air seals between hood and radiator.	(20) Replace air seals.

NOTE: *Immediately after shutdown, the engine enters a condition known as heat soak. This is caused by the cooling system being inoperative while engine temperature is still high. If coolant temperature rises above boiling point, expansion and pressure may push some coolant out of the radiator overflow tube. If this does not occur frequently, it is considered normal.*

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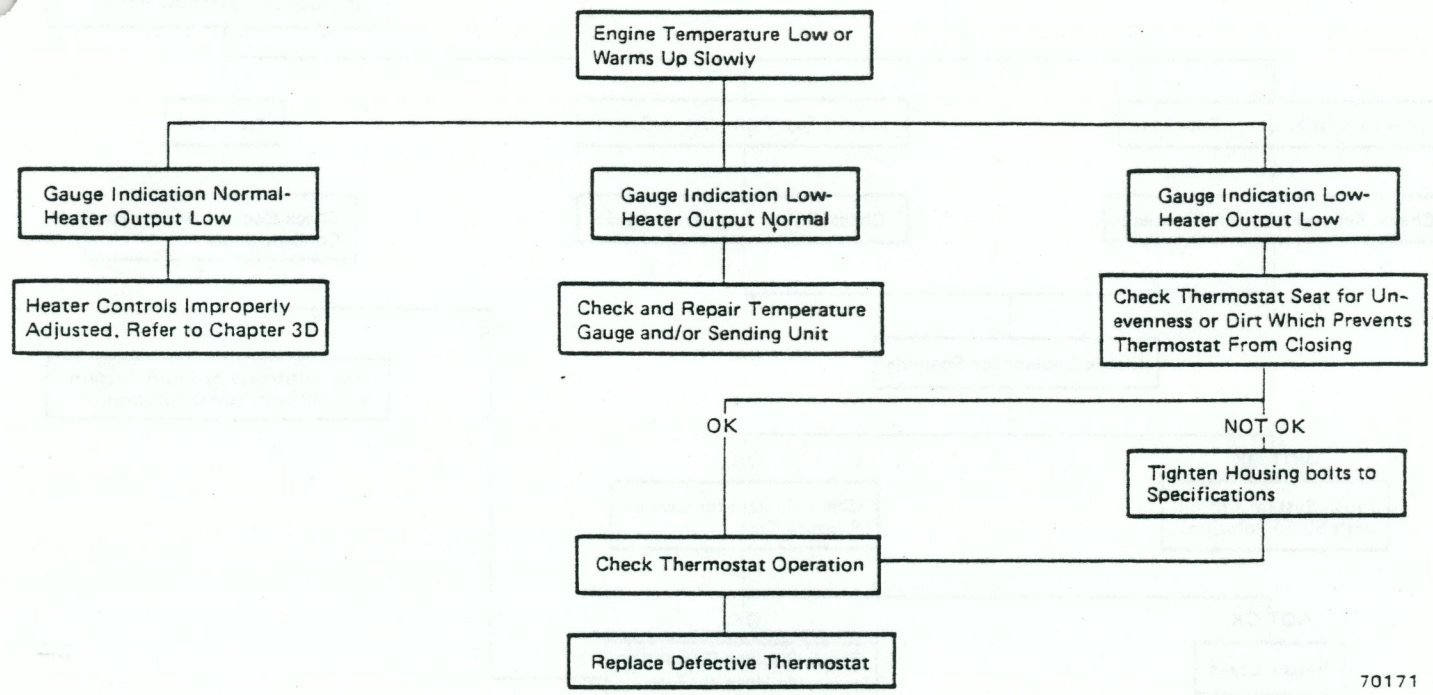
Service Diagnosis (Continued)

Condition	Possible Cause	Correction
	(21) Faulty gauge.	(21) Repair or replace gauge.
	(22) Loss of coolant flow caused by leakage or foaming.	(22) Repair leak, replace coolant.
	(23) Tempatrol fan inoperative.	(23) Perform Tempatrol fan test. Repair as necessary.
COOLANT LOSS—BOILOVER	Refer to Overheating Causes in addition to the following:	
	(1) Overfilled cooling system.	(1) Reduce coolant level to proper specification.
	(2) Quick shutdown after hard (hot) run.	(2) Allow engine to run at fast idle prior to shutdown.
	(3) Air in system resulting in occasional "burping" of coolant.	(3) Purge system.
	(4) Insufficient antifreeze allowing coolant boiling point to be too low	(4) Add antifreeze to raise boiling point.
	(5) Antifreeze deteriorated because of age of contamination.	(5) Replace coolant.
	(6) Leaks due to loose hose clamps, loose nuts, bolts, drain plugs, faulty hoses, or defective radiator.	(6) Pressure test system to locate leak then repair as necessary.
	(7) Faulty head gasket.	(7) Replace head gasket.
	(8) Cracked head, manifold, or block.	(8) Replace as necessary.
COOLANT ENTRY INTO CRANKCASE OR CYLINDER	(1) Faulty head gasket.	(1) Replace head gasket.
	(2) Crack in head, manifold or block.	(2) Replace as necessary.
COOLANT RECOVERY SYSTEM INOPERATIVE	(1) Coolant level low.	(1) Replenish coolant to FULL mark.
	(2) Leak in system.	(2) Pressure test to isolate leak and repair as necessary.
	(3) Pressure cap not tight or gasket missing or leaking.	(3) Repair as necessary.

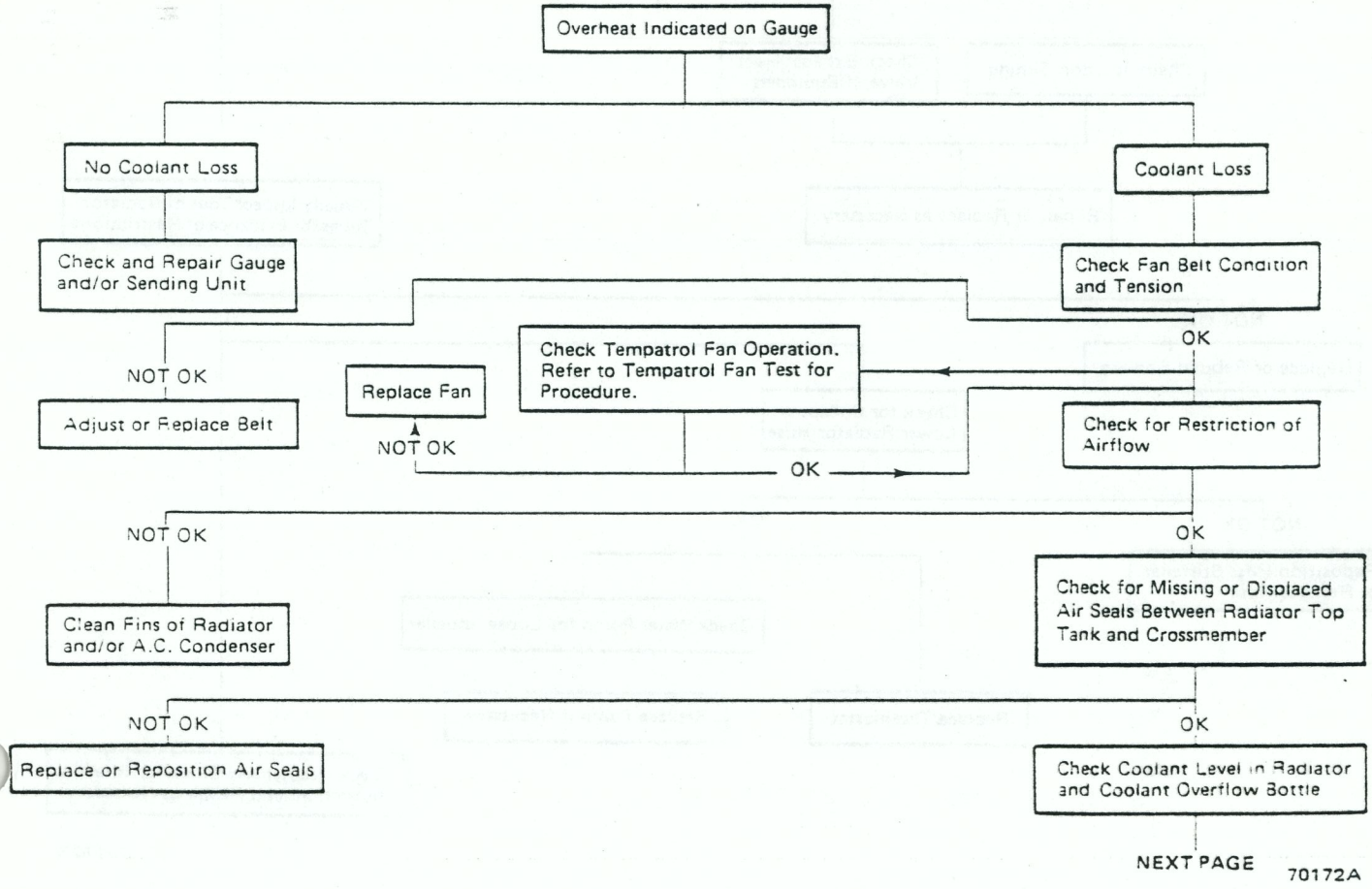
Service Diagnosis (Continued)

Condition	Possible Cause	Correction
	(4) Pressure cap defective.	(4) Replace cap.
	(5) Overflow tube clogged or leaking.	(5) Repair as necessary.
	(6) Overflow tube kinked .	(6) Repair as necessary.
	(7) Recovery bottle vent plugged.	(7) Remove restriction.
NOISE	(1) Fan contacting shroud.	(1) Reposition shroud and check engine mounts.
	(2) Loose water pump impeller.	(2) Replace pump.
	(3) Dry fan belt.	(3) Apply silicone or replace belt.
	(4) Loose fan belt.	(4) Adjust fan belt.
	(5) Rough surface on drive pulley.	(5) Replace pulley.
	(6) Water pump bearing worn.	(6) Remove belt to isolate. Replace pump.
	(7) Belt alignment.	(7) Check for improper pulley locations. Shim power steering pump.
LOW TEMPERATURE INDICATION— UNDERCOOLING	(1) Thermostat stuck open.	(1) Replace thermostat.
	(2) Faulty gauge.	(2) Repair or replace gauge.
	(3) Tempatrol fan drive constantly engaged.	(3) Perform fan test. Repair as necessary.
NO COOLANT FLOW THROUGH HEATER CORE	(1) Plugged return pipe in water pump.	(1) Remove obstruction.
	(2) Heater hose collapsed or plugged.	(2) Remove obstruction or replace hose.
	(3) Plugged heater core.	(3) Remove obstruction or replace core.
	(4) Plugged outlet in thermostat housing.	(4) Remove flash or obstruction.
	(5) Heater bypass hole in cylinder head plugged.	(5) Remove obstruction.
	(6) Heater tubes assembled on core incorrectly.	(6) Mount tubes correctly.

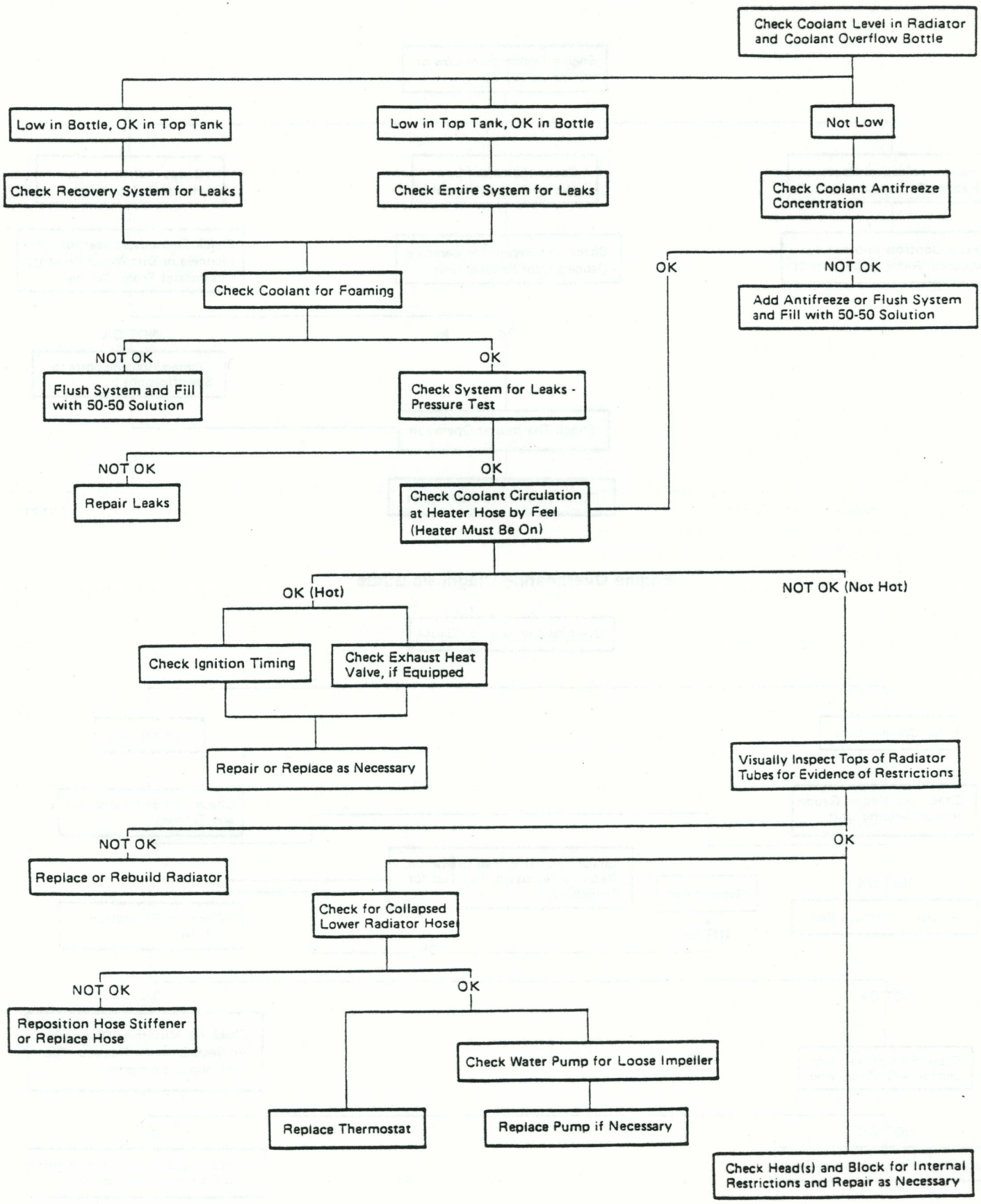
Low Engine Temperature Diagnosis Guide



Engine Overheating Diagnosis Guide



Engine Overheating Diagnosis Guide (Continued)



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(1) Carefully remove radiator pressure cap from filler neck and check coolant level.

NOTE: *Push down on the cap to disengage from the stop tabs.*

(2) Wipe inside of filler neck and examine lower inside sealing seat for nicks, cracks, paint, dirt and solder bumps.

(3) Inspect overflow tube for internal obstructions. Insert a wire through tube to ensure it is clear.

(4) Inspect cams on outside of filler neck. If cams are bent, seating of pressure cap valve and tester seal will be affected. Bent cams can be reformed if done carefully.

(5) Attach pressure tester to filler neck (fig. 1C-15). **Do not force.**

(6) Operate tester pump to apply 15 psi (103.4 kPa) pressure to system. If hoses swell excessively while testing, replace as necessary.

(7) Observe gauge pointer:

(a) **Holds Steady:** If pointer remains steady for two minutes, there are no serious leaks in the system.

NOTE: *There may be an internal leak that does not appear with normal system pressure. If it is certain that coolant is being lost and no leaks can be detected, check for interior leakage or perform Combustion Leakage Test.*

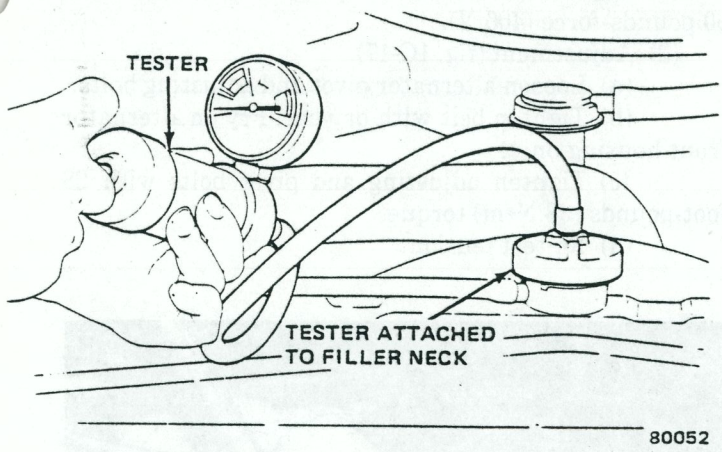

Fig. 1C-15 Cooling System Pressure Test

(b) **Drops Slowly:** Indicates presence of small leaks or seepage. Examine all connections for seepage or slight leakage with a flashlight. Check radiator, hose, gaskets and heater. Seal small leaks with AMC Sealer Lubricant, or equivalent. Repair leaks and recheck system.

(c) **Drops Quickly:** Indicates that serious leakage is present. Examine system for serious external leakage. If no leaks are visible, check for internal leakage.

NOTE: *Large radiator leaks should be repaired by a reputable radiator repair shop.*

Inspecting for Internal Leakage

(1) Remove oil pan drain plug and drain small amount of engine oil (coolant, being heavier, should drain first), or operate engine to churn oil, then examine dipstick for water globules.

(2) Inspect transmission dipstick for water globules.

(3) Inspect transmission fluid cooler for leakage. Refer to Transmission Fluid Cooler Leakage Test.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(4) Operate engine without pressure cap on radiator until thermostat opens.

(5) Attach Pressure Tester to filler neck. If pressure builds up quickly, leak exists as result of faulty head gasket or crack. Repair as necessary.

WARNING: *Do not allow pressure to exceed 15 psi (103.4 kPa). Turn engine Off. To release pressure, rock tester from side to side. When removing tester, do not turn tester more than 1/2 turn if system is under pressure.*

(6) If there is no immediate pressure increase, pump Pressure Tester until indicated pressure is within system range. Vibration of gauge pointer indicates compression or combustion leakage into cooling system.

CAUTION: *Do not disconnect spark plug wires while engine is operating.*

(7) Isolate compression leak by shorting each spark plug. Gauge pointer should stop or decrease vibration when spark plug of leaking cylinder is shorted because of the absence of combustion pressure.

CAUTION: *Do not operate engine with spark plug shorted for more than a minute, otherwise catalytic converter may be damaged.*

Testing for Combustion Leakage (Without Pressure Tester)

NOTE: *DO NOT WASTE reusable coolant. If solution is clean and is being drained only to service the cooling system, drain coolant into a clean container for reuse.*

WARNING: *DO NOT remove block drain plugs or loosen radiator draincock with system hot and under pressure because serious burns from coolant can occur.*

(1) Drain sufficient coolant to allow thermostat removal.

(2) Disconnect water pump drive belt.

(3) **Four- and Eight-Cylinder Engine:** Remove thermostat housing cover and remove thermostat.

Six-Cylinder Engine: Disconnect upper radiator hose from thermostat housing, remove thermostat and install thermostat housing on cylinder head.

(4) Add coolant to engine to bring level within 1/4 inch (6.3 mm) of top of thermostat housing.

CAUTION: *Avoid overheating. Do not operate engine for an excessive period of time. Open draincock immediately after test to eliminate boilover.*

(5) Start engine and accelerate rapidly to approximately 3000 rpm three times while observing coolant. If any internal engine combustion leaks to cooling system exist, bubbles will appear in coolant. If bubbles do not appear, there are no internal leaks.

Transmission Fluid Cooler Leakage Test

Transmission Fluid cooler leaks can be detected by the presence of transmission fluid in the coolant. If fluid appears in the coolant, check the fluid level of the automatic transmission. If the fluid level is low, check the fluid cooler as follows:

(1) Remove transmission-to-cooler lines at radiator.

(2) Plug one fitting in cooler.

(3) Remove radiator cap and ensure radiator is filled with coolant.

(4) Apply shop air pressure (50 to 100 psi [344 to 690 kPa]) to other fitting on cooler.

CAUTION: *Because of high fluid pressure, conventional soldering must not be used for fluid cooler repair. All repairs must be silver-soldered or brazed.*

Bubbles in coolant at filler neck indicate a leak in fluid cooler. If a transmission fluid cooler leak is discovered, remove radiator for cooler repair. Unsolder outlet tank for access to fluid cooler.

DRIVE BELT ADJUSTMENTS

General

After the need for adjustment has been determined, drive belts are adjusted by pivoting the driven component in its mount to achieve the desired tension. In some applications, a belt may drive several components or, for California six-cylinder engines, a single serpentine drive belt drives all components. It is necessary to loosen and pivot only one component.

(1) Locate drive belt that is to be tested for correct tension.

(2) Test tension with Gauge J-23600 (fig. 1C-16).

(3) If necessary, adjust drive belt.

(4) Test tension after adjustment.

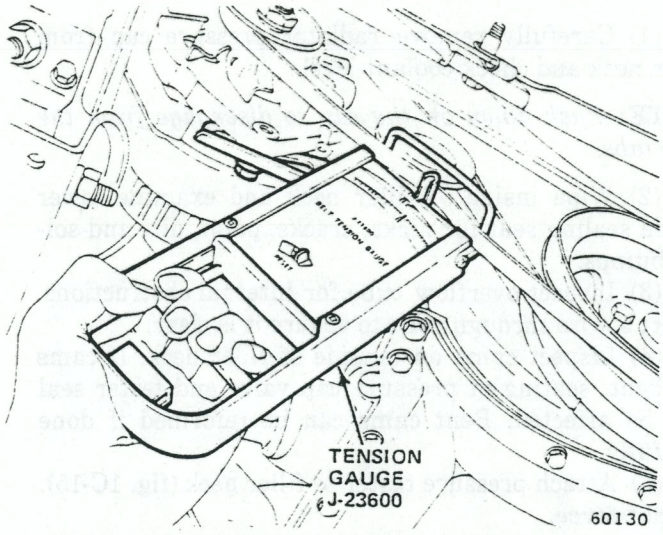

Fig. 1C-16 Testing Drive Belt Tension—Typical

Four-Cylinder Engine

Alternator and Fan (without Air Conditioner)

(1) Position Tension Gauge J-23600 on upper section of belt midway between alternator pulley and fan pulley. Test belt tension according to instructions on gauge.

(2) Adjust belt tension to specification if less than 90 pounds-force (400 N).

(3) Adjustment (fig. 1C-17).

(a) Loosen alternator pivot and adjusting bolts.

(b) Tighten belt with pry bar. Pry on alternator front housing only.

(c) Tighten adjusting and pivot bolts with 28 foot-pounds (38 N•m) torque.

(d) Re-test tension.

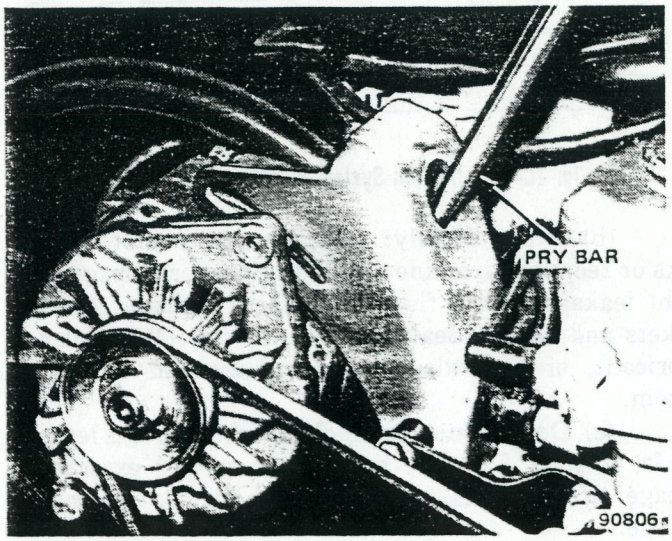

Fig. 1C-17 Four-Cylinder Engine Alternator Drive Belt Adjustment

Power Steering Pump

(1) Position Tension Gauge J-23600 on upper section of belt midway between pump pulley and fan pulley. Test belt tension according to instructions on gauge.

(2) Adjust belt tension to specification if less than 90 pounds-force (400 N).

(3) Adjustment (fig. 1C-18).

(a) Loosen pump-to-mounting bracket locknuts.

(b) Loosen pivot bolts.

(c) Insert drive lug of 1/2-inch drive ratchet into adjustment hole and pivot pump to tighten belt.

(d) Tighen nuts and pivot bolt with 28 foot-pounds (38 N•m) torque.

(e) Re-test tension.

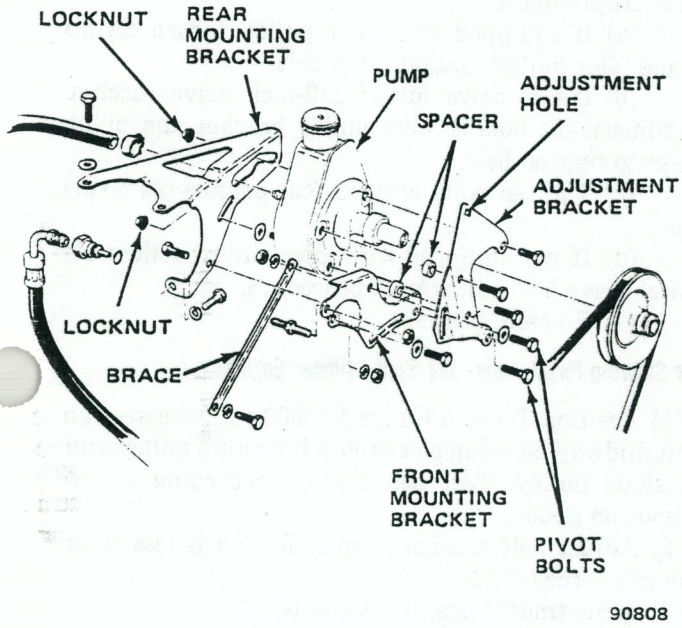

Fig. 1C-18 Four-Cylinder Engine Power Steering Pump Drive Belt Adjustment

Six- and Eight-Cylinder Engine

Alternator and Fan (Six-Cylinder Engine without Air Conditioner and All Eight-Cylinder Engines)

(1) Position Tension Gauge J-23600 on upper section of belt midway between alternator pulley and fan pulley. Test belt tension according to instructions on gauge.

(2) Adjust belt tension to specification if less than 90 pounds-force (400 N).

(3) Adjustment (fig. 1C-19 and 1C-20).

(a) Loosen alternator pivot and adjusting bolts.

(b) Tighten belt with pry bar. Pry on alternator nt housing only.

(c) Tighten adjusting bolt with 18 foot-pounds (24 N•m) torque. Tighten pivot bolt with 28 foot-pounds (38 N•m) torque.

(d) Re-test tension.

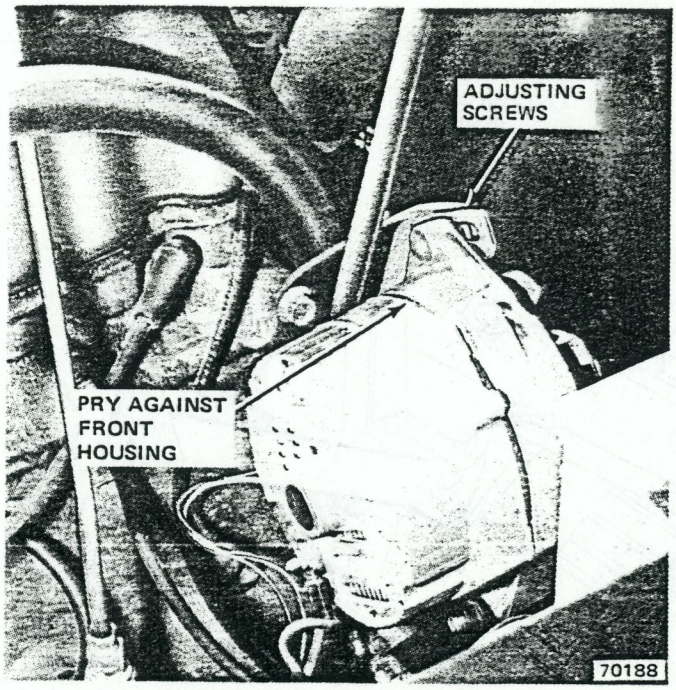

Fig. 1C-19 Six-Cylinder Engine (w/o A/C) Alternator Drive Belt Adjustment

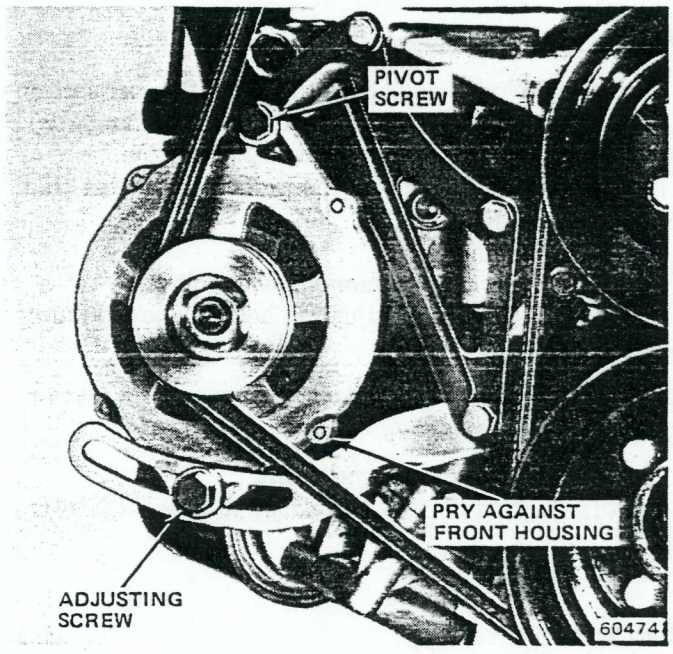

Fig. 1C-20 Eight-Cylinder Engine Alternator Drive Belt Adjustment

Alternator and Fan (Six-Cylinder Engine with Air Conditioner)

(1) Position Tension Gauge J-23600 on section of belt adjacent to inner fender panel. Test belt tension according to instructions on gauge.

(2) Adjust belt tension to specification if less than 90 pounds-force (400 N).

(3) Adjustment (fig. 1C-21).

(a) From underside of engine compartment, loosen lower mounting bracket pivot nut and adjusting bolt.

(b) Insert pry bar into hole in bottom of bracket and pry to tighten belt.

(c) Tighten adjusting bolt with 18 foot-pounds (24 N•m) torque. Tighten pivot nut with 28 foot-pounds (38 N•m) torque.

(d) Re-test tension.

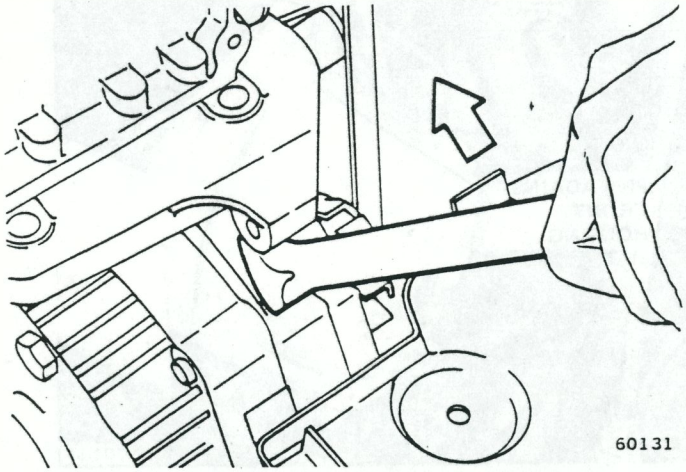

Fig. 1C-21 Six-Cylinder Engine (w/A/C) Alternator Drive Belt Adjustment

Air Pump (without Power Steering)

(1) Position Tension Gauge J-23600 on upper section of belt midway between air pump pulley and fan pulley. Test tension according to instructions on gauge.

(2) Adjust belt tension to specification if less than 60 pounds-force (267 N).

(3) Adjustment.

(a) Loosen lower retaining/pivot bolt.

(b) Loosen upper adjusting bolt to allow pump to be moved.

CAUTION: *Do not pry against sides of pump because internal pump damage may result.*

(c) Raise pump to tighten belt.

(d) Tighten bolts with 20 foot-pounds (27 N•m) torque.

(e) Re-test tension.

Air Pump (with Power Steering)

(1) Remove flexible tube attached to air cleaner snorkel.

(2) Position Tension Gauge J-23600 on outer section of belt (adjacent to inner fender panel) midway between power steering pump pulley and air pump pulley. Test belt tension according to instructions on gauge.

(3) Adjust belt tension to specification if less than 60 pounds-force (267 N).

(4) Adjustment.

(a) Loosen upper adjusting bolt.

(b) Loosen lower pivot nut to allow pump to be moved.

CAUTION: *Do not pry against sides of pump because internal pump damage may result.*

(c) Raise pump to tighten belt.

(d) Tighten adjusting bolt with 20 foot-pounds (27 N•m) torque. Tighten pivot nut with 15 foot-pounds (20 N•m) torque.

(e) Re-test tension.

Air Conditioner Compressor

(1) Position Tension Gauge J-23600 on upper section of belt midway between compressor pulley and either idler pulley or alternator pulley. Test belt tension according to instructions on gauge.

(2) Adjust belt tension to specification if less than 90 pounds-force (400 N).

(3) Adjustment.

(a) If equipped with idler pulley, loosen clamp bolt and idler pulley bracket pivot bolt.

(b) Insert drive lug of 1/2-inch drive ratchet into adjustment hole in idler pulley bracket and pivot bracket to tighten belt.

(c) Tighten bolts with 18 foot-pounds (24 N•m) torque.

(d) If not equipped with idler pulley, follow alternator drive belt adjustment procedure.

(e) Re-test tension.

Power Steering Pump—Six- and Eight-Cylinder Engines

(1) Position Tension Gauge J-23600 on lower section of belt midway between power steering pump pulley and crankshaft pulley. Test belt tension according to instuctions on gauge.

(2) Adjust belt tension to specification if less than 90 pounds-force (400 N).

(3) Adjustment (figs. 1C-22 and 1C-23).

(a) Loosen air pump drive belt (refer to Air Pump Drive Belt Adjustment).

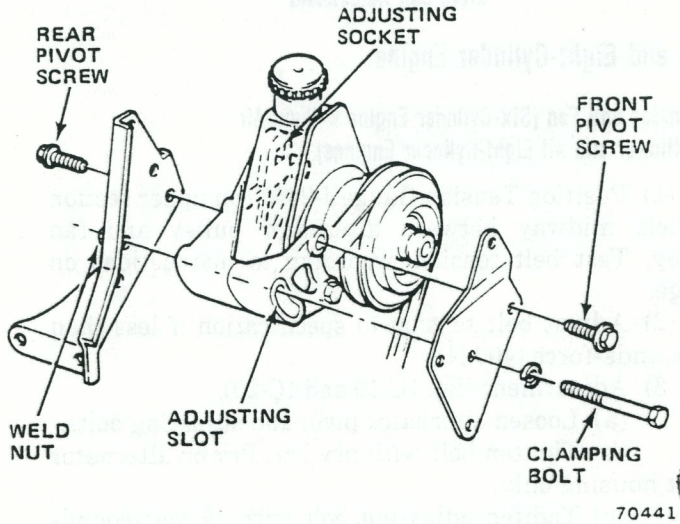

Fig. 1C-22 Six-Cylinder Engine Power Steering Pump Drive Belt Adjustment

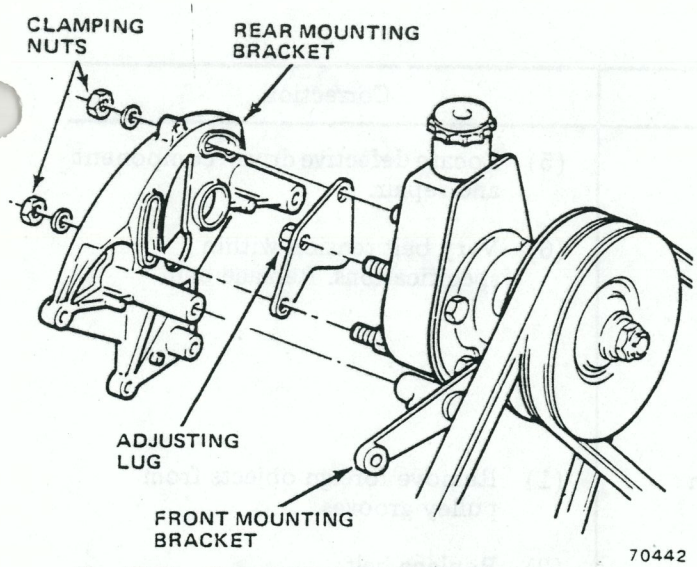

Fig. 1C-23 Eight-Cylinder Engine Power Steering Pump Drive Belt Adjustment

(b) Loosen adjusting bolts that attach power steering pump bracket to adaptor plates.

NOTE: *The bolt that attaches pump bracket to rear adaptor plate is located behind rear adaptor plate flange.*

(c) Insert drive lug of 1/2-inch drive ratchet into adjustment hole in bracket and pivot bracket to tighten belt.

(d) Tighten bolts with 30 foot-pounds (41 N•m) torque.

(e) Re-test tension.

(f) Adjust air pump drive belt (refer to Air Pump Drive Belt Adjustment).

Serpentine Drive Belt (California Only)

(1) Position Tension Gauge J-23600-B on largest accessible span of belt. Test belt tension according to manufacturer's instructions.

(2) Adjust belt tension to specification if less than 140 pounds-force (623 N).

(3) Adjustment.

(a) Loosen alternator adjustment and pivot bolts.

CAUTION: *Maintain a clearance of at least 1.2 inches (30.5 mm) between power steering pump body and air pump body. A 1.2-inch (30.5 mm) block gauge may prove useful to rapidly establish clearance between pumps. Do not use power steering pump to increase belt tension.*

(b) Tighten belt with pry bar. Pry on alternator front housing only.

(c) Tighten adjustment and pivot bolts with 28 foot-pounds (38 N•m) torque.

(d) Re-test tension.

NOTE: *Because of the higher tension required for serpentine drive belts, a helper may be necessary for belt adjustment.*

SERPENTINE DRIVE BELT DIAGNOSIS

Refer to diagnosis chart when servicing serpentine drive belts.

Serpentine Drive Belt Diagnosis

Condition	Possible Cause	Correction
TENSION SHEETING FABRIC FAILURE (WOVEN FABRIC ON OUTSIDE CIRCUMFERENCE OF BELT HAS CRACKED OR SEPARATED FROM BODY OF BELT)	(1) Grooved or backside idler pulley diameters are less than minimum recommended.	(1) Replace pulley(s) not conforming to specification.
	(2) Tension sheeting contacting stationary object.	(2) Correct rubbing condition.
	(3) Excessive heat causing woven fabric to age.	(3) Replace belt.
	(4) Tension sheeting splice has fractured.	(4) Replace belt.
NOISE (OBJECTIONAL SQUEAL, SQUEAK, OR RUMBLE IS HEARD OR FELT WHILE DRIVE BELT IS IN OPERATION)	(1) Belt slippage.	(1) Adjust belt.
	(2) Bearing noise.	(2) Locate and repair.
	(3) Belt misalignment.	(3) Align belt/pulley(s).
	(4) Belt-to-pulley mismatch.	(4) Install correct belt.

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Condition	Possible Cause	Correction
NOISE (OBJECTIONAL SQUEAL, SQUEAK, OR RUMBLE IS HEARD OR FELT WHILE DRIVE BELT IS IN OPERATION) (Continued)	(5) Driven component induced vibration.	(5) Locate defective driven component and repair.
	(6) System resonant frequency induced vibration.	(6) Vary belt tension within specifications. Replace belt.
RIB CHUNKING (ONE OR MORE RIBS HAS SEPARATED FROM BELT BODY)	(1) Foreign objects imbedded in pulley grooves.	(1) Remove foreign objects from pulley grooves.
	(2) Installation damage.	(2) Replace belt.
	(3) Drive loads in excess of design specifications.	(3) Adjust belt tension.
	(4) Insufficient internal belt adhesion.	(4) Replace belt.
RIB OR BELT WEAR (BELT RIBS CONTACT BOTTOM OF PULLEY GROOVES)	(1) Pulley(s) misaligned.	(1) Align pulley(s).
	(2) Mismatch of belt and pulley groove widths.	(2) Replace belt.
	(3) Abrasive environment.	(3) Replace belt.
	(4) Rusted pulley(s).	(4) Clean rust from pulley(s).
	(5) Sharp or jagged pulley groove tips.	(5) Replace pulley.
	(6) Rubber deteriorated.	(6) Replace belt.
LONGITUDINAL BELT CRACKING (CRACKS BETWEEN TWO RIBS)	(1) Belt has mistracked from pulley groove.	(1) Replace belt.
	(2) Pulley groove tip has worn away rubber to tensile member.	(2) Replace belt.
BELT SLIPS	(1) Belt slipping because of insufficient tension.	(1) Adjust tension.
	(2) Belt or pulley subjected to substance (belt dressing, oil, ethylene glycol) that has reduced friction.	(2) Replace belt and clean pulleys.
	(3) Driven component bearing failure.	(3) Replace faulty component bearing.
	(4) Belt glazed and hardened from heat and excessive slippage.	(4) Replace belt.

Condition	Possible Cause	Correction
"GROOVE JUMPING" (BELT DOES NOT MAINTAIN CORRECT POSITION ON PULLEY, OR TURNS OVER AND/OR RUNS OFF PULLEYS)	(1) Insufficient belt tension.	(1) Adjust belt tension.
	(2) Pulley(s) not within design tolerance.	(2) Replace pulley(s).
	(3) Foreign object(s) in grooves.	(3) Remove foreign objects from grooves.
	(4) Excessive belt speed.	(4) Avoid excessive engine acceleration.
	(5) Pulley misalignment.	(5) Align pulley(s).
	(6) Belt-to-pulley profile mismatched.	(6) Install correct belt.
	(7) Belt cordline is distorted.	(7) Replace belt.
BELT BROKEN (NOTE: IDENTIFY AND CORRECT PROBLEM BEFORE NEW BELT IS INSTALLED)	(1) Excessive tension.	(1) Replace belt and adjust tension to specification.
	(2) Tensile members damaged during belt installation.	(2) Replace belt.
	(3) Belt turnover.	(3) Replace belt.
	(4) Severe misalignment.	(4) Align pulley(s).
	(5) Bracket, pulley, or bearing failure.	(5) Replace defective component and belt.
CORD EDGE FAILURE (TENSILE MEMBER EXPOSED AT EDGES OF BELT OR SEPARTED FROM BELT BODY)	(1) Excessive tension.	(1) Adjust belt tension.
	(2) Drive pulley misalignment.	(2) Align pulley.
	(3) Belt contacting stationary object.	(3) Correct as necessary.
	(4) Pulley irregularities.	(4) Replace pulley.
	(5) Improper pulley construction.	(5) Replace pulley.
	(6) Insufficient adhesion between tensile member and rubber matrix.	(6) Replace belt and adjust tension to specifications.
SPORADIC RIB CRACKING (MULTIPLE CRACKS IN BELT RIBS AT RANDOM INTER-VALS)	(1) Ribbed pulley(s) diameter less than minimum specification.	(1) Replace pulley(s).
	(2) Backside bend flat pulley(s) diameter below minimum.	(2) Replace pulley(s).
	(3) Excessive heat condition causing rubber to harden.	(3) Correct heat condition as necessary.
	(4) Excessive belt thickness.	(4) Replace belt.
	(5) Belt overcured.	(5) Replace belt.
	(6) Excessive tension.	(6) Adjust belt tension.

SPECIFICATIONS

Cooling System Specifications

	Four-Cylinder Engine		Six-Cylinder Engine		Eight-Cylinder Engine	
	USA	Metric	USA	Metric	USA	Metric
Radiator Cap Relief Pressure	15 psi	103 kPa	15 psi	103 kPa	15 psi	103 kPa
Thermostat						
Rating	195°F	91°C	195°F	91°C	195°F	91°C
Must be open 0.003 inch (0.076mm) at	192°-198°F	89°-92°C	192-198°F	89-92°C	192-198°F	89-92°C
Fully open	218°F	103°C	218°F	103°C	218°F	103°C
Water Pump						
Type	Centrifugal		Centrifugal		Centrifugal	
Drive	V-Belt		V-Belt*		V-Belt	
Radiator						
Type	Tube & Spacer		Tube & Fin		Tube & Fin	
Cooling System Capacities						
(includes 1 quart for heater)	7.8 qts.	7.1 liters	10.5 qts.	9.9 liters	13.0 qts. (11.6 imp. qts.) 304 CID engine	12.3 liters
					14.0 qts. (10.8 imp. qts.) 360 CID engine	13.2 liters
Fan						
Number of Blades	Refer to Cooling System Components Chart					
Diameter	Refer to Cooling System Components Chart					
Drive Belt						
Angle of V	36°		38°		38°	
Width—top of groove	0.38 in.	9.65mm	0.391-0.453 in.	9.931-11.506 mm	0.391-0.453 in.	9.931-11.506 mm
Type (plain or cogged)	plain		plain		plain	
Serpentine						
Number of Ribs	6					
Rib Angle	40°					
Rib Width	0.14 in. 3.56mm					

* California: Serpentine Drive Belt

60570

Cooling System Components

Model	Cooling Package			Engine				Transmission		Radiator		Fan				Shroud
	STD	HD	AC	151	258	304	360	Man.	Auto.	Fins Per Inch	Rows of Tubes	Diam. (Inches)	No. of Blades	Spacer (Inches)	Tempa-trol	
	•				•			•		8	2	16.25③	4	0.88		
	•				•				•①	9	2	16.25③	4	0.88		
		•②			•			•		15	2	15.62	7	1.22		•
CJ-5		•②			•				•①	15	2	15.62	7	1.22		•
85			•②		•			•		15	2	15.62	7	1.22		•
			•②		•				•①	15	2	15.62	7	1.22		•
CJ-7	•					•		•		10.5	2	19.00	4	1.50		
87	•					•			•①	12	2	19.00	4	1.50		
		•	•			•		•		16	2	19.50	7		•	•
		•	•			•			•①	16	2	19.50	7		•	•
	•			•					•①	13	2	15.00	4	1.70		•
		•		•					•①	16	2	16.00	7		•	•
	•			•				•		11	2	15.00	4	1.70		•
		•		•				•		13	2	16.00	7		•	•
	•				•			•		9	2	16.25③	4	0.88		
	•				•				•	10	2	16.25③	4	0.88		
Wagoneer		•			•			•		15	2	19.50③	7		•	•
15		•			•				•	15	2	19.50③	7		•	•
			•		•			•		15	2	19.50③	7		•	•
Cherokee			•		•				•	15	2	19.50③	7		•	•
16, 17, 18	•						•	•		11.5	2	19.50	7		•	
	•						•		•	12.5	2	19.50	7		•	
Truck		•					•	•		16	2	19.50	7		•	•
25, 26, 27		•					•		•	16	2	19.50	7		•	•
			•				•	•		16	2	19.50	7		•	•
			•				•		•	16	2	19.50	7		•	•

NOTE: All radiator caps are rated at 15 psi (103 kPa)
① Not applicable to CJ-5 vehicles
② Not available in California
③ California: Reverse Rotation

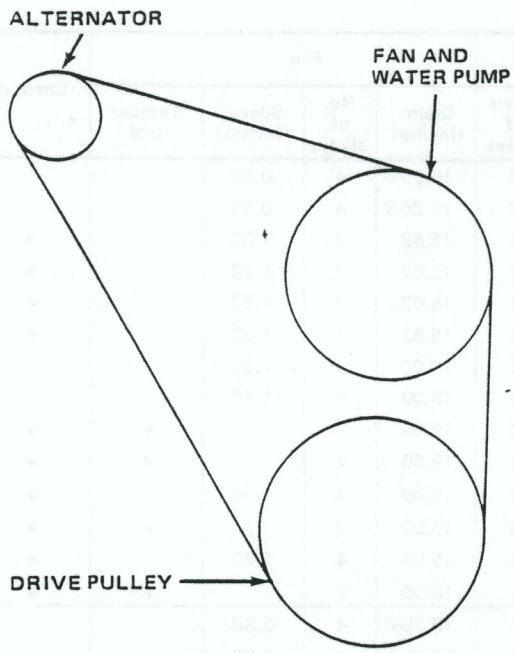
60875

Engine Drive Belt Tension

	Initial Pounds-Force New Belt	Reset Pounds-Force Used Belt	Initial Newtons New Belt	Reset Newtons Used Belt
Air Conditioner				
All	125-155	90-115	556-689	400-512
Air Pump				
All except six-cylinder w/PS	125-155	90-115	556-689	400-512
Six-Cylinder w/PS (3/8-inch belt)	65-75	60-70	289-334	267-311
Fan And Alternator	125-155	90-115	556-689	400-512
Power Steering Pump	125-155	90-115	556-689	400-512
Serpentine Drive Belt (Six-cylinder engine California)	180-200	140-160	800-890	623-712

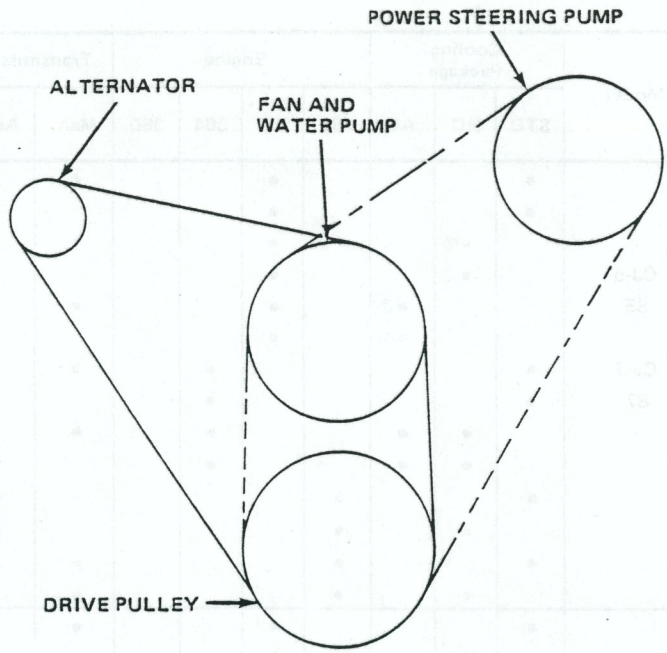
60253

Engine Drive Belt Arrangements



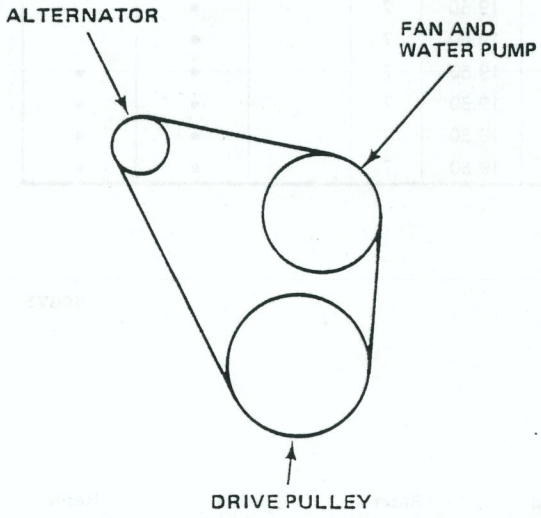
FOUR-CYLINDER ENGINE
BASIC BELT ARRANGEMENT

70708A



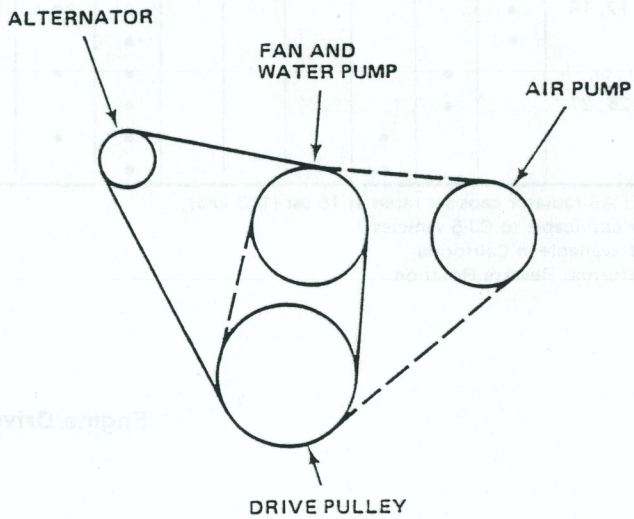
FOUR-CYLINDER ENGINE WITH
ALTERNATOR AND POWER STEERING

70708B



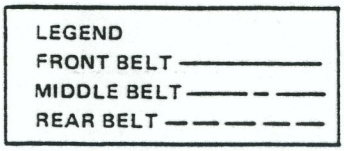
SIX-CYLINDER ENGINE
BASIC BELT ARRANGEMENT

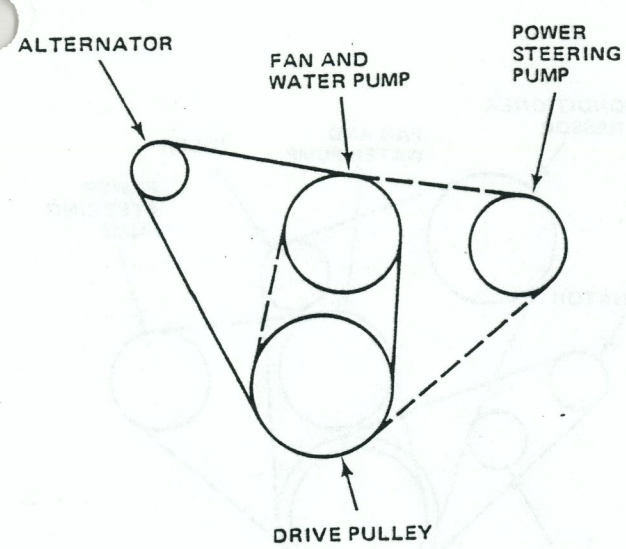
80415A



SIX-CYLINDER ENGINE WITH
ALTERNATOR AND AIR PUMP

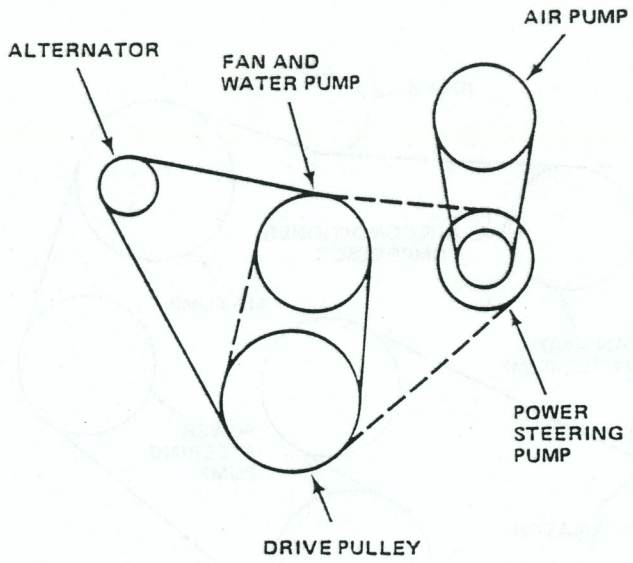
80415B





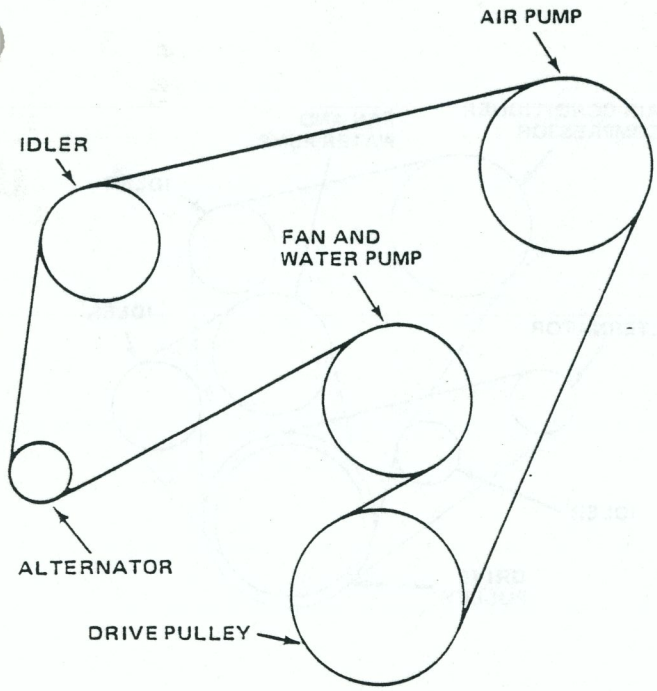
SIX-CYLINDER ENGINE WITH ALTERNATOR AND POWER STEERING

80415C



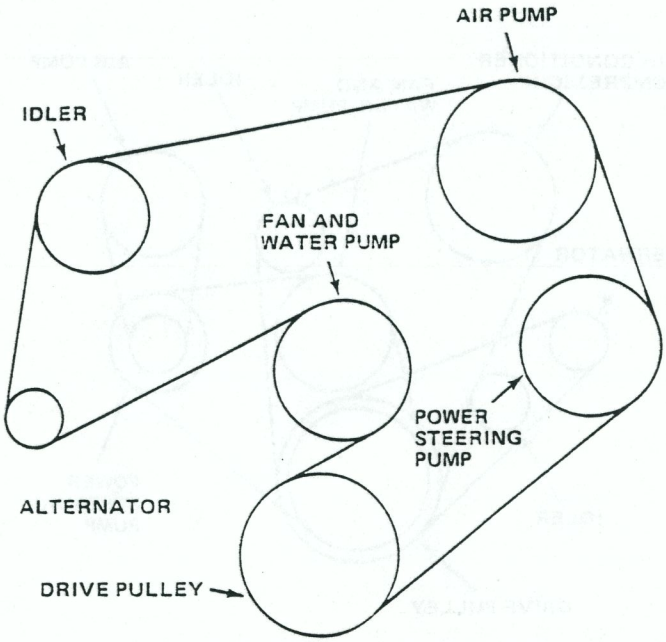
SIX-CYLINDER ENGINE WITH ALTERNATOR POWER STEERING AND AIR PUMP

80415D



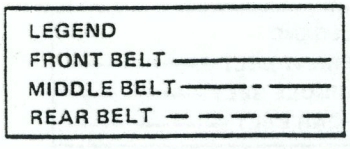
SIX-CYLINDER ENGINE WITH SERPENTINE DRIVE, ALTERNATOR AND AIR PUMP

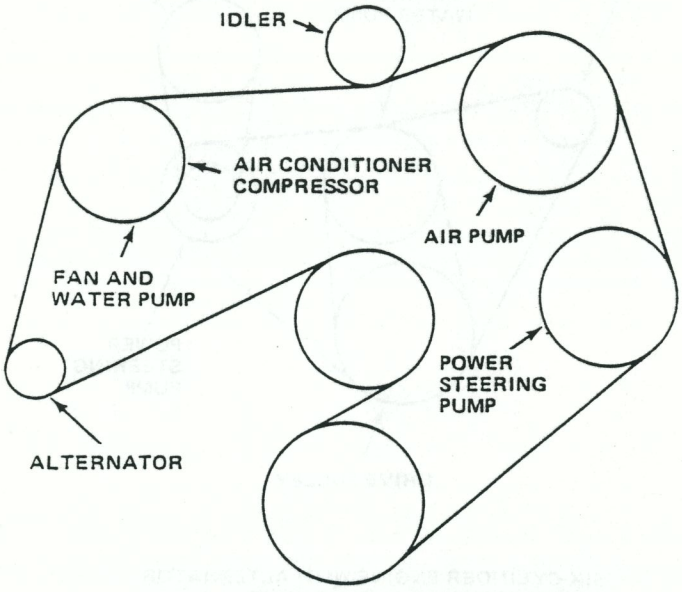
80415J



SIX-CYLINDER ENGINE WITH SERPENTINE DRIVE, ALTERNATOR, POWER STEERING AND AIR PUMP

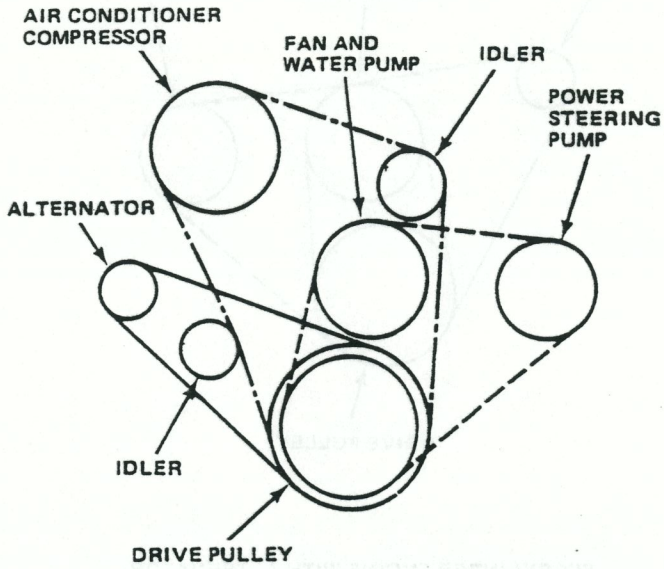
80415K





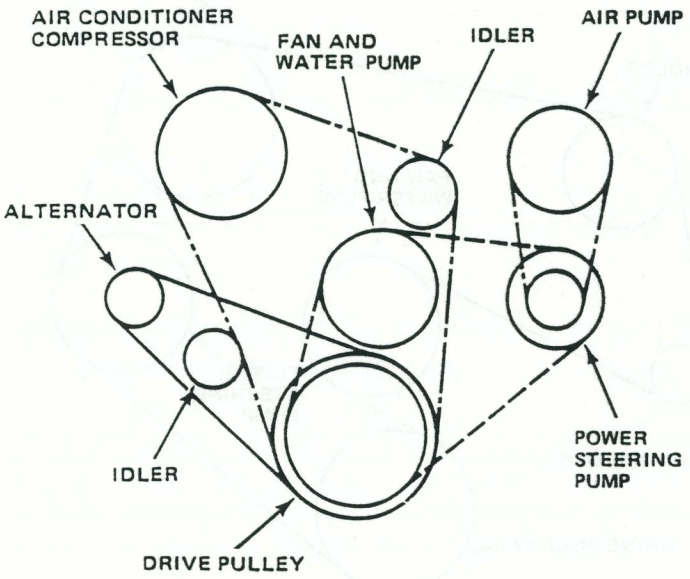
SIX-CYLINDER ENGINE WITH SERPENTINE DRIVE, ALTERNATOR, AIR CONDITIONING, POWER STEERING AND AIR PUMP

80415M



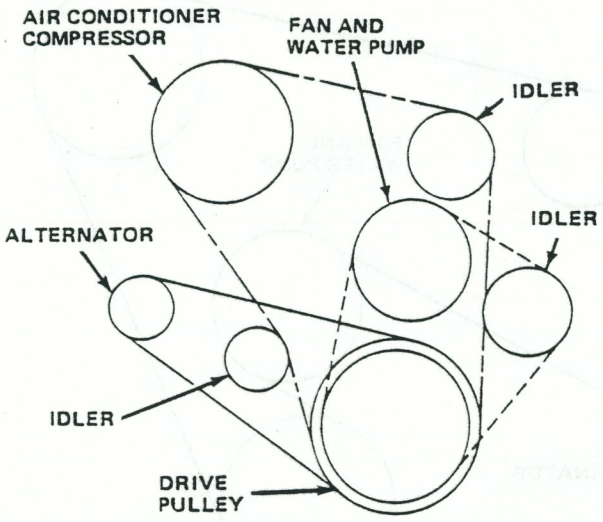
SIX-CYLINDER ENGINE WITH ALTERNATOR, AIR CONDITIONING AND POWER STEERING

90977A



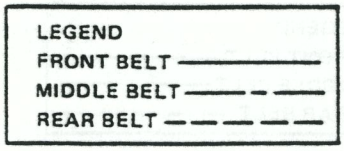
SIX-CYLINDER ENGINE WITH ALTERNATOR, POWER STEERING, AIR PUMP AND AIR CONDITIONING

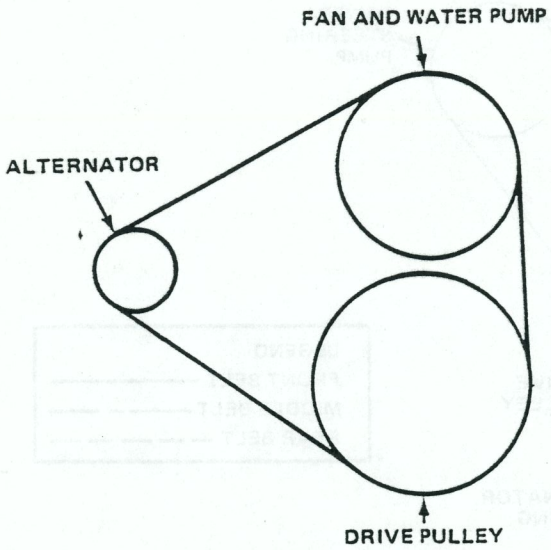
90977B



SIX-CYLINDER ENGINE WITH ALTERNATOR AND AIR CONDITIONER

90977C

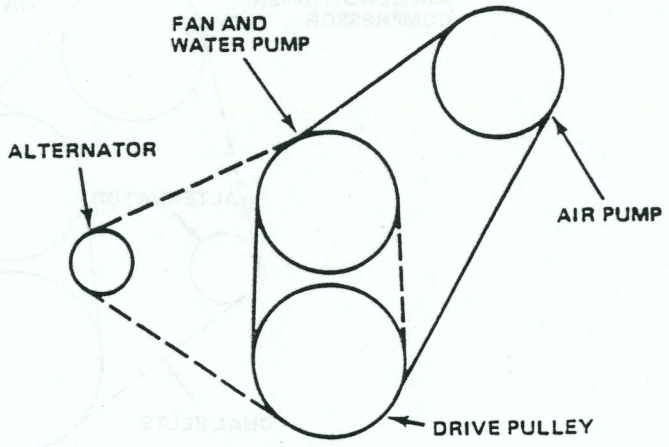




EIGHT-CYLINDER ENGINE
BASIC BELT ARRARNGEMENT

NOTE: 10 SI ALTERNATOR – 1 BELT
15 SI ALTERNATOR – 2 BELTS

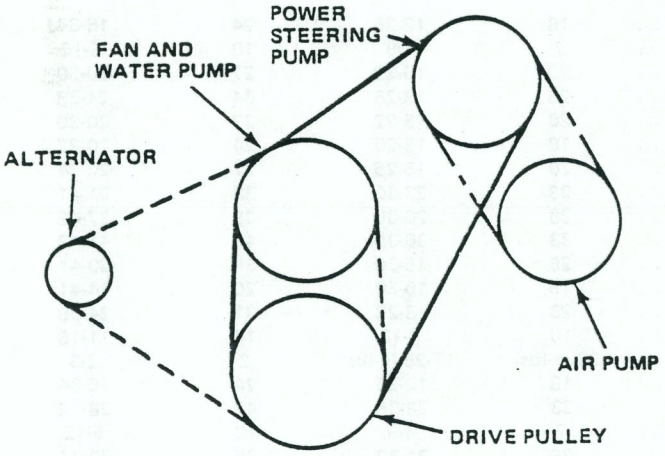
90977D



EIGHT-CYLINDER ENGINE WITH
ALTERNATOR AND AIR PUMP

NOTE: 10 SI ALTERNATOR – 1 BELT
15 SI ALTERNATOR – 2 BELT

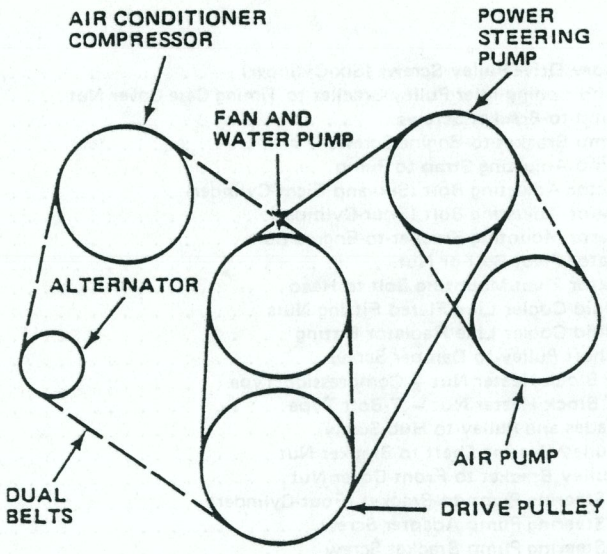
90977E



EIGHT-CYLINDER ENGINE WITH ALTERNATOR,
AIR PUMP AND POWER STEERING

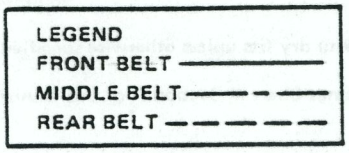
NOTE: 10 SI ALTERNATOR – 1 BELT
15 SI ALTERNATOR – 2 BELTS

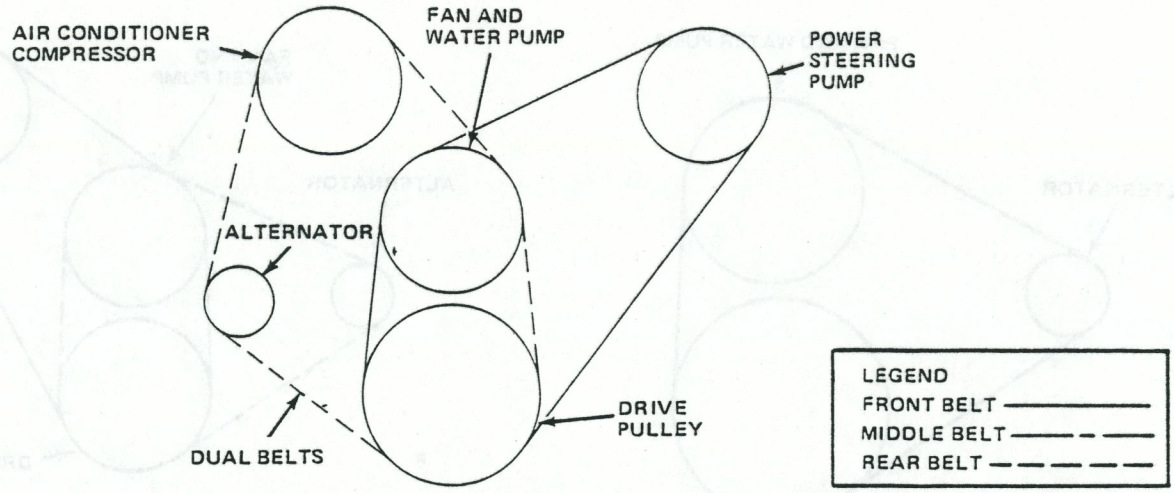
90977F



EIGHT-CYLINDER ENGINE WITH ALTERNATOR,
AIR PUMP, AIR CONDITIONING, AND POWER STEERING

90977G





EIGHT-CYLINDER ENGINE WITH ALTERNATOR, AIR CONDITIONING AND POWER STEERING

90977H

Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-tightened item.

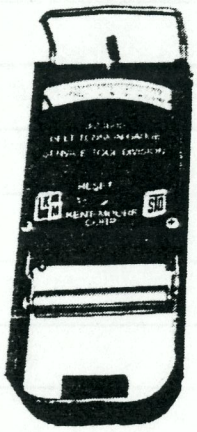
	USA (ft-lbs)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Accessory Drive Pulley Screws (Six-Cylinder)	18	12-25	24	16-34
Air Conditioning Idler Pulley Bracket to Timing Case Cover Nut	7	4-9	10	5-12
Air Pump-to-Bracket Screws	20	15-22	27	20-30
Air Pump Bracket-to-Engine Screws	25	18-28	34	24-38
Air Pump Adjusting Strap to Pump	20	15-22	27	20-30
Alternator Adjusting Bolt (Six- and Eight-Cylinder)	18	15-20	24	20-27
Alternator Adjusting Bolt (Four-Cylinder)	20	15-25	27	20-34
Alternator Mounting Bracket-to-Engine Bolt	28	23-30	38	31-41
Alternator Pivot Bolt or Nut	28	20-35	38	27-48
Alternator Pivot Mounting Bolt to Head	33	30-35	45	41-48
A/T Fluid Cooler Line Flared Fitting Nuts	25	15-30	34	20-41
A/T Fluid Cooler Line Radiator Fitting	15	10-30	20	14-41
Crankshaft Pulley to Damper Screw	23	18-28	31	24-38
Engine Block Heater Nut — Compression Type	10	8-13	14	11-18
Engine Block Heater Nut — T-Bolt Type	20 in-lbs	17-25 in-lbs	2	2-3
Fan Blades and Pulley to Hub Screw	18	12-25	24	16-34
Idler Pulley Bearing Shaft to Bracket Nut	33	28-38	45	38-52
Idler Pulley Bracket to Front Cover Nut	7	4-9	10	5-12
Power Steering Pump-to-Bracket (Four-Cylinder)	28	24-32	38	32-44
Power Steering Pump Adapter Screw	23	18-28	31	24-38
Power Steering Pump Bracket Screw	43	37-47	58	50-64
Power Steering Pump Mounting Screw	28	25-35	38	34-48
Power Steering Pump Pressure Line Nut	30	30-45	41	41-61
Power Steering Pump Pulley Nut	58	40-69	79	54-94
Thermostat Housing (Six- and Eight-Cylinder)	13	10-18	18	14-24
Thermostat Housing (Four-Cylinder)	20	17-23	27	24-30
Timing Case Cover to Block (Eight-Cylinder) (through Water Pump)	25	18-33	34	24-45
Water Pump-to-Block Screws (Six-Cylinder)	13	9-18	18	12-24
Water Pump to Block (Four- and Eight-Cylinder)	25	18-33	34	24-45
Water Pump-to-Timing Case Cover Screen (Eight Cylinder)	48 in-lbs	40-55 in-lbs	5	5-6

All Torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

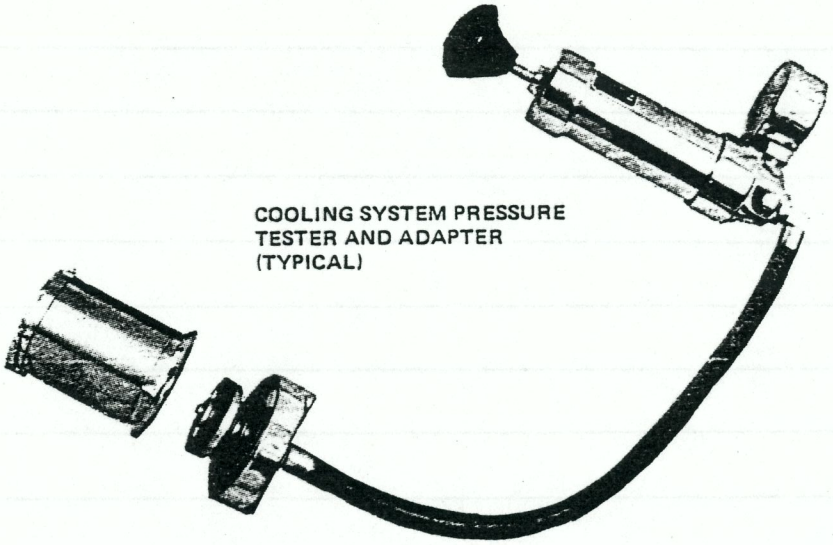
Refer to Standard Torque Specifications and Capscrew Markings Chart in Section A of this manual for any torque specifications not listed above.

60250

Tools



J-23600
BELT TENSION GAUGE



COOLING SYSTEM PRESSURE
TESTER AND ADAPTER
(TYPICAL)

AJ42005

NOTES

BATTERIES 1D

INDEX

	Page
Battery Classifications, Ratings and Codes	1D-1
Battery Replacement	1D-2
Charging	1D-3
DARS Chart	1D-7
General	1D-1
Maintenance	1D-2
Specifications	1D-9
Testing	1D-5

GENERAL

The batteries for 1981 Jeep vehicles are lightweight and have low-antimony/lead compound plates. In addition to helping reduce overall vehicle weight, they require less frequent electrolyte level inspections, have a decreased self-discharge rate from local action and have a longer shelf life. Electrolyte level inspections are required only at the beginning of each winter season and every 15,000 miles (24 000 km).

In addition to the standard equipment 380 cold crank amps battery, a 450 cold crank amps battery is optionally available for vehicles equipped with heavy-duty equipment. Both batteries are 12-volt, lead-acid units.

The vehicle battery tray has a removable spacer that, when removed, will permit the installation of a substitute conventional size group 24 battery in the event a lightweight replacement battery is not available.

NOTE: *A 440 Cold Crank Amps with 135-Minute Reserve Capacity is optionally available for 1981 J-Series vehicles equipped with a Police Package.*

BATTERY CLASSIFICATIONS, RATINGS AND CODES

Group Size Classification

The group size classification provides, by reference to Battery Council International listings or applicable SAE standard, the physical characteristics and electrical criteria for the applicable battery.

Reserve Capacity Minutes Rating

Reserve capacity minutes is defined as the number of minutes a fully charged battery at 80°F (26.7°C) can be discharged at a steady 25 ampere rate until a terminal voltage equivalent to 1.75 volts per cell (10.50 volts total battery voltage) is indicated. The reserve capacity rating for each Jeep battery is either listed on a label or stamped into the battery case. The batteries are also color coded to denote the rating.

Cold Crank Amps Rating

The cold crank amps rating specifies the minimum amps a fully charged battery can deliver at 0°F (-17.7°C) for thirty seconds without the battery terminal voltage dropping below 7.2 volts. The cold crank amps rating is either listed on a label or stamped in the battery case.

Battery Ratings

Group Size	Cold Crank Amps	Reserve Capacity Min.
55-380	380	75
56-450	450	90
24-440	440	135

90962

Battery Codes

Each battery is date coded at the time of shipment from the manufacturer. This code is stamped into the edge of the plastic case cover (fig. 1D-1). A second code number stamped on the side of the battery case represents manufacturing data and may be ignored.

The date code is decoded as follows:

- **Month:** Jan., Feb., etc.
- **Year:** 80—1980, 81—1981

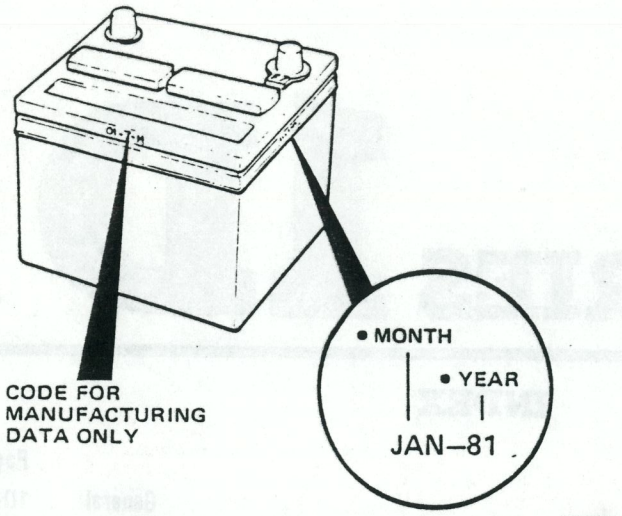


Fig. 1D-1 Date Code Location—Typical

BATTERY REPLACEMENT

Removal

(1) Loosen cable clamps.

(2) Use puller to remove cables if necessary. Remove positive cable first.

WARNING: *Use extreme care to prevent dropping battery and splattering the electrolyte because it can cause severe eye injury and skin burns. Rubber gloves, rubber aprons, protective eye shields and steel-toed shoes will decrease the hazards of this type accident. Immediate first aid is required for electrolyte splashed into the eyes and on the skin. Electrolyte spills should be immediately neutralized with a solution of sodium bicarbonate (baking soda) and water and then thoroughly rinsed with water.*

(3) Loosen holddowns and remove battery.

(4) Inspect cables for corrosion and damage. Remove corrosion using wire brush or post and terminal cleaner and soda solution. Replace cables that have damaged or deformed terminals.

(5) Inspect battery tray and holddowns for corrosion. Remove corrosion using wire brush and soda solution. Paint exposed bare metal. Replace damaged components.

(6) Clean outside of battery case if original battery is to be installed. Clean top cover with a diluted ammonia soda solution to remove acid film. Flush with clean water. Ensure soda solution does not enter cells. Remove corrosion from terminals with wire brush or post and terminal cleaner. Inspect case for cracks or other damage that would result in leakage of electrolyte.

Installation

(1) Refer to Specifications to determine if battery has correct rating for vehicle.

(2) Use hydrometer to test battery electrolyte. Charge if necessary.

CAUTION: *Ensure battery tray is clear of loose hardware or debris that could damage battery case.*

(3) Position battery in tray. Ensure positive and negative terminals are correctly located. Cables must reach their respective terminals without stretching.

(4) Ensure tang at battery base is positioned in tray properly before tightening holddown.

CAUTION: *It is imperative that the cables are connected to the battery positive-to-positive and negative-to-negative. Reverse polarity will damage alternator diodes and radios.*

(5) Connect and tighten positive cable first. Then connect and tighten negative cable.

NOTE: *The tapered positive terminal is 1/16 inch (1.6 mm) larger in diameter than the negative terminal. The opening in the positive cable clamp is correspondingly larger.*

(6) Apply thin coating of petroleum jelly or chassis grease to cable terminals and battery posts.

(7) Inspect negative cable connections on engine and vehicle body for condition, security and electrical continuity.

MAINTENANCE

Always observe the correct polarity when connecting a charger to a battery. Reversed battery connections will damage the alternator diodes and radios. The NEGATIVE battery terminal is grounded to the engine and body.

WARNING: *Explosive gases are present within and around the battery at all times. Avoid open flames and sparks. The danger of battery explosion is compounded by the fact that the acid would be splattered in every direction. Wear protective eye shields and clothing when servicing any battery. Ensure battery has adequate ventilation when charging.*

It is important that the battery be fully charged when a new vehicle is delivered. Maintaining a battery at partial charge could shorten its life.

Inspect electrolyte level in the battery at 15,000 mile (24 000 km) intervals and at the beginning of the winter season. Add distilled water to each cell until the level reaches the bottom of the vent well. DO NOT OVERFILL. Operate the engine immediately after adding water (particularly in cold weather) to assure proper mixing of the water and electrolyte.

Inspect to determine the external condition of the battery and the cables periodically.

The holddown should be tight enough to prevent the battery from vibrating or shifting position and cause damage to the battery case.

CAUTION: *Keep filler caps tight to prevent the neutralizing solution from entering the cells.*

Take particular care to ensure that the top of the battery is free of acid film and dirt between the battery terminals. For best results when cleaning the battery, wash with a diluted ammonia or soda solution to neutralize any acid present and flush with clean water.

To ensure good electrical contact, the battery cables must be tight on the battery posts. Ensure the terminal clamps have not stretched. This could cause the clamp ends to become butted together without actually being tight on the post. If the battery posts or cable terminals are corroded, disconnect the cables by loosening the terminal clamp bolts and remove the terminals with the aid of a puller. Do not twist, hammer or pry on a terminal to free it from the battery post. Clean the terminals and posts with a soda solution and wire brush or post and terminal cleaner. Connect the cable terminal clamps (positive terminal first) to the battery posts and apply a thin coat of petroleum jelly or grease. Inspect the battery negative cable and body ground cable for condition and good electrical continuity with engine and body.

Frozen Electrolyte

WARNING: *Do not attempt to charge or use a booster on a battery with frozen electrolyte. The frozen battery may explode!*

A 75 percent charged battery will not freeze. Maintain batteries at 75 percent charge or more, especially during winter weather.

Replace the battery if the electrolyte becomes either slushy or frozen. A battery in this condition, depending on the severity of the freeze, may accept and retain a charge, and even perform satisfactorily under a load test. However, after 120 to 150 days in service, a reduction in storage capacity and service life will become apparent as the individual plates lose their active material.

Electrolyte Freezing Temperature

Specific Gravity (Corrected to 80° F)	Freezing Temperature
1.270	– 84°F (– 64°C)
1.250	– 62°F (– 52°C)
1.200	– 16°F (– 27°C)
1.150	+ 05°F (– 15°C)
1.100	+ 19°F (– 7°C)

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Battery Storage

All wet cell batteries will discharge slowly from local action when stored. Batteries discharge faster when warm than when cold. For example, at 100°F (37.8°C), a normal self-discharge rate of 0.0024 specific gravity per day can be expected. At 50°F (10°C), a discharge rate of 0.0003 specific gravity per day is normal. Refer to Self-Discharge Rate chart.

Before storage, clean the battery case with a solution of sodium bicarbonate (baking soda) and water, rinse and wipe the case dry. When storing a battery, charge fully (no change in specific gravity after three tests taken at one hour intervals) and store in a cool, dry location. Refer to Charging and Testing.

Fully charge a stored battery before putting it into service. Refer to Charging for procedure. Refer to Battery Replacement for installation procedure.

Self-Discharge Rate

Temperature	Approximate Allowable Self-Discharge Per Day For First Ten Days
100°F (37.8°C)	0.0024 Specific Gravity
80°F (26.7°C)	0.0009 Specific Gravity
50°F (10°C)	0.0003 Specific Gravity

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CHARGING

General

A battery stores electrical energy in the form of chemical energy. When it is used to power an electrical device (e.g., a starter motor), the stored energy is released, or discharged, in the form of electrical energy.

The more cells and plate area a battery has, the greater its capacity for storing energy. When the maximum amount of energy is being stored, a battery is commonly said to be "fully charged." The relative amount of charge or stored energy is directly proportional to the specific gravity value of the electrolyte. This allows the use of a hydrometer to determine the state of charge or energy storage level of a battery in relation to the maximum possible charge (full charge).

Dry Charge Battery

WARNING: *Before activating a dry-charged battery, carefully read the instructions and poison/danger warning on the electrolyte carton.*

Do not remove seals until battery is to be activated. Once the seals are removed, the battery must be activated immediately. Discard seals after removal.

Activation Procedure

(1) Fill each cell with battery electrolyte to bottom of well, observing handling precautions listed on electrolyte carton.

(2) After cells are filled, tilt battery from side to side to release air bubbles.

(3) Recheck electrolyte level in each cell and add as necessary.

NOTE: *Uneven filling of cells will affect the battery capacity and service life.*

(4) Install caps supplied with battery.

(5) Inspect battery case for leakage to ensure no damage occurred in handling.

(6) Boost charge battery for 15 minutes at 30 amps or slow charge until battery electrolyte is gassing freely.

(7) Install battery in vehicle. Refer to Battery Replacement-Installation.

NOTE: *Because the apparent state of charge of a battery as indicated by a hydrometer is depressed for the first few cycles, load testing is the only valid test at the time of activation. Hydrometer testing may be used after the battery has been cycled in service.*

The specific gravity of a newly installed Jeep battery will be approximately 1.225 (±0.010). The specific gravity will normally rise to 1.250 to 1.265 after a few days in service.

NOTE: *Electrolyte is composed of sulfuric acid and water. Approximately 35 percent by weight or 24 percent by volume is acid.*

WARNING: *Never add pure acid to a battery.*

Slow Charge

WARNING: *Battery charging generates hydrogen gas, which is highly flammable and explosive. Hydrogen gas is present within and around a battery at all times, even when a battery is in a discharged condition. Keep open flames and sparks (including cigarettes, cigars, pipes) away from the battery. Always wear eye protection when handling, testing or charging a battery.*

Slow charging is the preferred method of recharging a battery. The slow charge method may be safely used, regardless of charge condition of the battery, provided the electrolyte is at the proper level in all cells and is not frozen.

WARNING: *Do not attempt to charge or use a booster on a battery with frozen electrolyte because it can cause the frozen battery to explode.*

The normal charging rate for a lightweight battery is 3 to 5 amps. A minimum period of 24 hours is required when charging at this rate. Charge time is inversely proportional to the temperature of the electrolyte.

A battery may be fully charged by the slow charge method unless it is not capable of accepting a full charge. **A battery is in a maximum charged condition when all cells are gassing freely and three corrected specific gravity tests, taken at one-hour intervals, indicate no increase in specific gravity.**

Fast Charge

CAUTION: *Always disconnect the battery cables before using a fast charger.*

A battery may be charged at any rate that does not cause the electrolyte temperature of any cell to exceed 125°F (51.7°C) and does not cause excessive gassing and loss of the electrolyte.

A fast charger cannot be expected to fully charge a battery within an hour, but will charge the battery sufficiently so that it may be returned to service. The battery will be fully charged by the vehicle charging system, provided the engine is operated a sufficient length of time.

Booster Charging

WARNING: *If the battery electrolyte is not visible or frozen, do not attempt to jump-start because the battery could rupture or explode. The battery must be warmed up to 40°F (4.4°C) and water added if necessary before it can be safely charged or the engine jump-started.*

The correct method for starting an engine with a discharged battery requires either a portable starting unit or a booster battery. When using either method, it is essential that connections be made correctly.

When using a portable starting unit, the voltage must not exceed 16 volts or damage to the battery, alternator, or starter may result. Because of the accompanying high voltage, a fast charger must not be used for jump-starting engines.

(1) Remove vent caps from booster battery and cover cap openings with dampened cloth.

CAUTION: *If the engine is being jump-started with a battery located in another vehicle, the vehicles must not contact each other.*

(2) Connect jumper cable between positive posts of batteries. Positive post has "+" stamped into it. POS is also embossed on battery cover in 1/8-inch letters adjacent to battery post.

(3) Connect one end of second jumper cable to negative terminal of booster battery. NEG is embossed on battery cover in 1/8-inch letters adjacent to battery post. Ensure cable clamps have good electrical contact with posts. **DO NOT CONNECT OTHER END OF JUMPER CABLE TO NEGATIVE TERMINAL OF DISCHARGED BATTERY.** Connect cable to screw, bracket, nut or other good ground connection on engine. Do not connect cable to carburetor, air cleaner or fuel line. Keep cable clear of fan, belts and pulleys.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(4) When engine starts, remove jumper cables. Disconnect cable from engine first.

(5) Discard cloth used to cover cap openings because it has been exposed to sulfuric acid.

(6) Install battery caps.

TESTING

General

NOTE: *A complete battery test includes cleaning the top of the battery case, cleaning posts and cable terminals and performing hydrometer and heavy load tests.*

The condition of a battery may be determined from the results of two tests—state of charge (hydrometer test) and ability to supply current (heavy load test). Refer to Battery Diagnosis and Repair Simplification (DARS) chart.

Perform the hydrometer test first. If specific gravity indicates less than 1.225, the battery must be charged before proceeding to further testing. A battery that will not accept a charge is defective and further testing is not necessary.

NOTE: *A battery with sulfated plates may require an overnight slow charge to determine if the sulfate coating is thin enough to be eliminated by a charge.*

A battery that is fully charged and does not pass the heavy load test is defective.

If a battery discharges and no apparent cause can be found, the battery should be fully charged and allowed to stand on a shelf for three to seven days to determine if the self-discharge is excessive. The Self-Discharge Rate chart lists allowable self-discharge for the first ten days of standing after a battery has been fully charged. A battery is fully charged when all cells are gassing freely and three corrected specific gravity tests, taken at one-hour intervals, indicate no increase in specific gravity.

Hydrometer Test

NOTE: *Periodically disassemble the hydrometer and wash components with soap and water. Inspect the float for possible leaks. If the paper inside has turned brown, the float is defective.*

Prior to testing, visually inspect the battery for any damage (cracked container, cover, loose post, etc.) that would cause the battery to be unserviceable. To interpret the hydrometer correctly, hold it with the top surface of the electrolyte in the hydrometer at eye level (fig. 1D-2). Disregard the curvature of the liquid where the surface rises against the float because of surface cohesion. Draw in only enough electrolyte to keep the float off the bottom of the hydrometer barrel with the bulb released. Keep the hydrometer in a vertical position while drawing in the electrolyte and observing the specific gravity. Exercise care when inserting the tip of the hydrometer into a cell to avoid damage to separators. Damaged separators can result in premature battery failure.

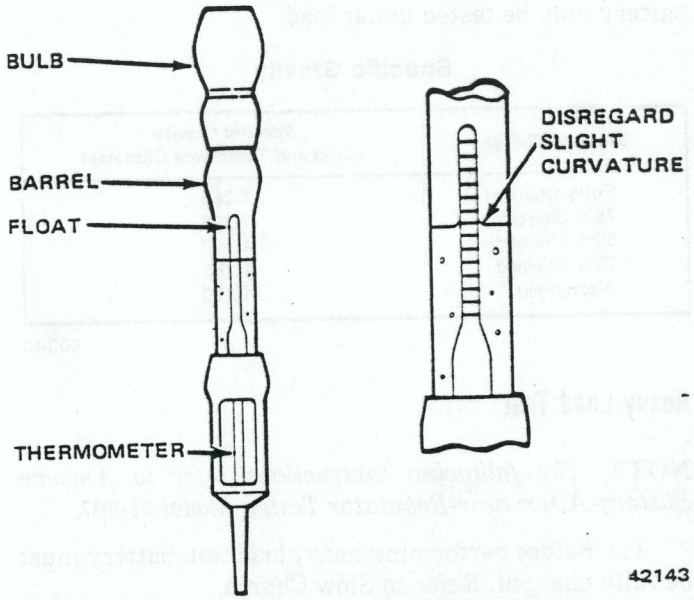

Fig. 1D-2 Hydrometer

Hydrometer floats are generally calibrated to indicate the specific gravity correctly at only one fixed temperature, 80°F (26.6°C). When testing the specific gravity at any other temperature, a correction factor is required. The correction factor is approximately a specific gravity value of 0.004, referred to as 4 points of gravity. For each 10°F above 80°F (5.5°C above 26.6°C), add 4 points. For each 10°F below 80°F (5.5°C below 26.6°C), subtract 4 points. Always correct the specific gravity for temperature variation. Test the specific gravity of the electrolyte in each battery cell.

Example: A battery is tested at 10°F and has a specific gravity of 1.240. The actual specific gravity is determined as follows:

Number of degrees above or below 80°F equals 70 degrees (80 minus 10).

70° divided by 10° (each 10° difference) equals 7.

7 multiplied by 0.004 (temperature correction factor) equals 0.028.

Temperature is below 80°F, therefore temperature correction is subtracted.

Temperature corrected specific gravity is 1.212 (1.240 minus 0.028).

A fully charged battery should have a temperature corrected specific gravity of 1.250 to 1.265.

If the specific gravity of all cells is above 1.235, but the variation between cells is more than 50 points (0.050), it is an indication that the battery is unserviceable. Remove the battery from the vehicle for additional testing.

If the specific gravity of one or more cells is less than 1.235, recharge the battery at a rate of approximately 5

amperes until 3 consecutive specific gravity tests, at one-hour intervals, are constant.

If the cell variation is more than 50 points (0.050) at the end of the charge period, replace the battery.

When the specific gravity of all cells is above 1.235 and variation between cells is less than 50 points, the battery may be tested under load.

Specific Gravity

State of Charge	Specific Gravity (Cold and Temperate Climates)
Fully Charged	1.265
75% Charged	1.225
50% Charged	1.190
25% Charged	1.155
Discharged	1.120

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Heavy Load Test

NOTE: *The following instructions refer to Amsery Battery-Alternator-Regulator Tester, Model 21-307.*

(1) Before performing heavy load test, battery must be fully charged. Refer to Slow Charge.

(2) Turn carbon pile rheostat knob of battery tester to **OFF** position (fig. 1D-3).

(3) Turn selector knob to **AMP** position.

(4) Connect test leads as illustrated in figure 1D-3.

(5) Turn carbon pile rheostat knob clockwise until ammeter indicates correct test amperage:

- 135 amperes for 55-380 battery (75 reserve capacity minutes, 380 cold crank amps).
- 180 amperes for 56-450 battery (90 reserve capacity minutes, 450 cold crank amps).

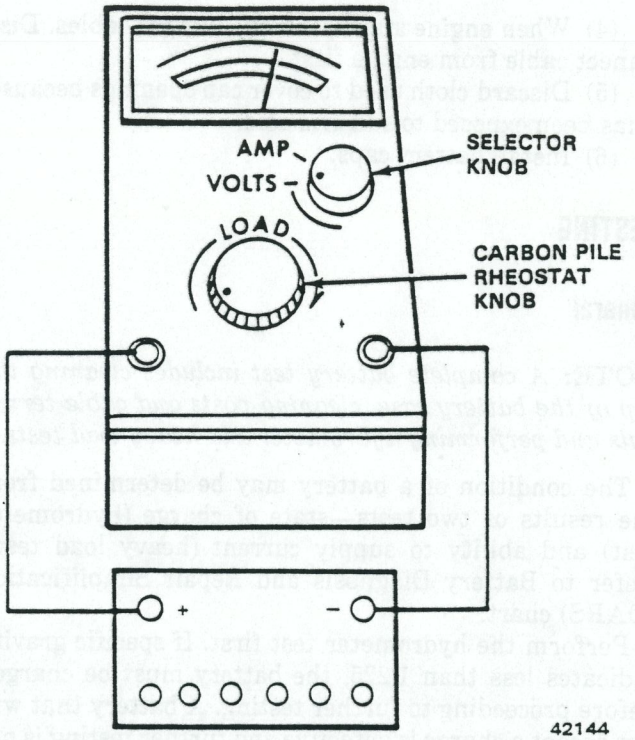


Fig. 1D-3 Heavy Load Test

- 230 amperes for 24-440 battery (135 reserve capacity minutes, 440 cold crank amps).

(6) Maintain load for 15 seconds. Turn selector switch to **VOLTS**, and note voltage.

If the voltmeter indicates 9.6 volts or higher with the battery temperature at a minimum of 70°F (21°C), the battery is in good condition. If less than 9.6 volts, replace the battery.

BATTERY DIAGNOSIS AND REPAIR SIMPLIFICATION (DARS) CHART

Note: Refer to Chapter A – General Information for details on how to use this DARS chart.

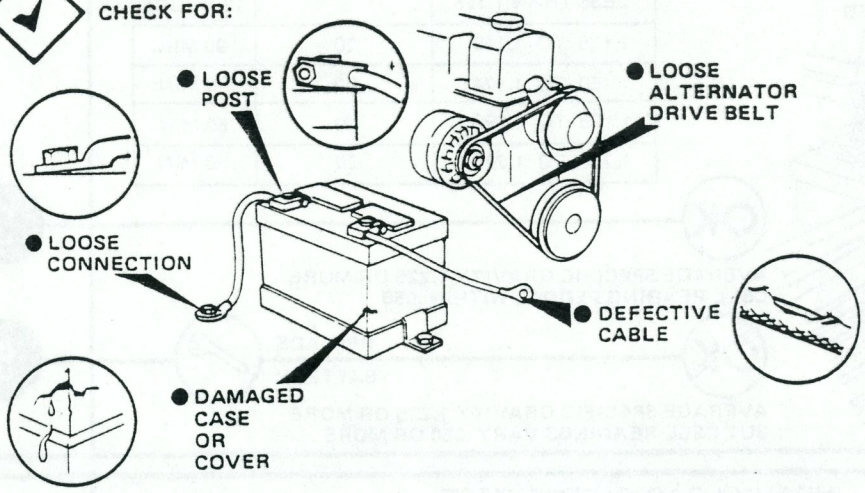
PROBLEM: ENGINE WILL NOT CRANK

Chart 1

STEP | **SEQUENCE** | **RESULT**

1

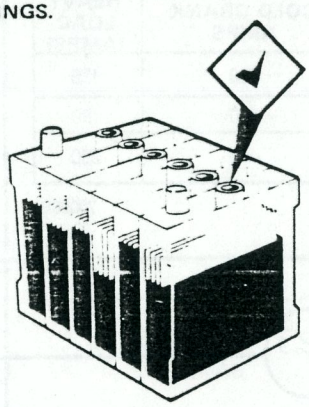
CHECK FOR:



REPAIR OR REPLACE IF NECESSARY → 2

2

● CHECK ELECTROLYTE LEVEL AND SPECIFIC GRAVITY IN EACH CELL AND RECORD READINGS.



ELECTROLYTE LEVEL TOO LOW FOR SPECIFIC TEST–ADD WATER. CHARGE BATTERY FOR 10 MIN. AT 20 AMPS. MEASURE SPECIFIC GRAVITY.

OK → 5

AVERAGE SPECIFIC GRAVITY 1.225 OR MORE CELL READINGS EQUAL WITHIN .050

O.K → REPLACE BATTERY → 6

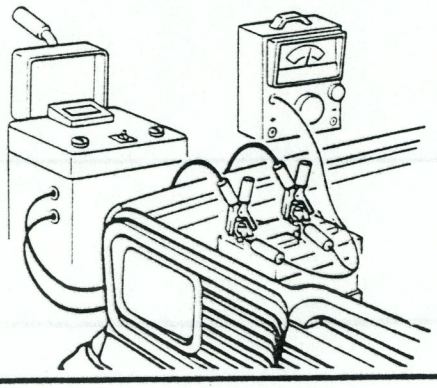
AVERAGE SPECIFIC GRAVITY 1.225 OR MORE BUT CELL READINGS VARY .050 OR MORE

O.K → 3

AVERAGE SPECIFIC GRAVITY BELOW 1.225

3

● CONNECT BATTERY CHARGER AND VOLTMETER
● CHARGE BATTERY FOR 3 MINUTES AT 40 AMPS
● AT THE END OF 3 MINUTES READ VOLTMETER WHILE CHARGER IS STILL CHARGING



OK → 4

VOLTAGE IS 15.5 OR LESS

O.K → SLOW CHARGE BATTERY AT 3 TO 4 AMPS FOR 48 TO 72 HOURS → 5

VOLTAGE ABOVE 15.5

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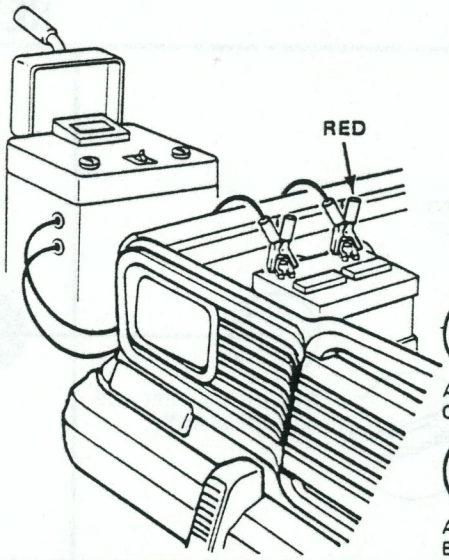
STEP **SEQUENCE** **RESULT**

4



CHARGE BATTERY AS INDICATED IN CHART, AFTER CHARGE IS COMPLETED, RECHECK SPECIFIC GRAVITY.

AVERAGE SPECIFIC GRAVITY	CHARGE RATE (AMPS)	TIME
LESS THAN 1.125	5	12 HOURS
1.125 TO 1.149	20	90 MIN.
1.150 TO 1.174	20	70 MIN.
1.175 TO 1.199	20	50 MIN.
1.200 TO 1.224	20	30 MIN.

OK → **5**

AVERAGE SPECIFIC GRAVITY 1.225 OR MORE
CELL READINGS EQUAL WITHIN .050

O.K → REPLACE BATTERY → **6**

AVERAGE SPECIFIC GRAVITY 1.225 OR MORE
BUT CELL READINGS VARY .050 OR MORE

5

- CLEAN BATTERY POST AND CABLE ENDS
- CONNECT HEAVY LOAD TESTER
- DETERMINE HEAVY LOAD FROM CHART
- ADJUST TESTER TO LOAD
- HOLD LOAD FOR 15 SECONDS
- READ VOLTMETER

HEAVY LOAD OUTPUT TEST

HEAVY LOAD CHART

GROUP SIZE	COLOR CODE	RESERVE CAPACITY (MINUTES)	COLD CRANK AMPS	HEAVY LOAD (AMPS)
55-380	Green	75	380	135
56-450	Red	90	450	180
24-440	Yellow	135	440	230

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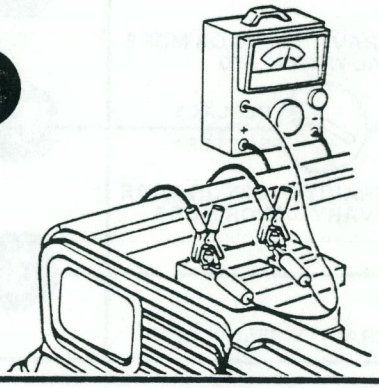

- VOLTAGE READING 9.6 OR MORE → **6**
- VOLTAGE READING LESS THAN 9.6 → REPLACE BATTERY → **6**

6

OK → ENGINE CRANKS → STOP

O.K → ENGINE DOES NOT CRANK → PERFORM STARTER DIAGNOSIS IN STARTER CHAPTER

70060B

SPECIFICATIONS

Battery Specifications

Engine	Group Size	Rating
151, 258, 304, and 360	55-380	380 amps 75 min.
Optional, Factory Installed	56-450	450 amps 90 min.
Optional, Police and Diesel	24-440	440 amps 135 min.

80380

Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (in-lbs)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Battery Box Screw	145	95-180	16	11-20
Battery Holddown Screw	75	50-95	8	6-11
Battery Cable Clamp	75	60-90	8	7-10

All Torque values given in inch-pounds and Newton-meters with dry fits unless otherwise specified.

Refer to the Standard Torque Specifications and Capscrew Markings Chart in Section A of this manual for any torque specifications not listed above.

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AMA 21-317
CIRCUIT TESTER

CHARGING SYSTEM 1E

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GENERAL

A Delco charging system is installed on all vehicles. This negative-ground system consists of two primary components: an alternator with an integral regulator and a battery. The non-repairable, non-adjustable regulator is a solid-state device located within the alternator housing.

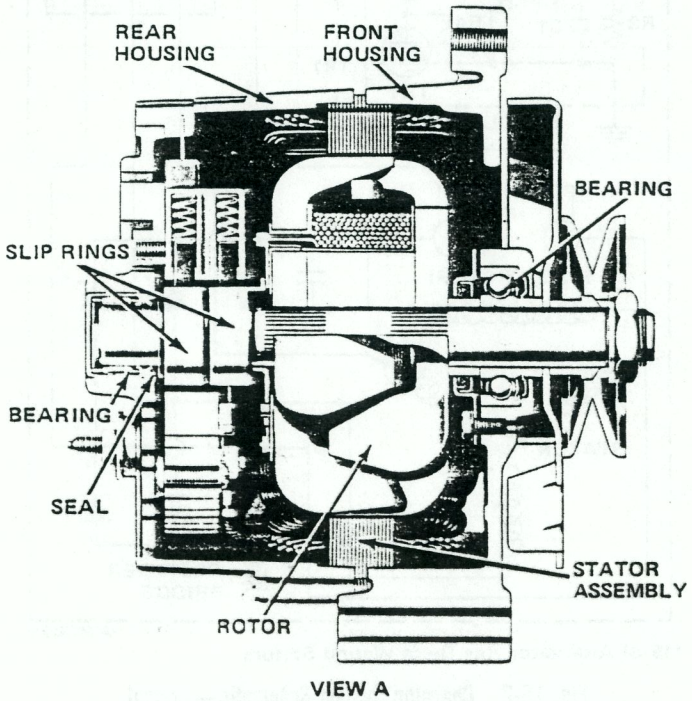
The standard equipment alternator is rated at 42 amps and the optional, heavy-duty alternators are rated at 55, 63, 70 and 85 amps.

COMPONENTS

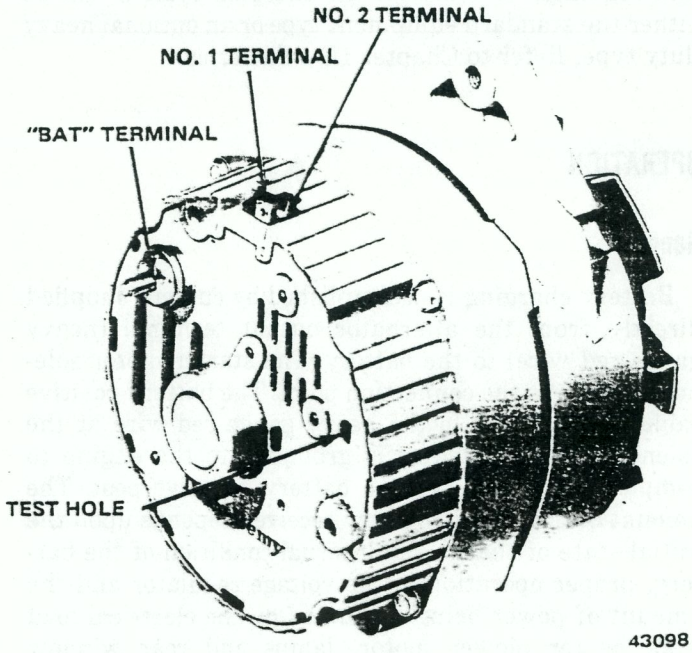
Alternator

The alternator (fig. 1E-1) is belt-driven by the engine. Its major components are front and rear housings, stationary windings (stator), rotating field winding (rotor), rectifying diodes and regulator.

The rotor assembly is supported in the front (drive end) housing by a ball bearing and in the rear (slip ring end) housing by a roller bearing. The bearings have sufficient lubricant for the life of the alternator and do



VIEW A



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VIEW B

Fig. 1E-1 Delco Alternator—Typical

not require periodic lubrication. Two brushes provide current through two slip rings to and from the field coil. The brushes are designed for long periods of attention-free service. Other than a regularly-scheduled drive belt tension adjustment, the alternator assembly requires no periodic adjustments or maintenance.

The stator windings are wound on the inside of a laminated core that is also part of the alternator frame. The bridge rectifier connected to the stator winding output is comprised of six diodes molded into a single assembly. The bridge rectifier converts the three-phase alternating current output to direct current for the vehicle electrical system.

Battery discharge through the alternator is prevented by the one-way current flow action of the diodes. This eliminates the need for a conventional cutout relay. Alternator field current is supplied through a diode trio that is also connected to the stator windings.

A capacitor, or condenser, located in the end housing, protects the bridge rectifier and diode trio from high surge voltages and suppresses radio interference noise.

NOTE: *All bolt and screw threads are in metric dimensions.*

Voltage Regulator

The voltage regulator utilizes an integrated circuit to regulate the excitation current supplied to the field (rotor) winding. All regulator components are encapsulated in a solid mold and, along with the brush holder assembly, is attached to the rear housing of the alternator. The voltage regulator is not adjustable or repairable.

Battery

The battery used in conjunction with the alternator and regulator to complete the charging system will be either the standard equipment type or an optional heavy duty type. Refer to Chapter 1D—Batteries.

OPERATION

General

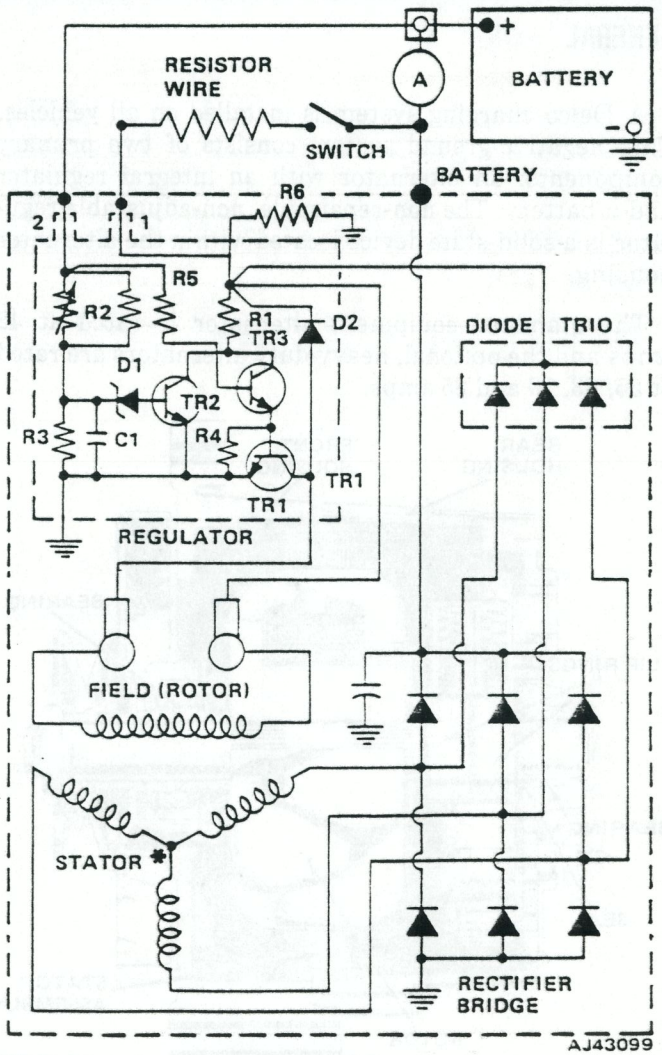
Battery charging is accomplished by current supplied directly from the alternator output terminal (heavy gauge red wire) to the battery. The starter motor solenoid is used as the connection point. The battery positive cable is connected to the heavy gauge red wire at the solenoid. The alternator is grounded to the engine to complete the circuit to the battery negative post. The amount of charge the battery receives depends upon the initial state of charge and internal condition of the battery, proper operation of the voltage regulator and the amount of power being consumed by the electrical load (e.g., heater blower motor, lamps and rear window defogger).

Energizing the System

When the ignition switch is turned to the **On** position (fig. 1E-2), positive battery voltage is applied to the regulator and current flows from ground to the regulator. The regulator controls the amount of excitation current allowed to flow through the field winding. The battery voltage provides the initial excitation that results in a large electromagnetic field around the rotor and a faster build-up of output voltage.

Within the regulator, TR1 and its associated biasing network controls the amount of field excitation current and, in so doing, the amplitude of the output voltage. As long as the rotor is stationary (i.e., no alternator output), all the current flows through the field winding, resistance wire and ammeter to the battery positive terminal. The ammeter will indicate negative (-) current flow (no alternator output).

NOTE: *Sometimes, without a battery installed in a vehicle (or if the battery is completely discharged), there will be no alternator output because there will be no*



*15-SI Alternator Has Delta Wound Stators

Fig. 1E-2 Charging System Schematic—Typical

energizing excitation current. In most instances the rotor will have sufficient residual magnetism to create a magnetic field and induce a voltage into the stator when the rotor is turned.

Voltage Output

When the rotor starts turning, the rotating electromagnetic field is cut by the stator windings. This action induces an AC voltage into the stator windings. The induced stator voltage is higher than the battery voltage and becomes the primary voltage source for excitation current flow through the field winding. The diode trio rectifies the current that flows from ground through TR1 and the field winding to the stator windings.

The six diodes in the bridge rectifier convert the stator AC voltage to DC output voltage. As alternator rotor rpm increases, increased power is generated for charging the battery and operating the electrical accessories. Because the voltage amplitude is higher on the alternator side of the ammeter, the current will flow through the ammeter to the alternator BAT terminal. The ammeter will indicate positive (+) current flow (charge).

Regulation

The No. 2 terminal on the alternator is always connected to the battery, but the discharge current is limited to a negligible value by the high resistances of R2 and R3.

As the alternator rotor rpm and stator voltage increase, the voltage across R3 increases to a level that causes zener diode D1 to conduct. Transistor TR2 is forward biased and conducts, and TR3 is reverse biased Off, which turns TR1 Off. With TR1 Off, the field current and system voltage decrease. When the voltage across R3 decreases, D1 stops conducting. Transistor TR2 is then reverse biased Off and transistors TR3 and TR1 forward biased On. In turn, the field current and output voltage increase. This cycle repeats many times per second to limit the alternator output to a preset value.

Capacitor C1 prevents abrupt voltage changes across R3. R4 prevents excessive back current through TR1 at high temperatures, and D2 protects TR1 by preventing a high induced voltage in the field winding when TR1 is turned Off. Resistor R2 is a thermistor that causes the regulated voltage to vary inversely with temperature, providing the optimum voltage over a wide temperature range for charging the battery.

TROUBLESHOOTING

Close adherence to the following procedures in the order presented will result in locating and correcting charging system malfunctions in the shortest possible time.

Figure 1E-3 depicts a basic wiring diagram for the charging system.

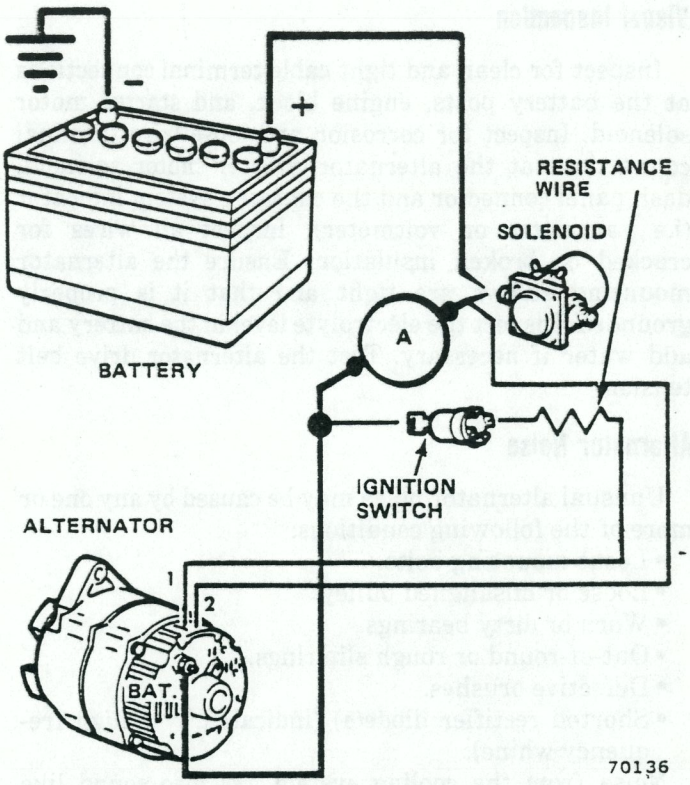


Fig. 1E-3 Basic Wire Connections

To avoid damage to the charging system, always observe the following precautions:

- Do not attempt to polarize the regulator.
- Do not short across or ground any of the terminals in the charging system except as specifically instructed.
- NEVER drive the alternator with the engine when the output terminal circuit is open and No. 1 and No. 2 wire terminals are connected to the alternator.
- Ensure the alternator and battery have the same ground polarity.
- When connecting a charger or a booster battery to the battery, connect negative to negative and positive to positive.

NOTE: *An ammeter is used on Cherokee, Wagoneer and Truck models to indicate the charging rate. CJ models are equipped with a voltmeter.*

Malfunction of the charging system is usually indicated by one or more of the following symptoms:

- Faulty ammeter (or voltmeter) operation.
- An undercharged battery, indicated by slow engine cranking and battery electrolyte having low specific gravity.
- An overcharged battery, indicated by excessive water usage.

Prior to performing any electrical tests, visually inspect all charging system components and wiring for obvious discrepancies.

Visual Inspection

Inspect for clean and tight cable terminal connections at the battery posts, engine block, and starter motor solenoid. Inspect for corrosion and loose wire terminal connections at the alternator, starter motor solenoid, dash panel connector and the charging system indicator (i.e., ammeter or voltmeter). Inspect all wires for cracked or broken insulation. Ensure the alternator mounting screws are tight and that it is properly grounded. Inspect the electrolyte level in the battery and add water if necessary. Test the alternator drive belt tension.

Alternator Noise

Unusual alternator noise may be caused by any one or more of the following conditions:

- Loose mounting bolts.
- Loose or misaligned pulley.
- Worn or dirty bearings.
- Out-of-round or rough slip rings.
- Defective brushes.
- Shorted rectifier diode(s) (indicated by a high frequency whine).

Noise from the cooling system can also sound like alternator noise. Disconnect and plug the heater hoses to eliminate the possibility of the alternator bracket reproducing heater core noises.

Faulty Ammeter or Voltmeter Operation

Diagnosis of the instrumentation circuits is described in Chapter 1L—Power Plant Instrumentation.

Overcharged/Undercharged Battery

For battery undercharged-overcharged diagnosis, refer to DARS charts 1 and 2.

Battery Discharge Through Alternator

If the alternator is suspected of discharging the battery because of excessive current leakage, perform the following test procedure with a No. 158 bulb and bulb socket with attached jumper wires.

WARNING: *Failure to disconnect battery negative cable before disconnecting alternator output wire can result in injury.*

(1) Disconnect battery negative cable. Disconnect output wire (red) from alternator.

(2) Connect test bulb jumper wires in series with output wire and alternator output terminal. Connect battery negative cable. Bulb should not light. If bulb lights (even dimly), replace bridge rectifier.

(3) Disconnect battery negative cable and remove jumper wires.

(4) Disconnect wires from No. 1 and 2 terminals of alternator.

(5) Connect test bulb jumper wires in series with No. 1 terminal at alternator and the battery positive post. Connect battery negative cable. Bulb should not light. If bulb lights (even dimly), test diode trio. If diode trio is not defective, replace voltage regulator.

(6) Connect test bulb jumper wires in series with No. 2 terminal at alternator and battery positive post. Bulb should not light. If bulb lights (even dimly), replace voltage regulator.

TESTING—OFF-VEHICLE

Rotor (Field) Winding Short-to-Ground Test

To perform this test, remove the rotor and front housing assembly from the stator and rear housing assembly. Refer to Alternator Overhaul for procedure. Perform the test with an ohmmeter set for the x1000 ohm scale or with a 110-volt test lamp.

Touch one test lead probe to rotor shaft and touch other probe to one slip ring (fig. 1E-4). Repeat with the other slip ring. In each test, the ohmmeter should indicate infinite resistance (no pointer movement) or the test lamp should not light.

Test Results

If the ohmmeter indicates other than an infinite resistance or test lamp lights, a short to the rotor shaft exists. Inspect the soldered connections at the slip rings to ensure they are secure and not shorted to the rotor shaft, or that excess solder is not shorting rotor winding to the shaft. Replace the rotor if defective.

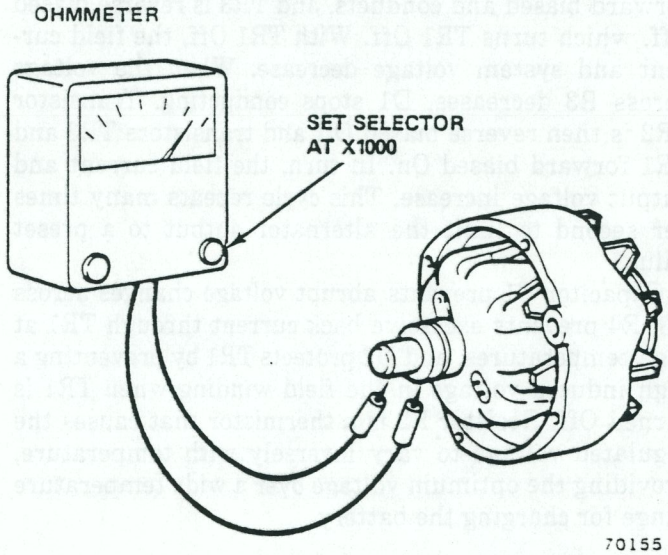


Fig. 1E-4 Rotor (Field) Winding Short-to-Ground Test

Rotor (Field) Winding Open Test

To perform this test, remove the rotor and front housing assembly from the stator and rear housing assembly. Refer to Alternator Overhaul for procedure.

Perform the test with an ohmmeter set for the x1 scale or with a 110-volt test lamp.

Touch one test lead probe to one slip ring and the other test lead probe to the other slip ring (fig. 1E-5). The ohmmeter should indicate 2.2 to 3.0 ohms or test lamp should light.

Test Results

If the ohmmeter indicates infinite resistance or the test lamp fails to light, the rotor winding is open.

Rotor (Field) Winding Internal Short Test

To perform this test, remove the front housing and rotor from the stator and rear housing assembly. Refer to Alternator Overhaul for procedure. This test is performed with a 12-volt battery and an ammeter.

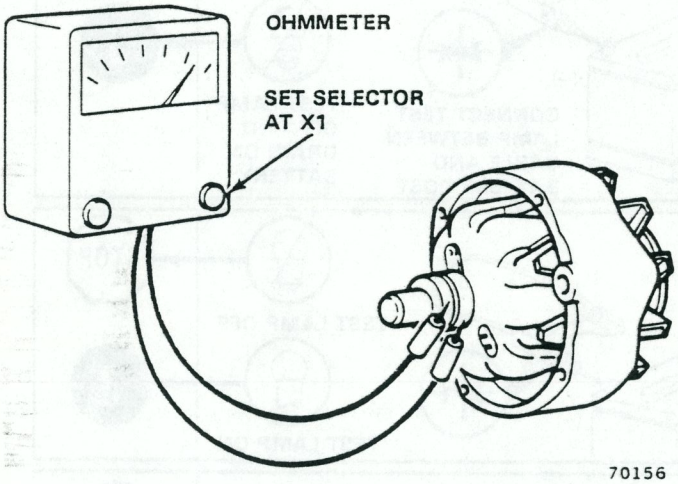


Fig. 1E-5 Rotor (Field) Winding Open Test

Connect battery and ammeter in series with the slip rings (fig. 1E-6). The field current at 12 volts applied at 80°F (27°C) should be between 4.0 and 5.0 amps.

Test Results

Current flow exceeding 5.0 amps indicates a shorted winding.

NOTE: *The winding resistance and ammeter indication will vary slightly with winding temperature changes. A current flow that is less than the specified value indicates excessive winding resistance. An alternate test method is to determine the resistance of the field winding by connecting an ohmmeter to the two slip rings. If the resistance is less than 2.2 ohms at 80°F (27°C), the winding is shorted. If the resistance is more than 3.0 ohms at 80°F (27°C), the winding has excessive resistance.*

Stator Windings Short-to-Ground Test

To perform this test, separate the rear housing and stator from the rotor and front housing assembly. Disconnect the stator windings from the rectifier terminals. Refer to Alternator Overhaul for procedure. The test is performed with an ohmmeter set for the x1000 scale or with a 110-volt test lamp.

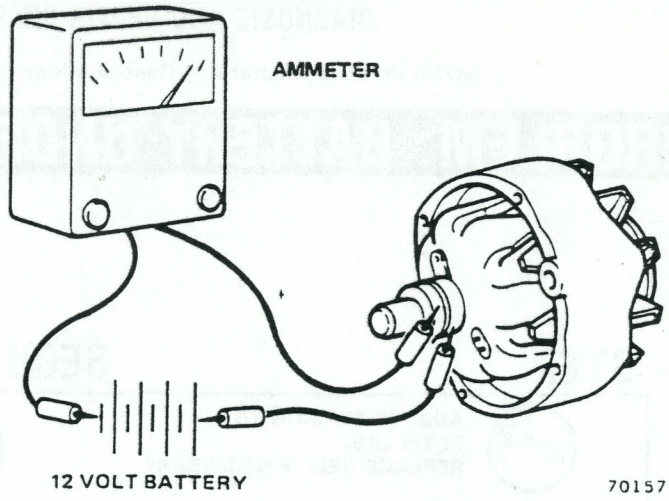


Fig. 1E-6 Rotor (Field) Winding Internal Short Test

Touch one test lead probe to the bare metal surface of the stator core and the other test lead probe to the end of one stator winding (1E-7). Because all three stator windings are soldered together, it is not necessary to test each winding. The ohmmeter should indicate infinite resistance (no pointer movement) or test lamp should not light.

Test Results

If the ohmmeter indicates other than an infinite resistance or test lamp lights, the stator windings are shorted to the core and must be replaced.

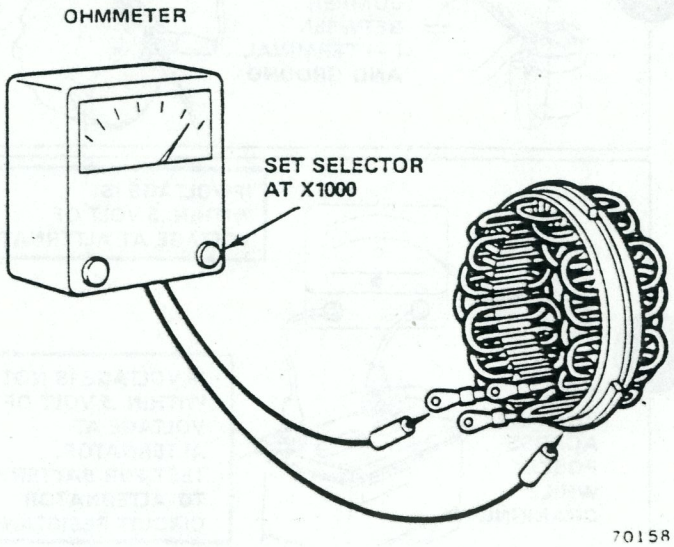


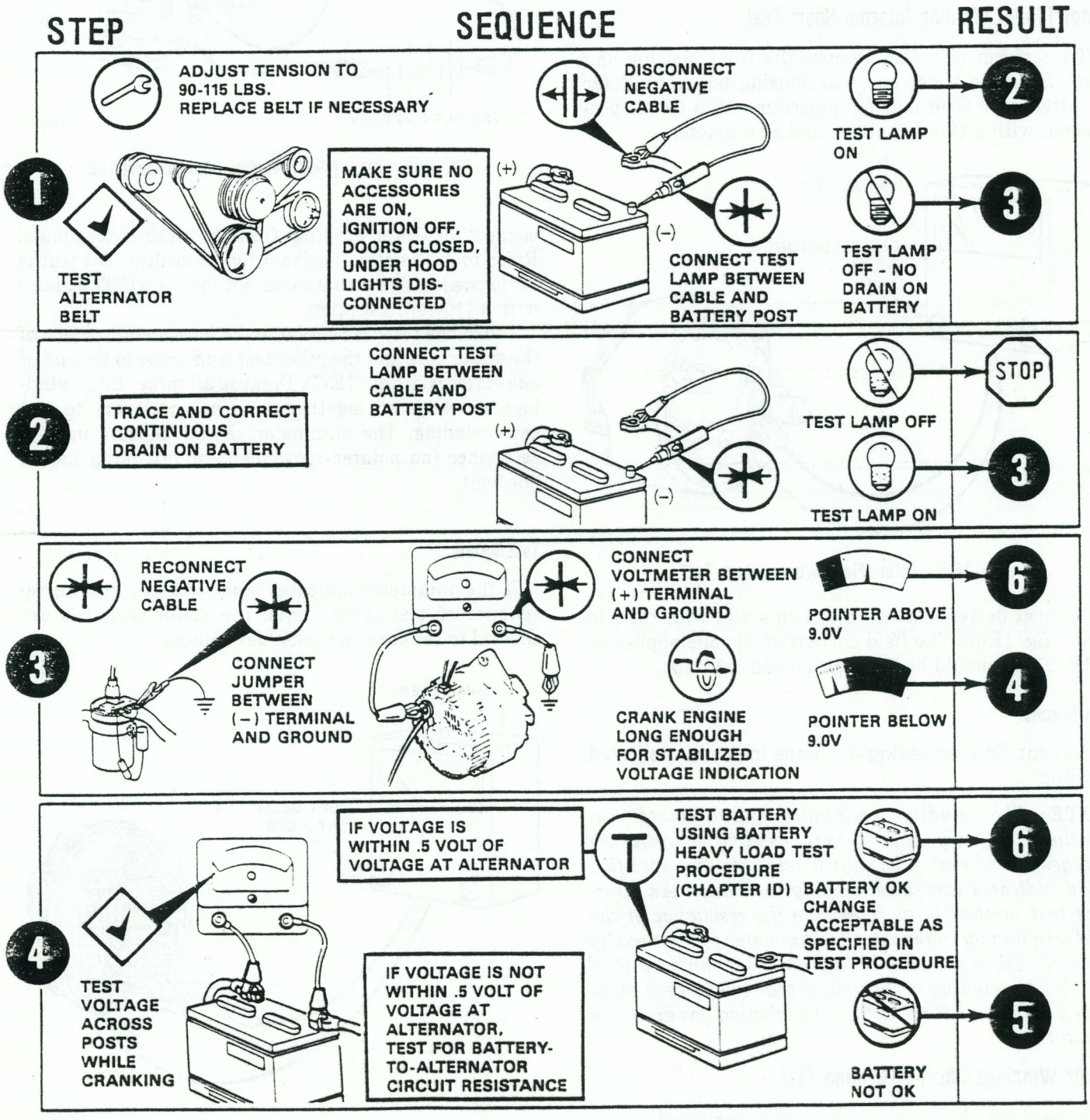
Fig. 1E-7 Stator Windings Short-to-Ground Test

FOUR- AND SIX-CYLINDER ENGINE CHARGING SYSTEM DIAGNOSIS AND REPAIR SIMPLIFICATION (DARS) CHARTS

NOTE: Refer to Chapter A — General Information for details on how to use this DARS chart.

PROBLEM: BATTERY UNDERCHARGED

Chart 1



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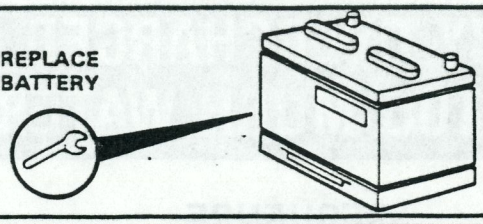
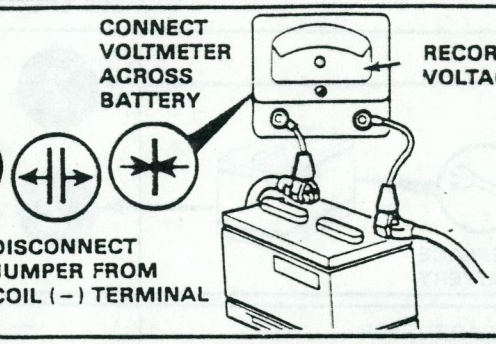
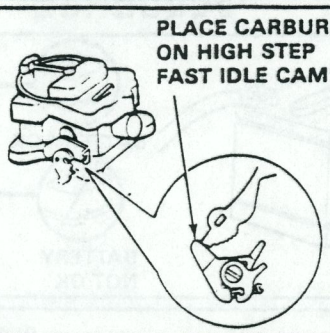
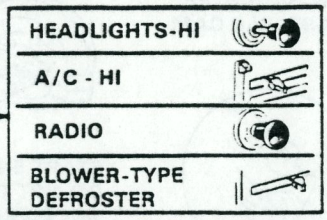
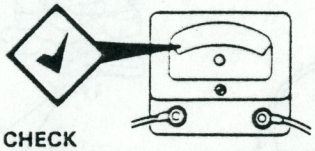
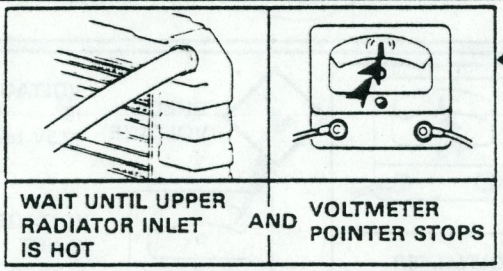
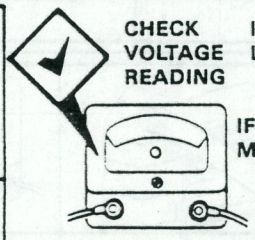
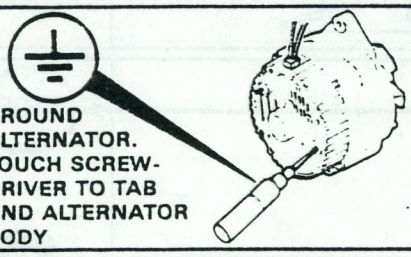
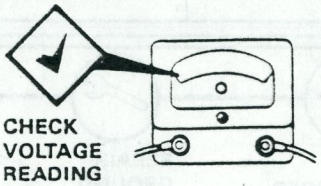
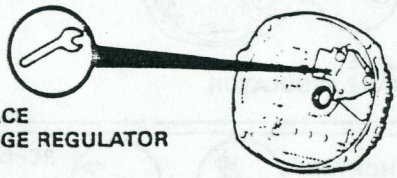
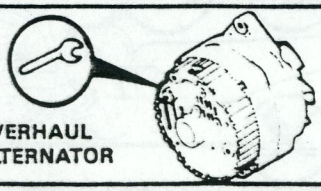
STEP	SEQUENCE	RESULT
5		6
6	  START ENGINE. DO NOT TOUCH ACCELERATOR PEDAL	7
7	TURN ON ACCESSORIES   CHECK VOLTAGE	IF VOLTAGE IS LOWER THAN IN STEP 6 → 9 IF VOLTAGE IS HIGHER THAN IN STEP 6 → 8
8	TURN OFF ACCESSORIES   CHECK VOLTAGE READING	IF VOLTAGE IS LESS THAN 12.5V → 9 IF VOLTAGE IS MORE THAN 15.5V → 10 IF VOLTAGE IS 12V TO 15.5V SEE NOTE BELOW → STOP
9	  CHECK VOLTAGE READING	IF VOLTAGE IS HIGHER THAN IN STEP 6 → 10 IF VOLTAGE IS LOWER THAN IN STEP 6 → 11
10		STOP
11		STOP

NOTE: IF NO FAULT HAS BEEN FOUND, EXCESSIVE IDLING AND SLOW OR SHORT DISTANCE DRIVING, WITH ALL ACCESSORIES ON, MAY HAVE CAUSED HEAVY DRAIN ON BATTERY — RESULTING IN UNDERCHARGED CONDITION.

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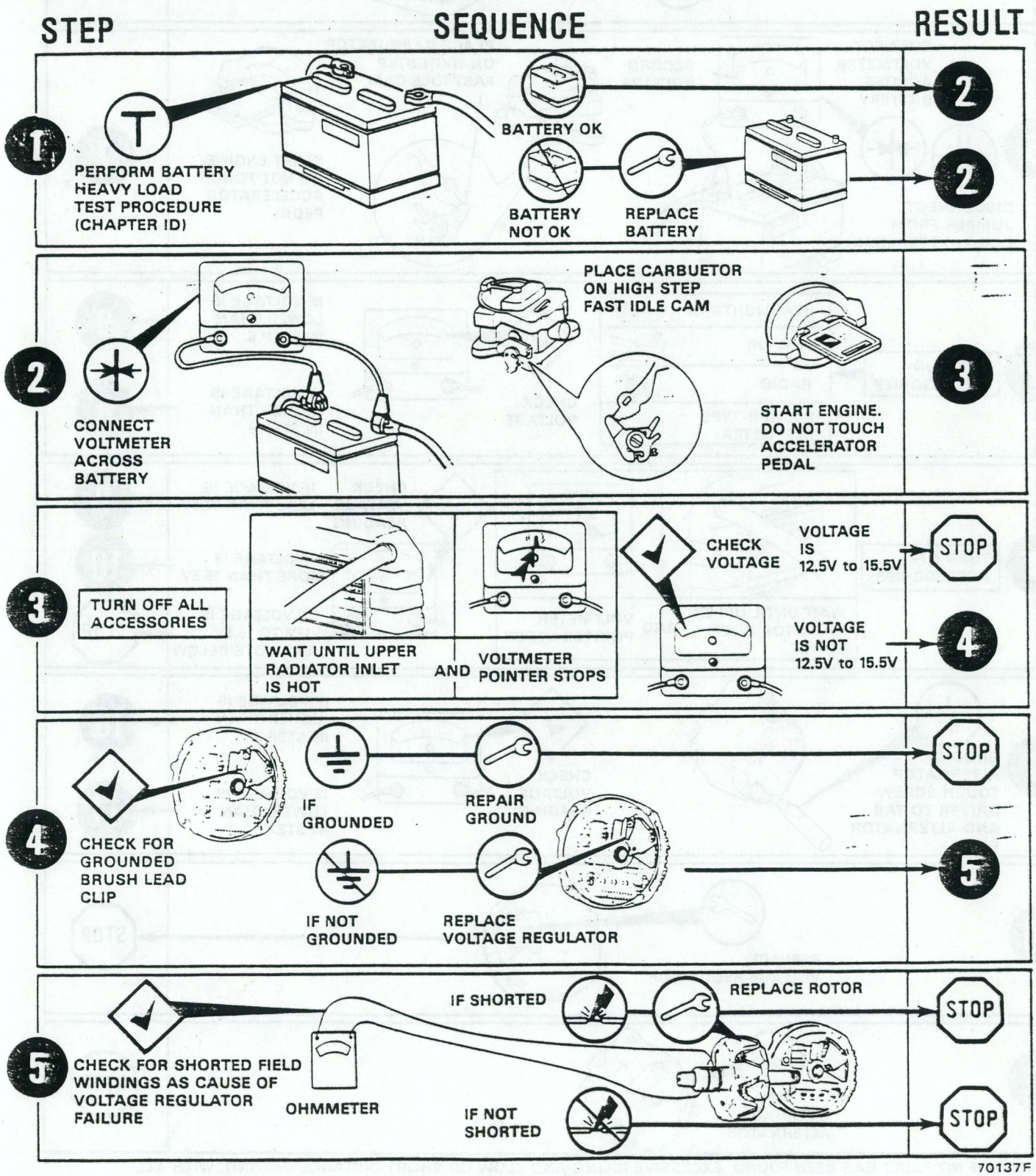
NOTE: Refer to Chapter A — General Information for details on how to use this DARS chart.

PROBLEM: BATTERY OVERCHARGED (USES TOO MUCH WATER)

Chart 2



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Stator Windings Continuity Test

NOTE: *The optional 70 and 85 amp alternators (Delco 5-SI) have delta wound stator windings that cannot be tested for open windings with an ohmmeter or test lamp. However, if the results of all other tests are normal and the alternator fails to supply the rated output, open stator windings are probable.*

To perform this test, remove the stator and rear housing assembly from the rotor and front housing assembly. Refer to Alternator Overhaul for procedure. An ohmmeter set for the x1 scale is used to perform the test.

Touch ohmmeter lead probes to any two stator windings and note the resistance (fig. 1E-8). Test all the stator windings in this manner. Equal indications should be obtained for each pair of windings tested.

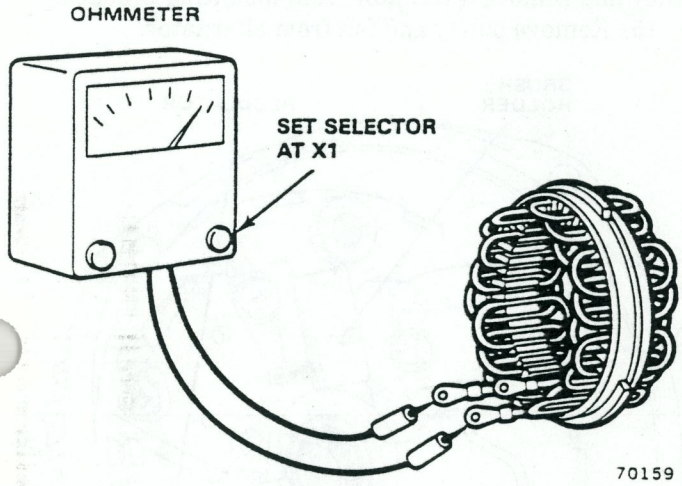


Fig. 1E-8 Stator Windings Continuity Test

Test Results

An infinite resistance (no pointer movement) indicates an open winding. Inspect the neutral junction splice for a poor solder connection. Resolder the connection even if it appears to be good. Retest the continuity. If an open still exists, replace the stator windings.

An indication of more than 1 ohm indicates a possible cold solder joint. Inspect the neutral junction splice and resolder if necessary.

Stator Internal Short Circuit Test

An internal short (e.g., between adjacent windings) is difficult to locate without laboratory test equipment. If all other electrical checks are normal and the alternator fails to supply the rated output, shorted stator windings are probable.

Diode Trio Short Circuit Test

The diode trio is tested in two ways: when installed in the rear housing and when removed from the rear housing.

CAUTION: *Do not use high voltage, such as a 110-volt test lamp, to test the diode trio.*

Test with Diode Trio Installed

(1) Before removing diode trio, connect ohmmeter, with lowest range scale selected, from brush lead clip to rear housing (fig. 1E-9) and note resistance.

(2) Reverse test lead probe connections. If both indications are zero, inspect for grounded brush lead clip caused by absence of insulating washer, absence of insulating sleeve over screw, or damaged insulation (fig. 1E-14).

(3) Remove screws to inspect washers and sleeves. If screw assembly is correct and both ohmmeter observations are same, replace voltage regulator.

Test with Diode Trio Removed

(1) Remove diode trio from rear housing assembly.

(2) Connect ohmmeter having 1-1/2 volt cell to brush terminal and one stator winding terminal (fig. 1E-10). Observe resistance on lowest range scale.

(3) Reverse probes at same two terminals.

(4) Replace diode trio if both resistances are identical. Good diode trio will give one high and one low resistance.

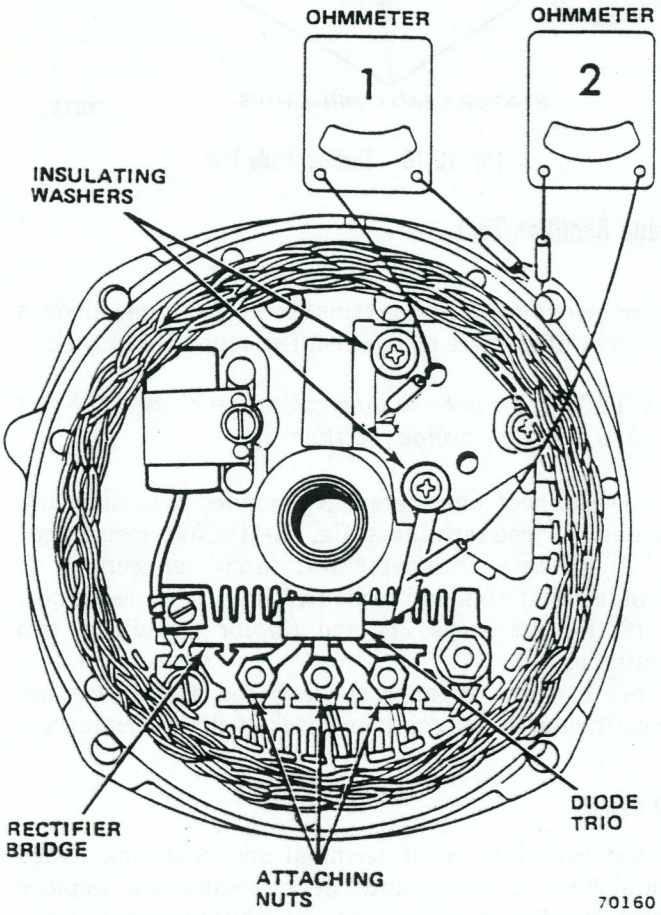


Fig. 1E-9 Rear Housing Assembly

(5) Repeat steps (2), (3), and (4) for each stator winding terminal of diode trio.

(6) Connect ohmmeter to any two stator winding terminals. If resistance is zero, open diode is indicated. Replace diode trio. Repeat test for each combination of stator winding terminals.

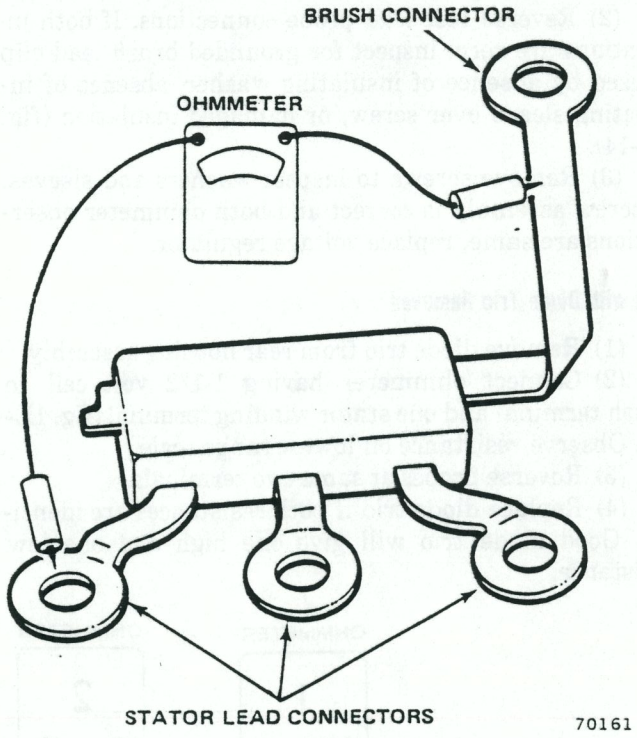


Fig. 1E-10 Testing Diode Trio

Bridge Rectifier Test

The bridge rectifier contains six diodes. If one diode is defective, the entire bridge rectifier must be replaced.

CAUTION: *Do not use high voltage, such as a 110-volt test lamp, to test bridge rectifier.*

(1) Connect ohmmeter to grounded heat sink and any one of three terminals (fig. 1E-11). Note resistance.

(2) Reverse ohmmeter test probe connections to grounded heat sink and same terminal. Note resistance.

(3) Repeat steps (1) and (2) for remaining two terminals.

(4) In same manner as described above, test between insulated heat sink and each of three terminals.

Test Results

Each combination of terminal and heat sink tested should have one high and one low resistance. Replace bridge rectifier if any one pair of resistance indications is the same.

ALTERNATOR REPLACEMENT

Removal

NOTE: *All bolt and screw threads are in metric dimensions.*

WARNING: *Failure to disconnect the battery negative cable before disconnecting the red wire from the alternator can result in injury.*

(1) Disconnect battery negative cable.

(2) Disconnect two-terminal plug and red wire at back of alternator.

(3) Remove mounting and adjusting bolts, washers and nuts.

(4) Remove alternator drive belt from alternator pulley and remove alternator from mounting bracket.

(5). Remove pulley and fan from alternator.

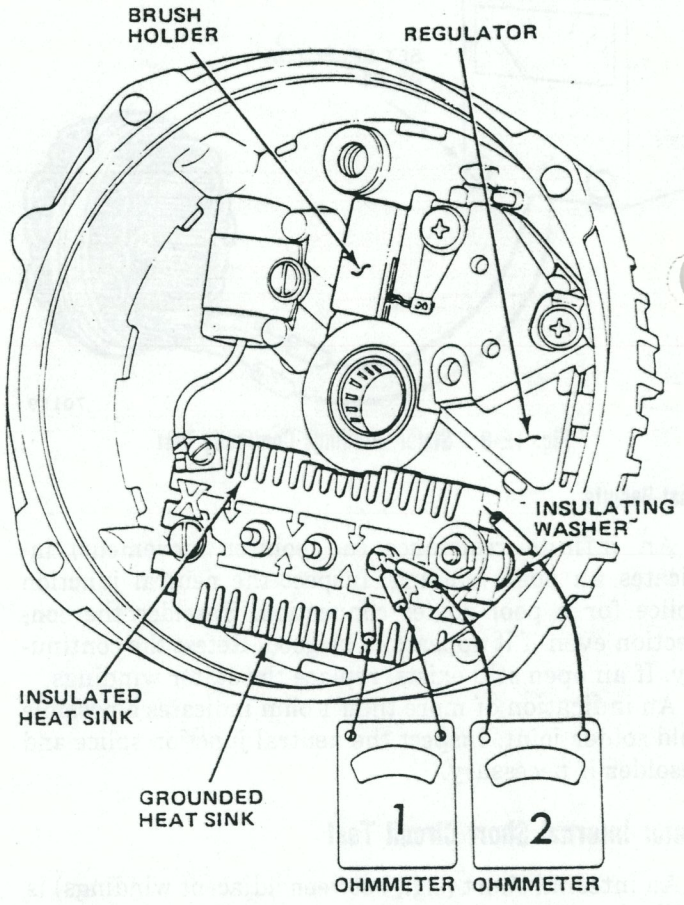


Fig. 1E-11 Testing Bridge Rectifier

Installation

(1) Install original pulley and fan on replacement alternator.

(2) Attach alternator to mounting bracket with washers and bolts. Tighten bolts finger-tight only.

(3) Install alternator drive belt.

(4) Tighten belt to specified tension. Refer to Drive Belt Adjustment for correct belt tightening procedure.

(5) Tighten bolt at sliding slot bracket with 20 foot-pounds (27 N•m) torque. Tighten remaining bolts with 30 foot-pounds (41 N•m) torque.

(6) Install two-terminal plug and red wire on alternator.

(7) Connect battery negative cable.

ALTERNATOR OVERHAUL

Disassembly

CAUTION: *As the rotor and drive end housing assembly is separated from the slip ring housing assembly the brushes will spring out onto the rotor shaft and come in contact with lubricant. Immediately clean brushes that contact shaft to avoid contamination by lubricant, otherwise, they will have to be replaced.*

NOTE: *All bolt and screw threads are in metric dimensions.*

(1) Scribe across front housing, stator frame and rear housing for assembly reference.

(2) Remove four through-bolts that connect rear housing to front housing (fig. 1E-12).

(3) Separate front housing and rotor assembly from rear housing and stator assembly by prying housings apart with screwdriver.

NOTE: *After disassembly, cover the rear housing bearing with tape to prevent entry of dirt and other foreign material. Also, cover the rotor shaft on the slip ring end with tape. Use pressure-sensitive tape and not friction tape, which would leave a gummy deposit on the shaft. If the brushes are to be reused, clean with a soft, dry cloth.*

CAUTION: *Avoid excessive tightening of the rotor in the vise to prevent rotor distortion.*

(4) Place rotor in vise and tighten vise only enough to permit removal of pulley nut.

(5) Alternate pulley nut removal procedure requires use of Allen wrench to prevent rotor from turning while loosening nut with wrench (fig. 1E-13).

(6) Remove pulley nut, lockwasher, pulley, fan, and collar.

(7) Separate front end housing from rotor shaft.

(8) Remove three stator winding attaching nuts and washers and remove stator windings from bridge rectifier terminals.

(9) Separate stator from rear housing.

(10) Remove diode trio strap terminal attaching screw from brush holder and remove diode trio.

(11) Remove capacitor holddown screw.

(12) Disconnect capacitor wire terminal from bridge rectifier. Remove capacitor.

(13) Remove bridge rectifier attaching screws and battery wire terminal screw.

(14) Remove bridge rectifier. Note insulator located between heat sink and rear housing.

(15) Remove two brush holder screws (fig. 1E-14). Note position of all insulator washers to facilitate correct assembly.

(16) Remove brush holder and brushes. Carefully note position of parts for assembly.

(17) Remove voltage regulator.

(18) Remove front bearing retainer plate screws, retainer plate and inner collar.

(19) Press out front bearing and slinger from front housing with suitable tube or collar.

NOTE: *If the bearing is in satisfactory condition, it may be reused.*

(20) Press out rear bearing using tube or collar that fits inside rear housing. Press from inside of housing toward outside.

NOTE: *Replace the bearing in the rear housing if its lubricant supply is exhausted. Do not attempt to lubricate and reuse a dry bearing.*

Cleaning and Inspection

CAUTION: *Do not clean rotor with a degreasing solvent.*

(1) Clean rotor poles by brushing with oleum spirits, or equivalent.

(2) Inspect slip rings for dirt and roughness. Clean with solvent. If necessary, clean and finish slip rings with commutator paper, or 400 grit polishing cloth. **Do not use metal-oxide paper.** Spin rotor in lathe or other support while holding abrasive against rings.

NOTE: *When using an abrasive, support the rotor while spinning to clean slip rings evenly. Cleaning slip rings without support may result in flat spots on slip rings. This will cause brush noise and premature brush wear.*

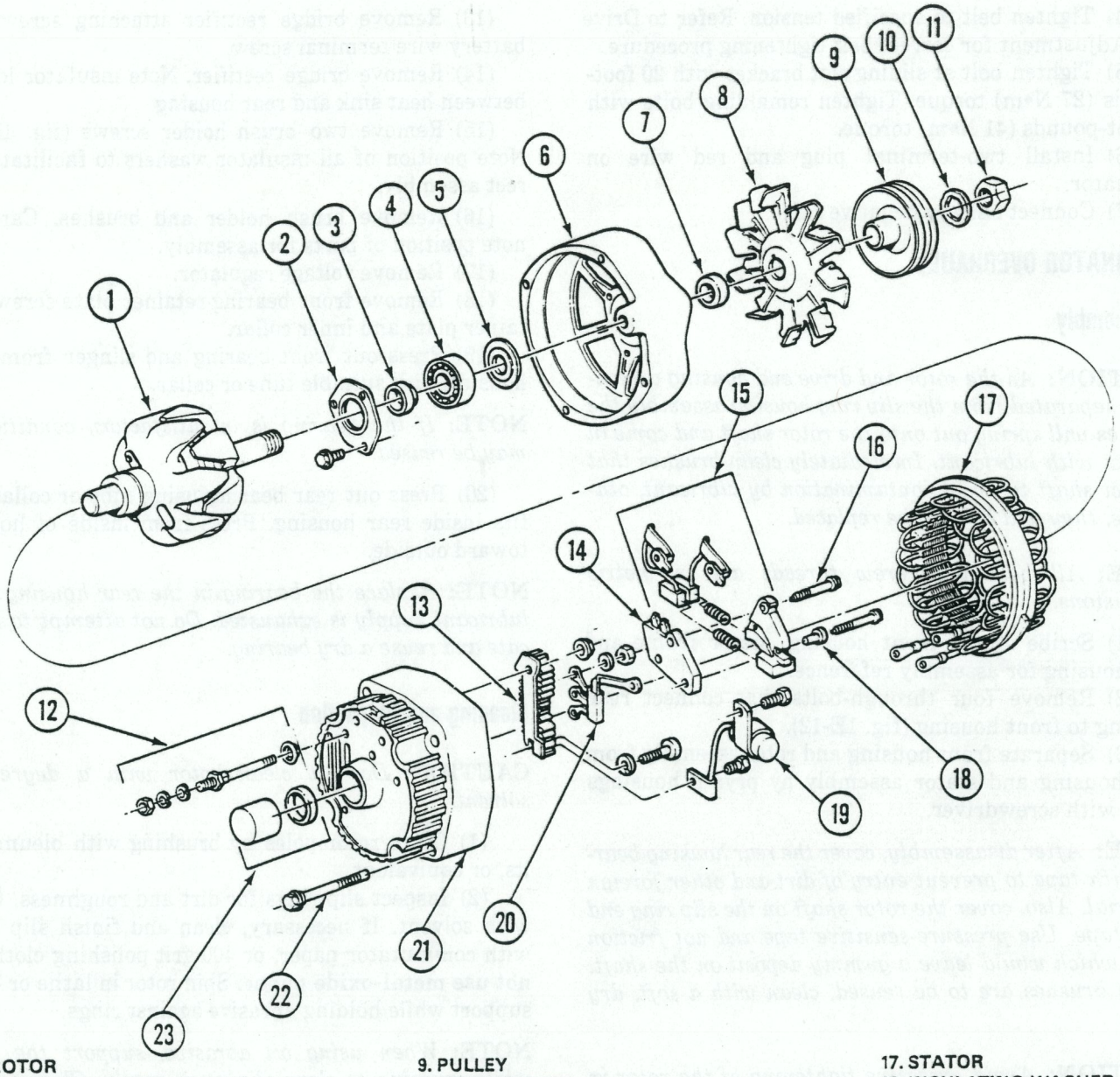
(3) True rough or out-of-round slip rings in lathe to 0.002 inch (0.051 mm) maximum indicator reading. Remove only enough material to make rings smooth and round. Finish with commutator paper, or 400 grit polishing cloth, and blow away all dust.

CAUTION: *Do not clean stator in degreasing solvent.*

(4) Clean stator by brushing with oleum spirits, or equivalent.

(5) Inspect brush springs for evidence of damage or corrosion. Replace springs if there is any doubt about their condition.

(6) Inspect brushes for wear or contamination. If brushes are to be reused, clean with soft, dry cloth until completely free of lubricant.



1. ROTOR
2. FRONT BEARING RETAINER PLATE
3. COLLAR (INNER)
4. BEARING
5. SLINGER
6. FRONT HOUSING
7. COLLAR (OUTER)
8. FAN
9. PULLEY
10. LOCKWASHER
11. PULLEY NUT
12. TERMINAL ASSEMBLY
13. BRIDGE RECTIFIER
14. REGULATOR
15. BRUSH ASSEMBLY
16. SCREW
17. STATOR
18. INSULATING WASHER
19. CAPACITOR
20. DIODE TRIO
21. REAR HOUSING
22. THROUGH-BOLT
23. BEARING AND SEAL ASSEMBLY

Fig. 1E-12 Alternator Components 43105

(7) Inspect condition of brush holder screw insulating washers for broken or cracked insulation (fig. 1E-14).

Assembly

CAUTION: *Overfilling may cause the bearing to overheat.*

(1) Fill cavity between retainer plate and bearing one-quarter full with Delco lubricant 1948791, or equivalent.

(2) Assemble bearing and slinger into front housing (fig. 1E-15).

Fig. 1E-15 Front Housing Bearing Assembly 43111

(3) Press bearing in with suitable tube or collar that fits over outer bearing race.

NOTE: *Install a replacement retainer plate if the felt seal in the retainer plate has hardened.*

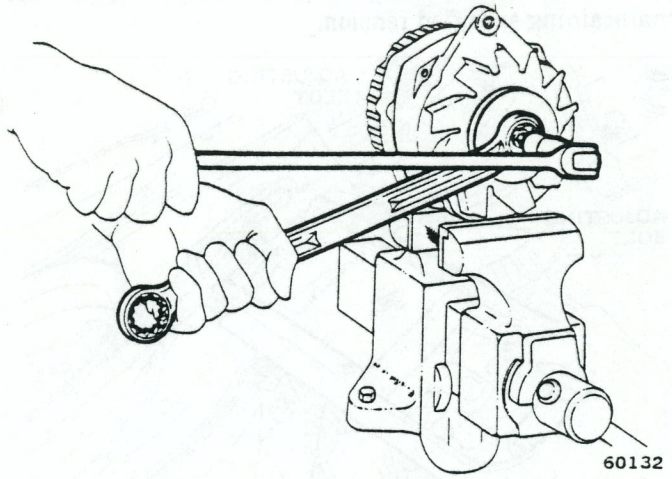


Fig. 1E-13 Removing Pulley Nut

(4) Install inner collars retainer plate and screws.

(5) Position housing, outer collar, fan, pulley and washer on rotor shaft and install pulley nut.

(6) Place rotor in vise. Tighten vise only enough to permit tightening of pulley nut. Tighten nut with 50 foot-pounds (68 N•m) torque.

(7) Alternate method of tightening pulley nut requires use of Allen wrench to prevent rotor from turning while tightening nut with wrench (fig. 1E-16).

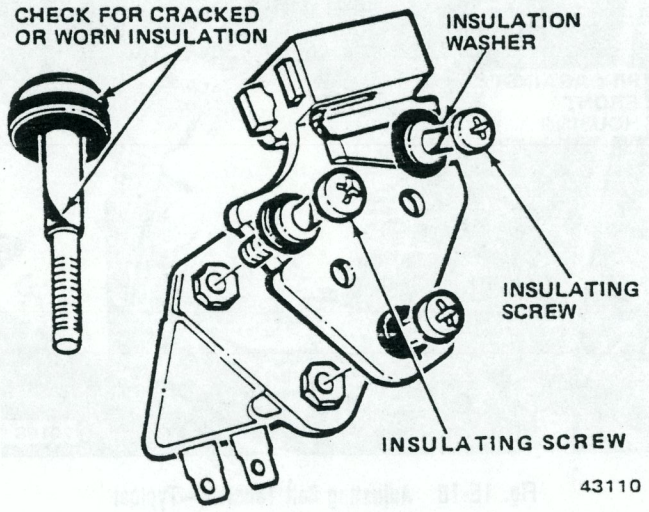


Fig. 1E-14 Brush Holder Assembly

(8) If rear bearing was removed, support inside of rear housing with hollow cylinder.

CAUTION: *Use extreme care to avoid misalignment or placing undue stress on bearing.*

(9) Place flat plate over bearing and press bearing into housing from outside until bearing is flush with housing.

(10) Install replacement bearing seal. Lightly oil lip to facilitate installation of rotor shaft. Press seal in with lip away from bearing.

(11) Install springs and brushes into brush holder. Brushes should slide in and out of brush holder without binding.

NOTE: *Should any of the brush holder assembly parts require replacement, it is necessary to replace the entire brush holder assembly. Individual parts are not serviced.*

(12) Insert straight wooden or plastic toothpick (to prevent scratching brushes) into hole at bottom of holder to retain brushes.

(13) Install voltage regulator.

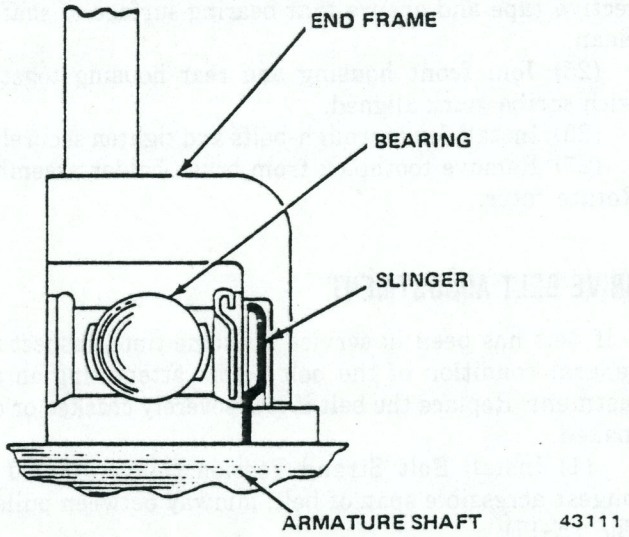


Fig. 1E-15 Front Housing Bearing Assembly

(14) Attach brush holder to rear housing. Carefully note position of insulating washers (fig. 1E-14). Allow toothpick to protrude through hole in rear housing.

(15) Install diode trio terminal strap attaching screw and insulating washer.

(16) Tighten remaining two brush holder screws securely.

(17) Position bridge rectifier on rear housing with insulator inserted between insulated heat sink and rear housing.

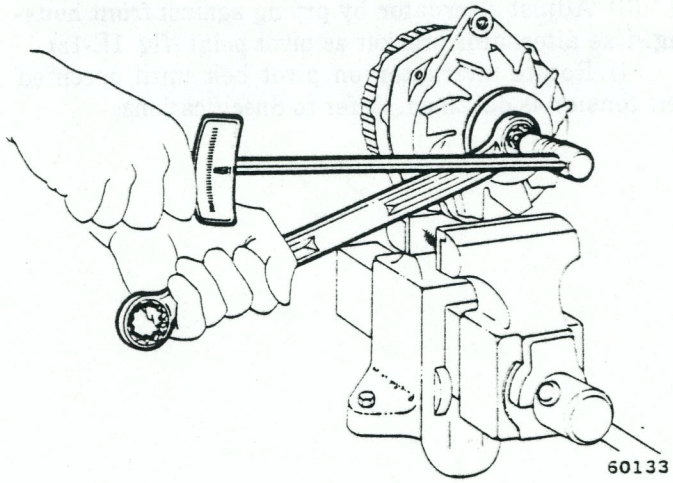


Fig. 1E-16 Tightening Pulley Nut

(18) Install bridge rectifier attaching screw and battery wire terminal screw.

(19) Connect capacitor wire terminal to bridge rectifier and tighten screw securely.

(20) Install capacitor holddown screw.

(21) Position diode trio strap terminals on bridge rectifier terminal studs.

(22) Install stator in rear housing.

(23) Attach stator windings to bridge rectifier terminal studs. Secure with washers and nuts.

(24) Before joining rotor and front housing assembly with stator and rear housing assembly, remove protective tape and ensure that bearing surface of shaft is clean.

(25) Join front housing and rear housing together with scribe mark aligned.

(26) Install four through-bolts and tighten securely.

(27) Remove toothpick from brush holder assembly. Rotate rotor.

DRIVE BELT ADJUSTMENT

If belt has been in service for some time, inspect for general condition of the belt before attempting an adjustment. Replace the belt if it is severely cracked or oil-soaked.

(1) Install Belt Strand Tension Gauge J-23600 on longest accessible span of belt, midway between pulleys (fig. 1E-17).

NOTE: *Eight-cylinder engines with air conditioning use dual drive belts. When testing belt tension, attach Tension Gauge to one belt only. Testing both belts simultaneously will give an inaccurate tension. When using the gauge on a notched belt, position the middle finger of the gauge in the notched cavity of the belt.*

(2) Loosen alternator pivot bolt and adjusting strap bolt.

CAUTION: *Do not pry against the rear housing because the aluminum casting will be damaged.*

(3) Adjust alternator by prying against **front housing**. Use alternator bracket as pivot point (fig. 1E-18).

(4) Rotate alternator on pivot bolt until specified belt tension is obtained. Refer to Specifications.

(5) Tighten adjusting strap bolt and pivot bolt while maintaining specified tension.

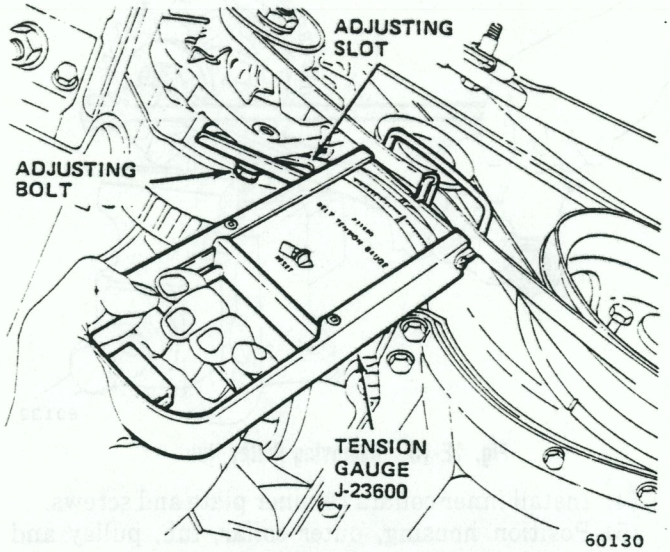


Fig. 1E-17 Testing Belt Tension—Typical

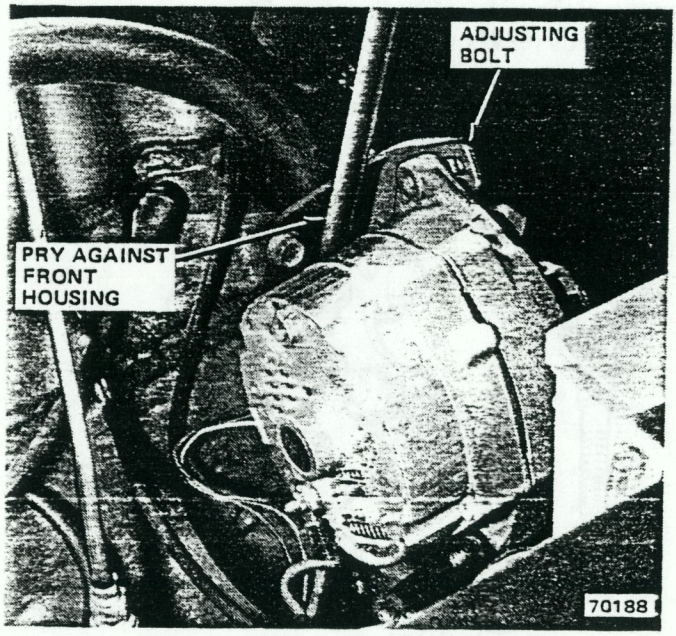


Fig. 1E-18 Adjusting Belt Tension—Typical

SPECIFICATIONS

Delco Charging System Specifications

Alternator

Manufacturer	Delco
Standard (4, 6 and 8 cyl.)	42 amp
Optional (4, 6 and 8 cyl.)	63 amp
Optional (6 and 8 cyl.)	70 amp
Optional (Police)	85 amp
Field Current	4.0 to 5.0 amps at 80°F.
Rotation (Viewing Drive End)	Clockwise
Pulley Size	2.43 in. (6.18 cm)
Belt Tension	
New Belt	Set to 125-155 pounds-force (559-689 newtons)
Used Belt	Recheck 90-115 pounds-force (400-512 newtons)
New Belt	(6 cyl. Calif. Serpentine Drive) 180-200 pounds-force (800-890 newtons)
Used Belt	140-160 pounds-force (623-712 newtons)

Regulator

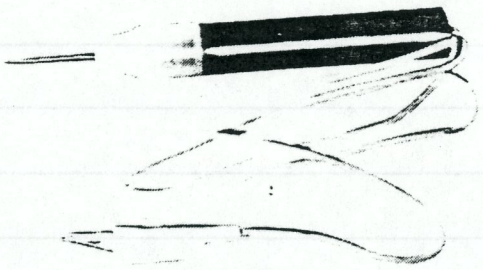
Manufacturer	Delco
Model	1116387
Type	Solid State
Adjustment	None

Output Voltage Specifications

Ambient Temperature in Degrees Fahrenheit	Acceptable Voltage Range
0-50	14.3-15.3
50-100	13.9-14.9
100-150	13.4-14.4
150-200	13.0-14.1

80807

Tools



J-21008
CONTINUITY
LIGHT

70271

Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft-lbs)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Alternator Adjusting Bolt	18	15-20	24	20-27
Alternator Mounting Strap Bolt	28	23-30	38	31-41
Alternator Pivot Bolt or Nut	28	20-35	38	27-47
Pulley Nut	50	45-55	68	58-78

All Torque values given in newton-meters and foot-pounds with dry fits unless otherwise specified.

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NOTES

STARTING SYSTEM 1F

SECTION INDEX

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FOUR-CYLINDER ENGINE STARTING SYSTEM

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Neutral Safety Switch Replacement	1F-5	Starter Motor Overhaul	1F-5
Service Diagnosis	1F-1	Starter Motor Replacement	1F-5
Specifications	1F-10	Tools	1F-24
Starter Motor General Diagnosis	1F-8		

GENERAL

The four-cylinder engine starter motor system consists of a 5MT starter motor, ignition/start switch, battery and related electrical wiring. These components are connected electrically as illustrated in figure 1F-1.

STARTER MOTOR OPERATION

The 5MT starter motor is shown in figure 1F-2. The field windings are permanently mounted in the motor frame. Both the shift lever mechanism and the solenoid plunger are enclosed in the drive housing to protect them from exposure to dirt, icing conditions and water splash.

In the basic circuit illustrated in figure 1F-1, the solenoid is energized when the ignition/starting key switch is closed. The resulting plunger and shift lever movement causes the pinion gear to engage the engine flywheel (or drive plate) ring gear and the solenoid main contacts to close, and engine cranking is initiated. When the engine starts, the pinion gear overrun clutch protects the armature from excessive speed until the switch is opened, at which time the return spring disengages the pinion gear. To prevent excessive overrun, the key switch should be released immediately after the engine starts.

Neutral Safety Switch

The Neutral Safety Switch is a three-connector plunger switch mounted on the automatic transmission case. The outside terminals connect to the back-up lamps, while the center terminal provides a ground path for the starter motor relay circuit. Ground is provided only when the transmission is in Park or Neutral position.

NOTE: *CJ vehicles equipped with a four-cylinder engine and automatic transmission have a starter motor relay that is energized when the ignition key is in the START position, providing the automatic transmission selector is in either the NEUTRAL or PARK position. When the relay is energized, battery voltage is applied to the starter motor pull-in and hold-in windings.*

SERVICE DIAGNOSIS

Before removing any unit from the starter motor system for repair, perform the following inspections.

(1) **Battery:** To determine condition of battery, follow testing procedure outlined in Chapter 1D—Batteries.

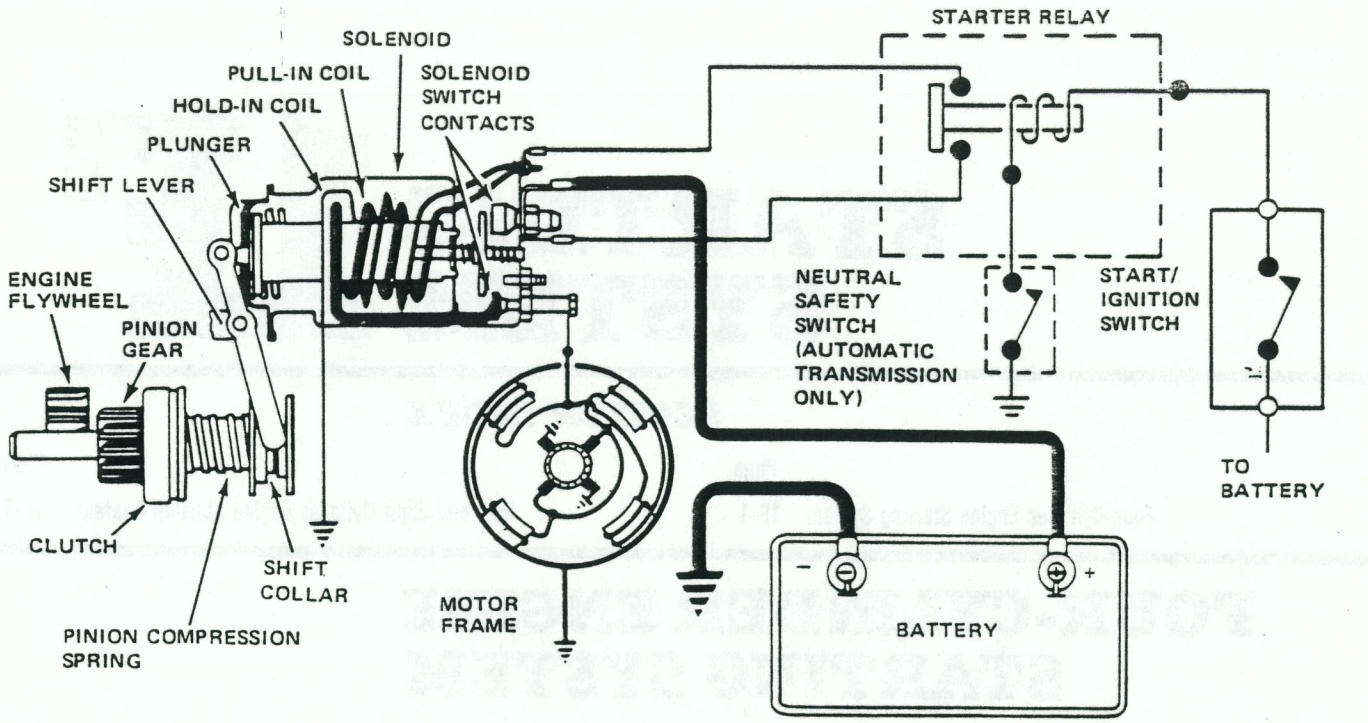
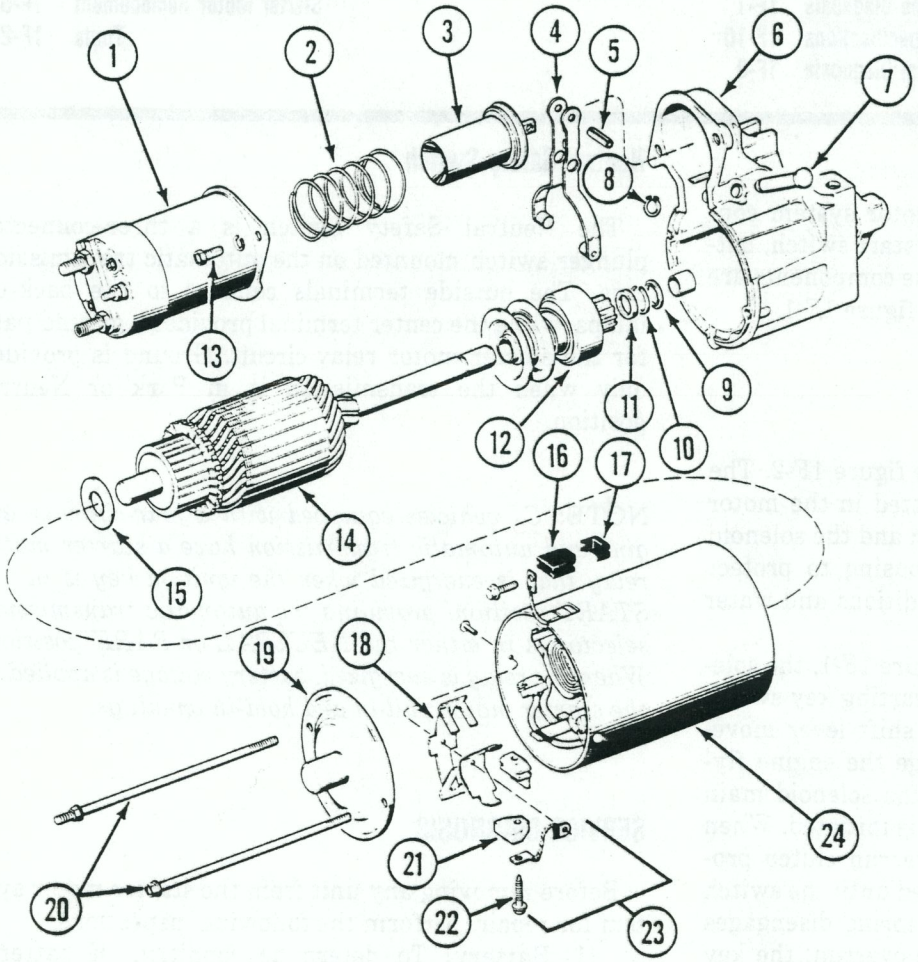


Fig. 1F-1 Four-Cylinder Engine Starter Motor System



1. SOLENOID SWITCH
2. PLUNGER RETURN SPRING
3. PLUNGER
4. SHIFT LEVER
5. PLUNGER PIN
6. DRIVE END HOUSING
7. SHIFT LEVER SHAFT
8. LEVER SHAFT RETAINING RING
9. THRUST COLLAR
10. PINION STOP RETAINER RING
11. PINION STOP COLLAR
12. DRIVE
13. SCREW
14. ARMATURE
15. WASHER
16. GROMMET
17. GROMMET
18. BRUSH HOLDER
19. COMMUTATOR END FRAME
20. THROUGH BOLT
21. BRUSH
22. SCREW
23. BRUSH AND HOLDER ASSY.
24. FRAME AND FIELD WINDING

Fig. 1F-2 5MT Starter Motor—Exploded View

(2) **Wiring:** Inspect wiring for damage. Inspect all connections at starter motor solenoid, relay (if equipped), neutral safety switch (if equipped), ignition/start switch, and battery, including all ground connections. Clean and tighten all connections as required.

(3) **Solenoid and Ignition/Start Switch:** Inspect solenoid and switch to determine their condition. Also, if equipped with automatic transmission, inspect condition of starter motor relay.

(4) **Starter Motor Noise:** To correct starter motor noise during starting, use the following procedure:

(a) Refer to Starter Motor Noise Diagnosis Chart to determine problem.

(b) If complaint is similar to first two conditions, correction can be achieved by proper "shimming" as follows.

1. Remove flywheel or drive plate ring gear inspection plate.
2. Inspect flywheel or drive plate and ring gear for damage; i.e., warp, unusual wear and excessive runout. Replace flywheel, ring gear or drive plate as necessary.
3. Disconnect battery negative cable (to prevent inadvertant cranking of engine).

NOTE: *Two shim thicknesses are available. One is 0.015 inch (0.381 mm) and the other 0.045 inch (1.143 mm). If shims are not available, they can be fabricated from plain washers or other suitable material.*

4. If complaint is similar to first condition, starter motor must be moved toward flywheel/drive plate. This can be accomplished by shimming (fig. 1F-3) only outboard starter motor mounting pad. (This is generally condition that causes broken flywheel ring gear teeth or starter motor housings).
5. If complaint is similar to second condition, starter motor must be moved away from flywheel/drive plate. This is accomplished by installing shim(s) (fig. 1F-3). More than one shim may be required.

(c) Conditions 3 and 4 may require starter motor replacement or repair in some instances.

(5) **Starter Motor:** If battery, wiring, switches, solenoid and relay (if equipped) are in satisfactory condition, and engine is known to be functioning properly, remove starter motor and follow test procedures outlined below.

CAUTION: *Never operate the starter motor more than for a 30-second duration without pausing to allow it to cool for at least two minutes. Overheating, caused by excessive cranking, will seriously damage the starter motor.*

Starter Motor Test

A general diagnosis is described at the end of this section. Once a problem has been traced to the starter motor, proceed to the test procedure outlined below.

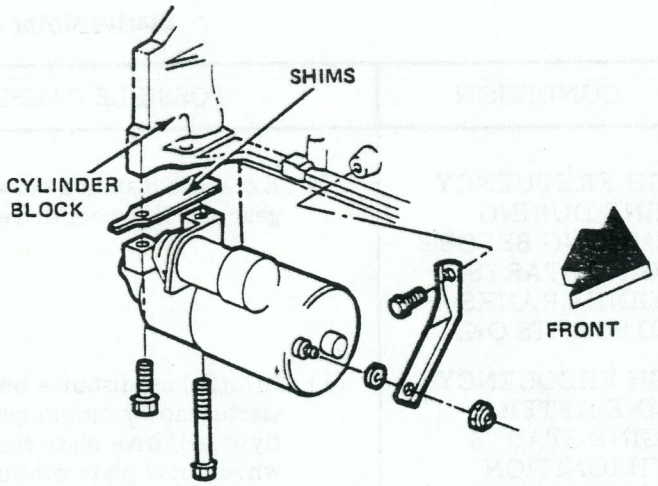


Fig. 1F-3 Starter Motor Shimming and Mounting

Test Procedure

With the starter motor removed from the engine, the pinion gear should be tested for freedom of operation by turning it on the screw shaft. The armature should be tested for freedom of rotation by prying the pinion gear with a screwdriver to engage it with the shaft. Tight bearings, a bent armature shaft, or a bent frame will cause the armature to not rotate freely. If the armature does not rotate freely, the motor should be disassembled immediately. However, if the armature does rotate freely, the motor should be given a no-load test before disassembly.

No-Load Test

Connect a voltmeter (fig. 1F-4) between the motor terminal and the motor frame, and use a tachometer to measure armature speed. Connect the motor and an ammeter in series with a fully charged battery of the specified voltage, and a switch (in the open position) from the solenoid battery terminal to the solenoid switch terminal. Close the switch and compare the rpm, current, and voltage with those listed in the specifications. It is not necessary to obtain the exact voltage specified because an accurate interpretation can be made by recognizing that if the voltage is slightly higher, the rpm will be proportionately higher, with the current remaining the same. However, if the exact voltage is desired, a carbon pile rheostat connected across the battery can be used to reduce the voltage to the specified value. The specified current flow includes the solenoid current flow. Make disconnections only with the switch open. Interpret the test results as follows:

(1) Rated current flow and specified no-load speed indicate normal condition of starter motor.

Starter Motor Noise Diagnosis

CONDITION	POSSIBLE CAUSE	CORRECTION
HIGH FREQUENCY WHINE DURING CRANKING BEFORE ENGINE STARTS; ENGINE CRANKS AND STARTS OK.	(1) Excessive distance between pinion gear and flywheel/drive plate gear.	(1) Shim starter motor toward flywheel/drive plate.
HIGH FREQUENCY WHINE AFTER ENGINE STARTS WITH IGNITION KEY RELEASED. STARTS OK.	(1) Insufficient distance between starter motor pinion gear and flywheel/drive plate gear. Flywheel/drive plate runout can cause noise to be intermittent.	(1) Shim starter motor away from flywheel/drive plate. Inspect flywheel/drive plate for damage; bent, unusual wear, and excessive runout. Replace flywheel/drive plate as necessary.
A LOUD "WHOOP" AFTER ENGINE STARTS WHILE STARTER MOTOR IS ENGAGED	(1) Most probable cause is defective overrunning clutch. Clutch replacement normally corrects this condition.	(1) Replace overrunning clutch or drive assembly.
A "RUMBLE", "GROWL" OR "KNOCK" AS STARTER MOTOR COASTS TO STOP AFTER ENGINE STARTS.	(1) Most probable cause is bent or unbalanced starter motor armature. Armature replacement normally corrects this condition.	(1) Replace starter motor armature.

(2) Low no-load speed and high current flow indicate:

(a) Too much friction—tight, dirty, or worn bearings, bent armature shaft or bent frame causing armature to drag.

(b) Shorted armature winding. This can be further determined on growler after disassembly.

(c) Grounded armature or field windings. Inspect further after disassembly.

(3) No armature rotation and high current flow indicate:

(a) Terminal or field windings shorted to ground.

(b) Seized bearings (this should have been determined by turning armature by hand).

(4) No armature rotation and no current flow indicate:

(a) Open field winding circuit. This can be determined after disassembly by inspecting internal connections and testing circuit with test lamp.

(b) Open armature windings. Inspect commutator for badly burned bars after disassembly.

(c) Broken brush springs, worn brushes, protruding insulation between commutator bars or other causes that would prevent good contact between brushes and commutator.

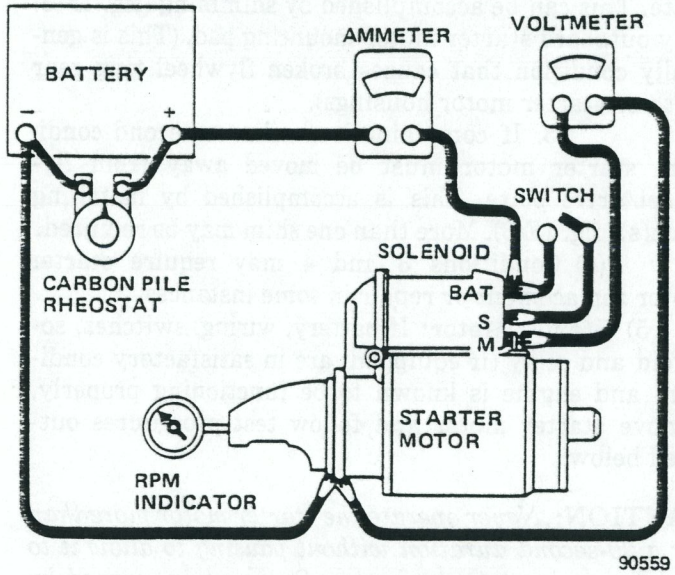


Fig. 1F-4 No-Load Test Connections

(5) Low no-load speed and low current flow indicate high internal resistance because of poor connections, defective wires, dirty commutator and causes listed under step (4) above.

(6) High no-load speed and high current flow usually indicate shorted field windings. If shorted field windings are suspected, replace field winding and frame assembly and retest for improved performance. In some instances, armature winding could also be shorted. Test on growler.

STARTER MOTOR REPLACEMENT

Starter motors do not require lubrication except during overhaul.

When the motor is disassembled for any reason, lubricate as follows:

(1) Armature shaft and drive end and commutator end bushings should be covered with a thin coating of Lubriplate, or equivalent.

(2) Roll type overrunning clutch requires no lubrication. However, drive assembly should be wiped clean. **Do not** clean in degreasing tank or with grease dissolving solvents because this will dissolve lubricant in clutch mechanism. Use silicone grease (General Electric CG321, Dow Corning 33 Medium, or equivalent) on shaft underneath overrruning clutch assembly.

NOTE: *Avoid excessive lubrication.*

Starter Motor Removal

Use the following procedure to remove the starter motor from the engine:

(1) Disconnect battery negative cable at battery.

(2) Remove starter-to-engine brace (fig. 1F-3).

(3) From beneath vehicle, remove two starter motor-to-engine bolts (fig. 1F-3), and allow starter to drop down.

(4) Disconnect solenoid wires and battery cable, and remove starter motor. To replace, reverse procedure outlined above. Replace any shims that were removed.

Solenoid Removal

Use the following procedure to remove the solenoid from the starter motor:

(1) Disconnect field strap.

(2) Remove solenoid-to-drive housing attaching screws, motor terminal bolt, and remove solenoid by twisting.

(3) Replace by reversing procedure outlined above.

NEUTRAL SAFETY SWITCH REPLACEMENT

(1) Disconnect wiring connector and remove switch from transmission. Allow fluid to drain into container.

(2) Move selector lever to Park and Neutral positions. Inspect switch operating lever fingers to ensure they are properly centered in switch opening.

(3) Install switch and seal on transmission case. Tighten switch with 24 foot-pounds (6 N•m) torque.

(4) Test switch continuity.

(5) Correct transmission fluid level as required.

STARTER MOTOR OVERHAUL

If the starter motor does not function correctly (as described in the No-Load Test above), it should be disassembled for further testing of the components. The starter motor should be disassembled only enough to permit repair or replacement of the defective parts. Safety glasses should be worn when disassembling or assembling the starter motor.

Disassembly

The following procedure should be used to disassemble and reassemble the starter motor. Component inspections are also included. Refer to figure 1F-2 and proceed as follows:

(1) Disconnect field winding connection from solenoid terminal.

(2) Remove through-bolts.

(3) Remove commutator end frame and field frame assembly.

(4) Remove armature assembly from drive housing. Remove solenoid and shift lever assembly from drive housing before removing armature assembly.

(5) Remove thrust collar from armature shaft.

(6) Remove pinion gear from armature by sliding metal cylinder onto shaft and by striking metal cylinder against retainer with hammer. Drive retainer toward armature core and off snap ring (fig. 1F-5).

(7) Remove snap ring from groove in armature shaft.

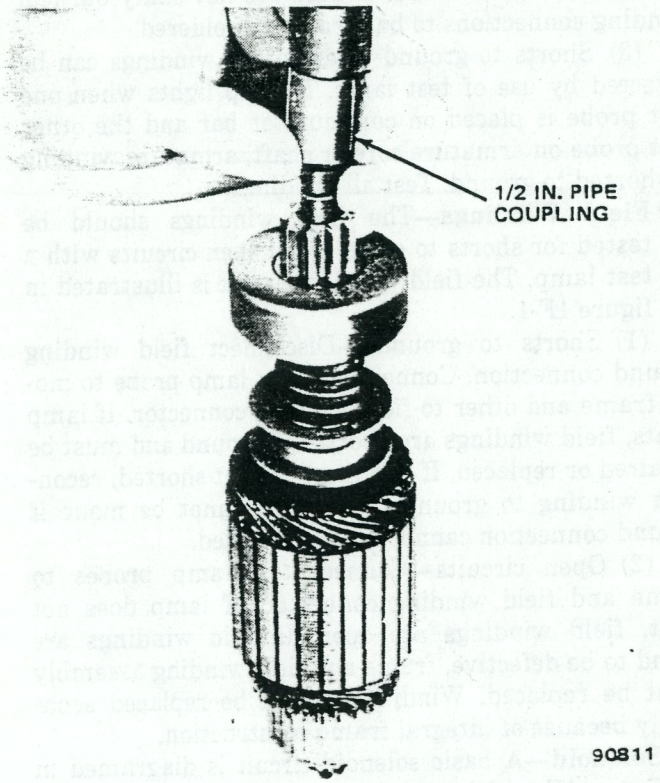


Fig. 1F-5 Removing Retainer From Snap Ring

(8) Roller type clutches are designed to be serviced as a complete unit. Do not disassemble, replace if necessary.

Component Inspection

- **Brushes and Brush Holders**—Inspect the brushes for wear. If they are worn excessively when compared with a new brush, they should be replaced. Ensure the brush holders are clean and the brushes are not binding in the holders. The complete brush surface should ride on the commutator for proper operation. Check by hand to ensure that the brush springs are providing firm contact between the brushes and commutator. If the springs are distorted or discolored, they should be replaced.
- **Armature Windings**—Commutators should not have the insulation undercut, and out-of-round commutators should **not** be turned in a lathe. The armature windings should be tested for internal short circuits, open circuits, and shorts to ground:

(1) Internal short circuits are located by rotating armature in growler with steel strip (e.g., hacksaw blade) held above armature. Steel strip will vibrate when at area of short circuit. Short circuits between commutator bars are sometimes caused by brush dust or copper imbedded between bars. Cleaning dust and copper out of bars may eliminate short circuits.

(2) Open circuits can be located by inspecting connections joining armature windings to commutator bars for looseness. Loose connections cause arcing and burning of commutator bars. If bars are not badly burned, winding connections to bars can be resoldered.

(3) Shorts to ground in armature windings can be detected by use of test lamp. If lamp lights when one test probe is placed on commutator bar and the other test probe on armature core or shaft, armature winding is shorted to ground. Test all windings.

- **Field Windings**—The field windings should be tested for shorts to ground and open circuits with a test lamp. The field winding circuit is illustrated in figure 1F-1.

(1) Shorts to grounds—Disconnect field winding ground connection. Connect one test lamp probe to motor frame and other to field winding connector. If lamp lights, field windings are shorted to ground and must be repaired or replaced. If windings are not shorted, reconnect winding to ground. This test cannot be made if ground connection cannot be disconnected.

(2) Open circuits—Connect test lamp probes to frame and field winding connector. If lamp does not light, field windings are open. If field windings are found to be defective, frame and field winding assembly must be replaced. Windings cannot be replaced separately because of integral frame construction.

- **Solenoid**—A basic solenoid circuit is diagramed in figure 1F-1. Solenoids can be tested electrically by connecting a battery of the specified voltage, a switch, and an ammeter to the two solenoid windings. With all wires disconnected from the solenoid, make test connections to the solenoid switch terminal and to ground to test the hold-in winding (fig. 1F-6). Use the carbon pile rheostat across the battery to decrease the battery voltage to the value listed in specifications. Compare the current flow with the value listed in Specifications. A high current flow indicates a shorted or grounded hold-in winding, and a low current flow indicates excessive resistance.

To test the pull-in winding, connect the battery across the solenoid switch (S) terminal and the Solenoid motor (M) terminal. To reduce the voltage to the specified value, connect the carbon pile rheostat

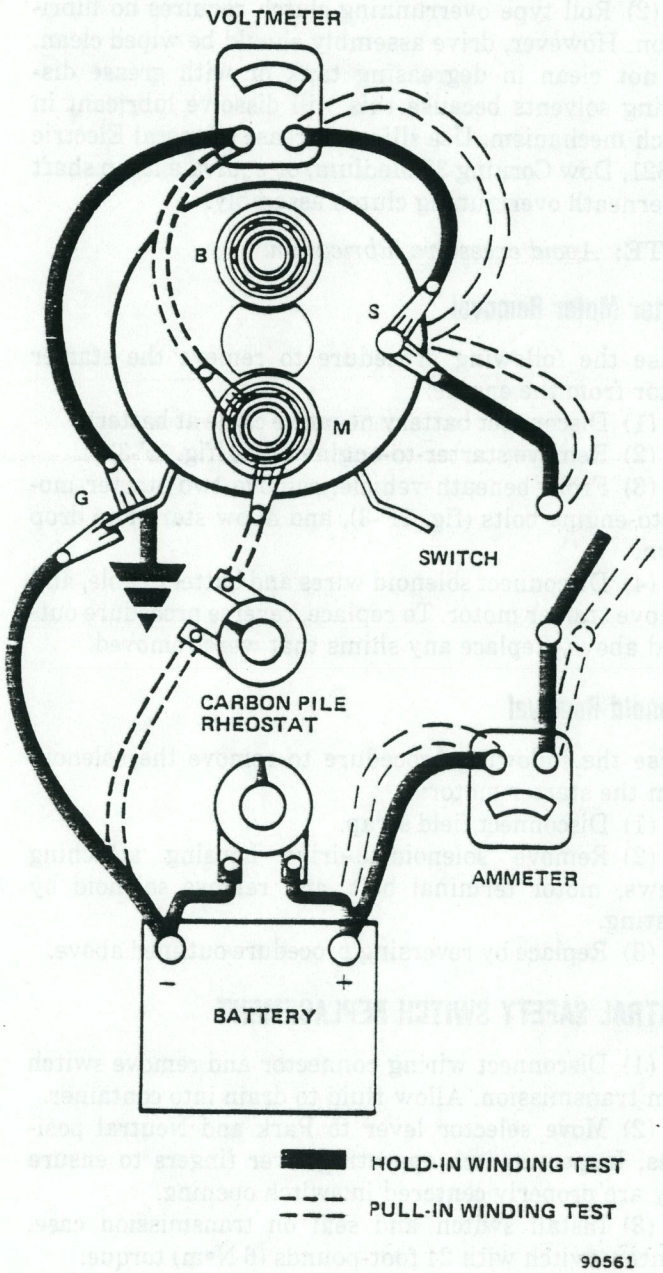


Fig. 1F-6 Solenoid Test Connections

between the battery and M-terminal as shown with dashed lines (fig. 1F-6) instead of across the battery as shown with solid lines. If not needed, connect a jumper directly from the battery to the M-terminal.

CAUTION: *To prevent overheating, do not allow the pull-in winding to be energized more than 15 seconds. The current flow will decrease as the winding temperature increases.*

- **Overrunning Clutch**—Test the overrunning clutch action. The pinion gear should turn freely in the overrunning direction. Inspect the pinion gear teeth to ensure that they have not been chipped, cracked, or excessively worn. Replace assembly if necessary. Badly chipped pinion gear teeth indicate possible chipped teeth on the ring gear. The ring gear should be examined and replaced if necessary.

Test the overrunning clutch for slipping with the clutch attached to the armature. Wrap the armature with a shop towel and clamp in a vise. Using a 12-point deep socket and torque wrench, place the socket on the clutch and turn counterclockwise. The clutch should not slip with up to 50 foot-pounds (68 N•m) torque applied. If it does, replace the clutch.

Reassembly

(1) Position clutch assembly on armature shaft. To replace snap ring and retainer onto armature:

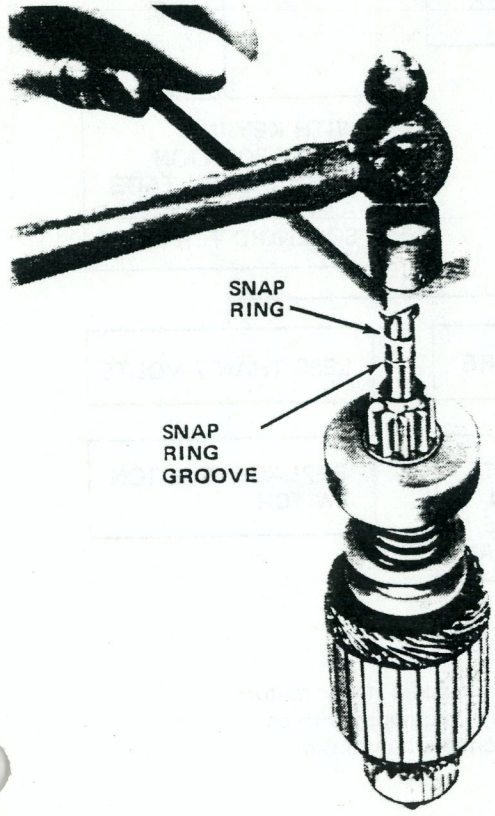


Fig. 1F-7 Forcing Snap Ring Over Shaft

(a) Position retainer on armature shaft with cupped surface facing snap ring groove.

(b) Position snap ring on end of shaft. With piece of wood on top, force ring over shaft and tap in place (fig. 1F-7), then slide ring down into groove.

(c) To force retainer over snap ring, place a suitable washer over shaft and squeeze retainer and washer together with pliers (fig. 1F-8).

(d) Remove washer.

(e) Slide thrust collar over shaft.

(2) Refer to disassembly procedure and follow in reverse order to complete reassembly.

(3) When solenoid is installed, apply sealing compound between motor frame, flange, and solenoid junction.

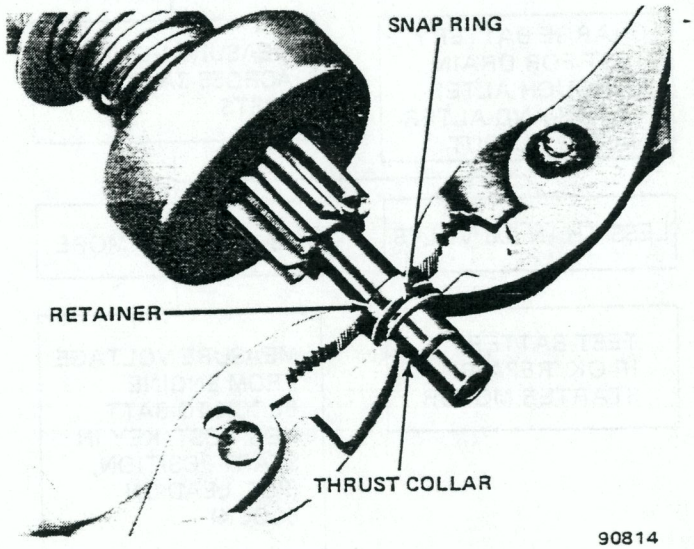


Fig. 1F-8 Forcing Retainer Over Snap Ring

Pinion Gear Clearance Test

The pinion gear clearance cannot be adjusted but should be tested after reassembly of the starter motor to ensure proper clearance. Improper clearance is an indication of worn parts.

To measure pinion gear clearance, follow the steps listed below:

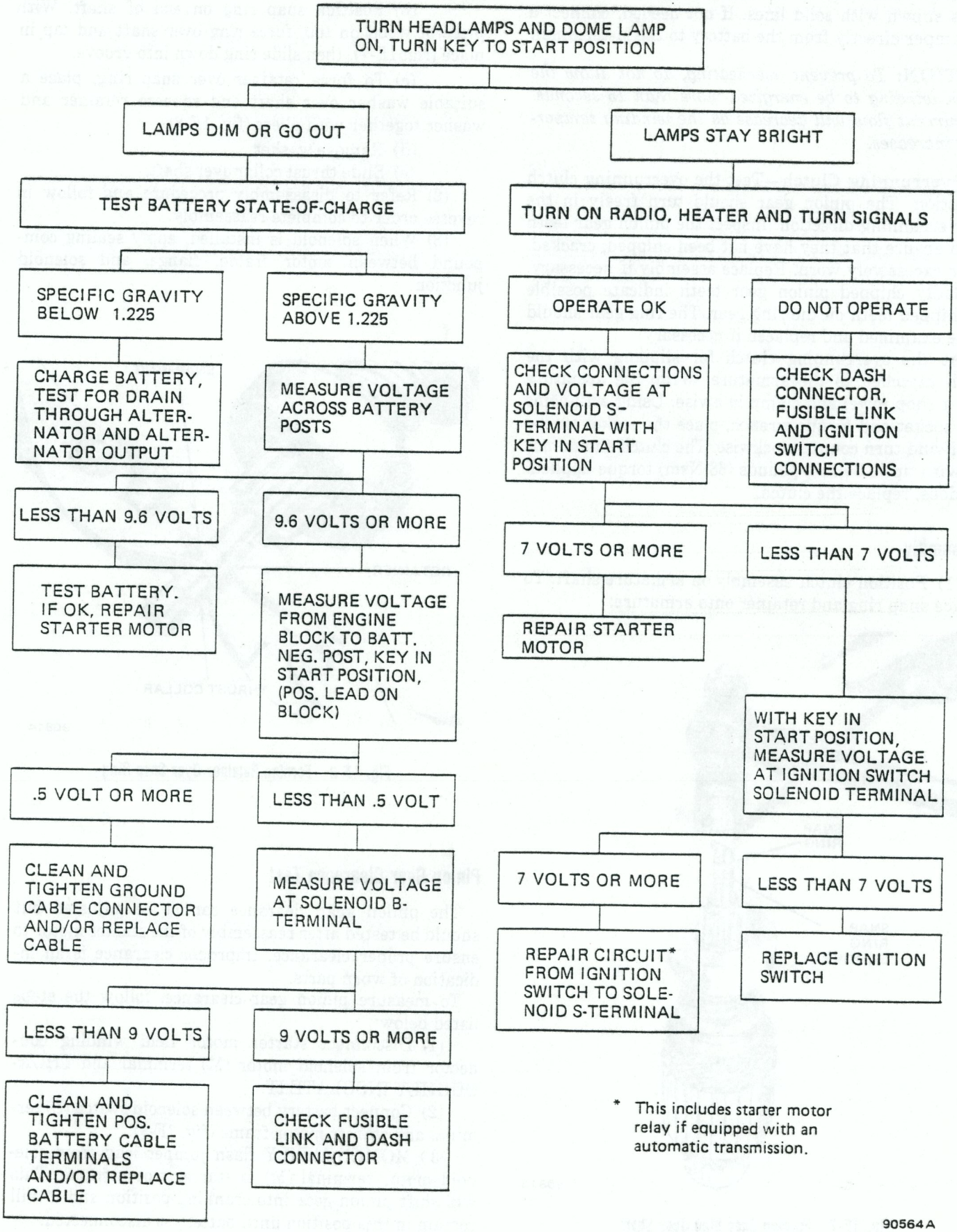
(1) Disconnect starter motor field winding connector from solenoid motor (M) terminal and THOROUGHLY INSULATE IT.

(2) Connect battery between solenoid switch (S) terminal and starter motor frame (fig. 1F-9).

(3) MOMENTARILY flash jumper lead from solenoid motor terminal (M) to starter motor frame. This will shift pinion gear into cranking position and it will remain in this position until battery is disconnected.

Starter Motor General Diagnosis

NO CRANKING, SOLENOID DOES NOT ENERGIZE



* This includes starter motor relay if equipped with an automatic transmission.

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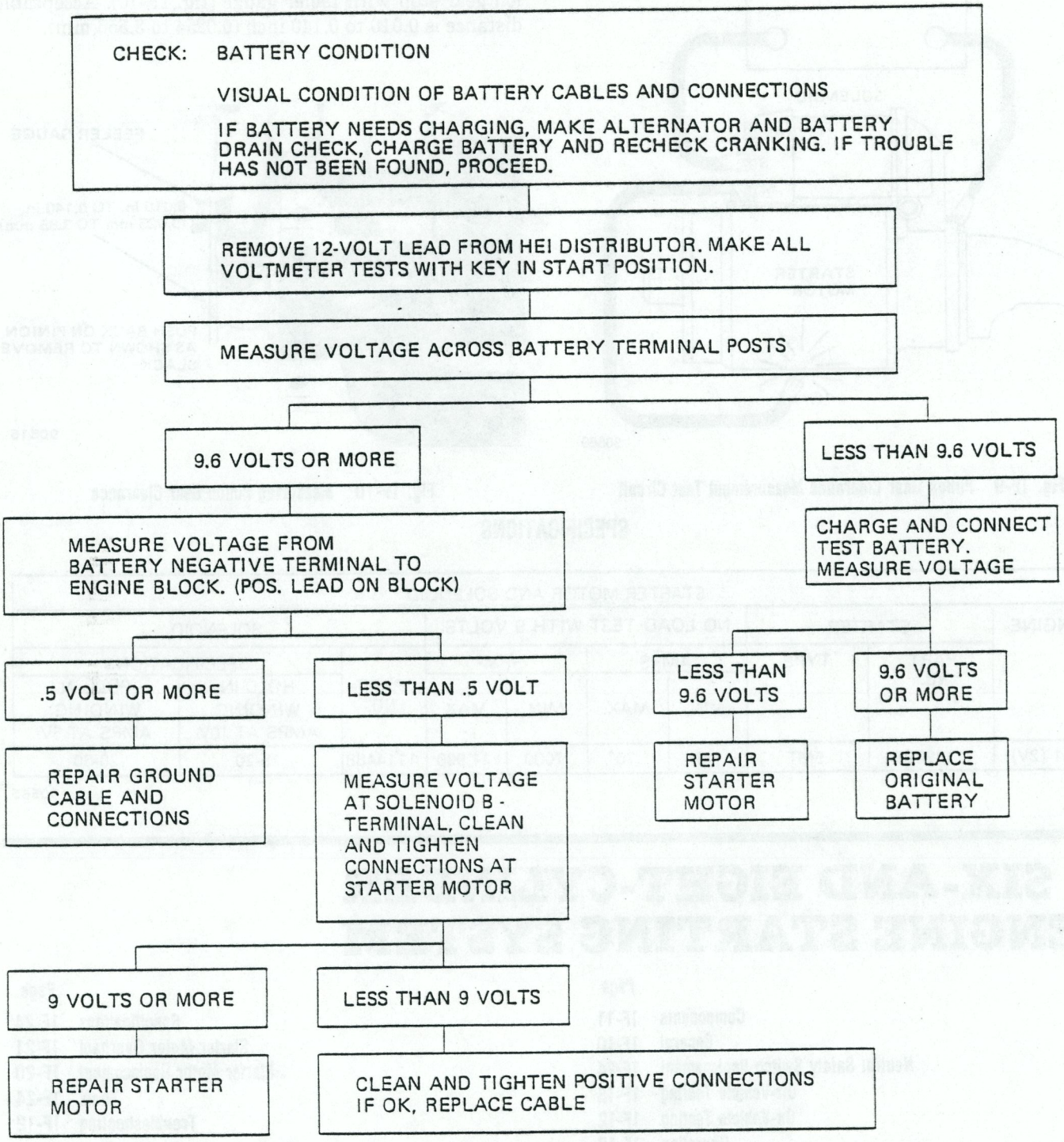
Starter Motor General Diagnosis (Continued)

SLOW CRANKING, SOLENOID CLICKS OR CHATTERS



NOTE: THIS DIAGNOSIS IS DESIGNED FOR USE ON ENGINES AND BATTERIES AT ROOM OR NORMAL OPERATING TEMPERATURES. IT IS ALSO NECESSARY THAT THERE BE NO ENGINE DEFECTS THAT WOULD CAUSE CRANKING PROBLEMS. TO USE IT UNDER OTHER CONDITIONS CAN RESULT IN AN INCORRECT DIAGNOSIS.

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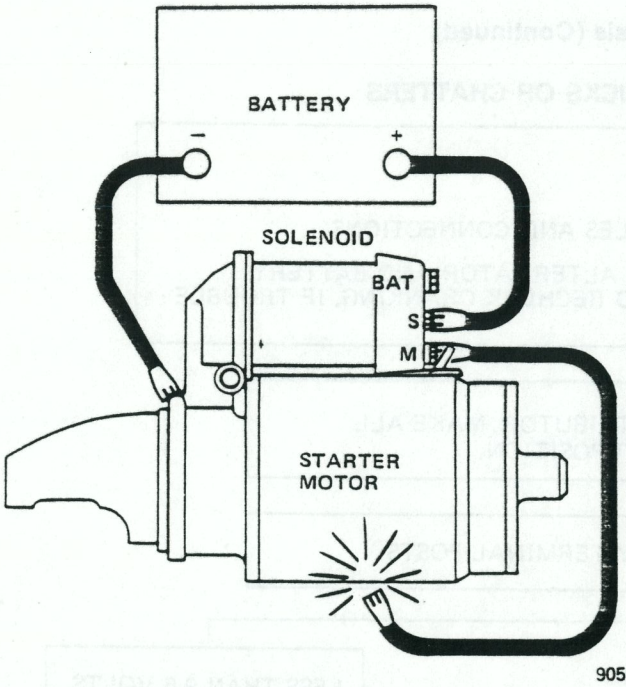

Fig. 1F-9 Pinion Gear Clearance Measurement Test Circuit

(4) Push pinion gear back toward commutator end to eliminate any slack.

(5) Measure distance between pinion gear and pinion gear stop with feeler gauge (fig. 1F-10). Acceptable distance is 0.010 to 0.140 inch (0.0254 to 3.556 mm).

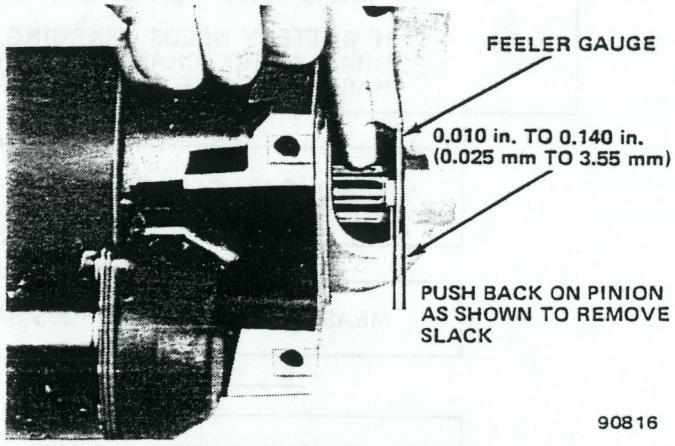

Fig. 1F-10 Measuring Pinion Gear Clearance

SPECIFICATIONS

STARTER MOTOR AND SOLENOID									
ENGINE	STARTER		NO LOAD TEST WITH 9 VOLTS				SOLENOID		
	PART NO.	TYPE	AMPS		RPM		PART NO.	SPECIFICATIONS	
			MIN.	MAX.	MIN.	MAX.		HOLD-IN WINDING AMPS AT 10V	PULL-IN WINDING AMPS AT 5V
151 (2V)	1109526	5MT	45	70	7000	11,900	1114488	15-20	20-30

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SIX-AND EIGHT-CYLINDER ENGINE STARTING SYSTEM

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GENERAL

The starting system used with all Jeep six- and eight-cylinder engines consists of a positive engagement starter motor, a starter motor solenoid, an ignition/start switch, circuits protected by fusible links and the battery. Vehicles equipped with an automatic transmission also have a neutral safety switch. The starter motor has a moveable pole shoe and appropriate linkage to engage the drive mechanism. Inside the drive assembly, an overrunning clutch prevents the starter motor from being driven by the ring gear.

COMPONENTS

Starter Motor

Identification

At the time of manufacture, the starter motor identification code is stamped on the frame adjacent to the Jeep part number. The date is decoded as follows:

- Year (0—1980) (1—1981)
- Month (A—Jan., B—Feb., etc.)
- Week (A—first week in month, B—second week, etc.)

Field Windings

Four field windings are used. Each is wound around an iron pole shoe that concentrates the electromagnetic flux created when current flows through the field winding. Three of the field windings have fixed pole shoes, while the fourth winding has a moveable pole shoe. This fourth winding, located at the top of the starter motor, has an additional, smaller winding wound inside of it. This is the hold-in winding.

Drive Assembly

A pinion gear, driven by the starter motor armature, is forced to move into mesh with the engine flywheel (or drive plate) ring gear when the starter motor is actuated. The movement is accomplished by the action of the moveable pole shoe and its drive yoke (fig. 1F-11). As long as the ignition key is held in the **Start** position, the pinion gear remains in mesh with the ring gear. An overrunning (one-way) clutch in the drive assembly permits the starter motor to drive the ring gear, but after the engine starts, the clutch prevents the engine from driving the starter motor before the key is released to the **On** position.

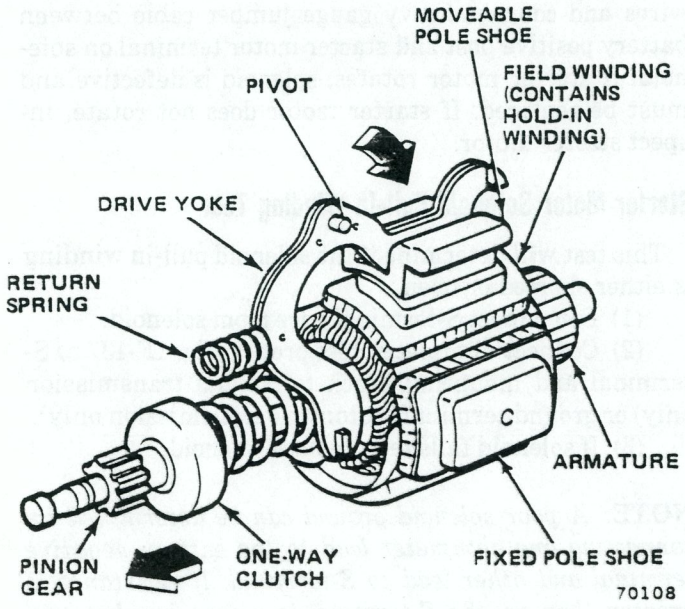

Fig. 1F-11 Moveable Pole Shoe Operation

Starter Motor Solenoid

Two different starter motor solenoids are used, one with manual transmissions and the other with automatic transmissions. The solenoids differ only in the method of providing a ground for the solenoid pull-in winding.

The ground circuit for the solenoid pull-in winding is completed through the solenoid mounting bracket on manual transmission equipped vehicles.

On vehicles equipped with an automatic transmission, the pull-in winding is grounded through an additional terminal on the bottom of the solenoid. A wire connected to this terminal provides a ground path from the neutral safety switch located on the transmission. The pull-in winding ground circuit is completed at the neutral safety switch only when the automatic transmission gear selector is placed in Neutral or Park.

NOTE: *The neutral safety switch and back-up lamp switch are enclosed in a single housing.*

The starter motor solenoid pull-in winding is energized when battery voltage is applied to the S-terminal of the solenoid and the pull-in winding is grounded. When the solenoid pull-in winding is energized, the contact disc is forced into the closed position. The disc mates with two contacts in the solenoid and this completes the circuit between the battery and the starter motor.

All starter motor solenoids have an I-terminal that is connected to the ignition system. When the starter motor is in operation, the I-terminal provides full battery voltage for the ignition coil. This circuit bypasses the resistance wire that provides voltage for the coil after the engine starts. Refer to Chapter 1G—Ignition Systems for additional information.

CAUTION: *Starter motor solenoids used in previous years (before solid-state ignitions) look similar to the solenoids presently used but are very different internally. Use of the wrong type solenoid can damage the neutral safety switch. Verify the part number stamped on the replacement solenoid before installation.*

CAUTION: *Starter motor solenoids are equipped with both blade terminals and long studs. The blade terminals are attached to the long studs and held in place by retaining nuts. Loosening of the retaining nuts could cause the loss of internal connections and necessitate replacement of the solenoid.*

Neutral Safety Switch

The Neutral Safety Switch is a three-terminal plunger switch mounted on the automatic transmission case. The two outer terminals connect to the back-up lamp circuit, while the center terminal provides a ground path for the starter motor solenoid circuit. Ground is provided only when the automatic transmission is in Park or Neutral position.

Starter System Circuits

The starting system has two electrical circuits, a low current circuit and a high current circuit (fig. 1F-12). The low current circuit is the control circuit. It includes the connections and wires leading from the ignition switch to the S-terminal on the starter motor solenoid, and from the ground terminal of the starter motor solenoid to the neutral safety switch on automatic transmission equipped vehicles. The high current circuit runs from the battery through the starter motor solenoid to the starter motor to ground. This circuit uses heavy gauge cables because of the large current flow required for the starter motor.

Fusible Link

A fusible link is used in the low current starting system circuit (fig. 1F-12). Current flows from the starter motor solenoid battery terminal by cable to the battery positive terminal. From the solenoid battery terminal, voltage is also distributed to other vehicle circuits. A 14-gauge fusible link is connected between the solenoid terminal and the main body wire harness. This fusible link protects the complete vehicle electrical system as well as the solenoid.

Fusible links are covered with a special non-flammable insulation. Each link is manufactured with a specific load rating and is intended for a specific circuit. Replacement links are available from Jeep service parts sources.

OPERATION

The starter motor low current circuit is controlled by the ignition/start switch (fig. 1F-12). The ignition/start switch applies battery voltage to the starter motor solenoid S-terminal when the ignition key is in the **Start** position. This energizes the solenoid pull-in winding, which completes the high current circuit between the battery and the starter motor. The starter motor is then actuated and begins rotating the engine crankshaft.

TROUBLESHOOTING

The Service Diagnosis chart may be used to isolate the source of the problem when the starter motor either rotates the engine too slowly, will not rotate the engine, or has abnormal drive engagement.

If the starter motor rotating speed is normal and the drive pinion gear engages properly with the ring gear but the engine does not start, a problem exists either in the fuel system or ignition system.

ON-VEHICLE TESTING

Starter Motor Will Not Rotate

(1) Verify battery and cable condition as outlined in Chapter 1D—Batteries to assure correct voltage is available.

(2) Inspect and tighten battery and starter motor cable connections at starter motor solenoid terminals.

(3) Disconnect wire at solenoid S-terminal.

WARNING: *Place transmission in Neutral (manual) or Park (automatic) position and apply parking brake before conducting solenoid test.*

(4) Connect jumper wire from battery positive post to solenoid S-terminal. If starter motor rotates, solenoid is not defective. Inspect ignition/start switch circuit.

(5) If starter motor does not rotate, connect another jumper wire from battery negative terminal to solenoid mounting bracket (manual transmission only) or ground terminal (automatic transmission only). Ensure good connection is made. If solenoid energizes, it was not properly grounded. Remove rust or corrosion and attach solenoid to inner-fender panel with cadmium-plated screws (manual transmission only) or test operation of neutral safety switch (automatic transmission only).

(6) If starter motor does not rotate, remove jumper wires and connect heavy gauge jumper cable between battery positive post and starter motor terminal on solenoid. If starter motor rotates, solenoid is defective and must be replaced. If starter motor does not rotate, inspect starter motor.

Starter Motor Solenoid Pull-In Winding Test

This test will determine if the solenoid pull-in winding is either shorted or open.

(1) Disconnect S-terminal wire from solenoid.

(2) Connect ohmmeter test probes (fig. 1F-13) to S-terminal and mounting bracket (manual transmission only) or ground terminal (automatic transmission only).

(3) If solenoid fails test, replace solenoid.

NOTE: *A poor solenoid ground can be determined by connecting one ohmmeter lead to the battery negative terminal and other lead to S-terminal. If resistance is greater than in the S-terminal-to-mount bracket test (fig. 1F-13), the solenoid has a poor ground.*

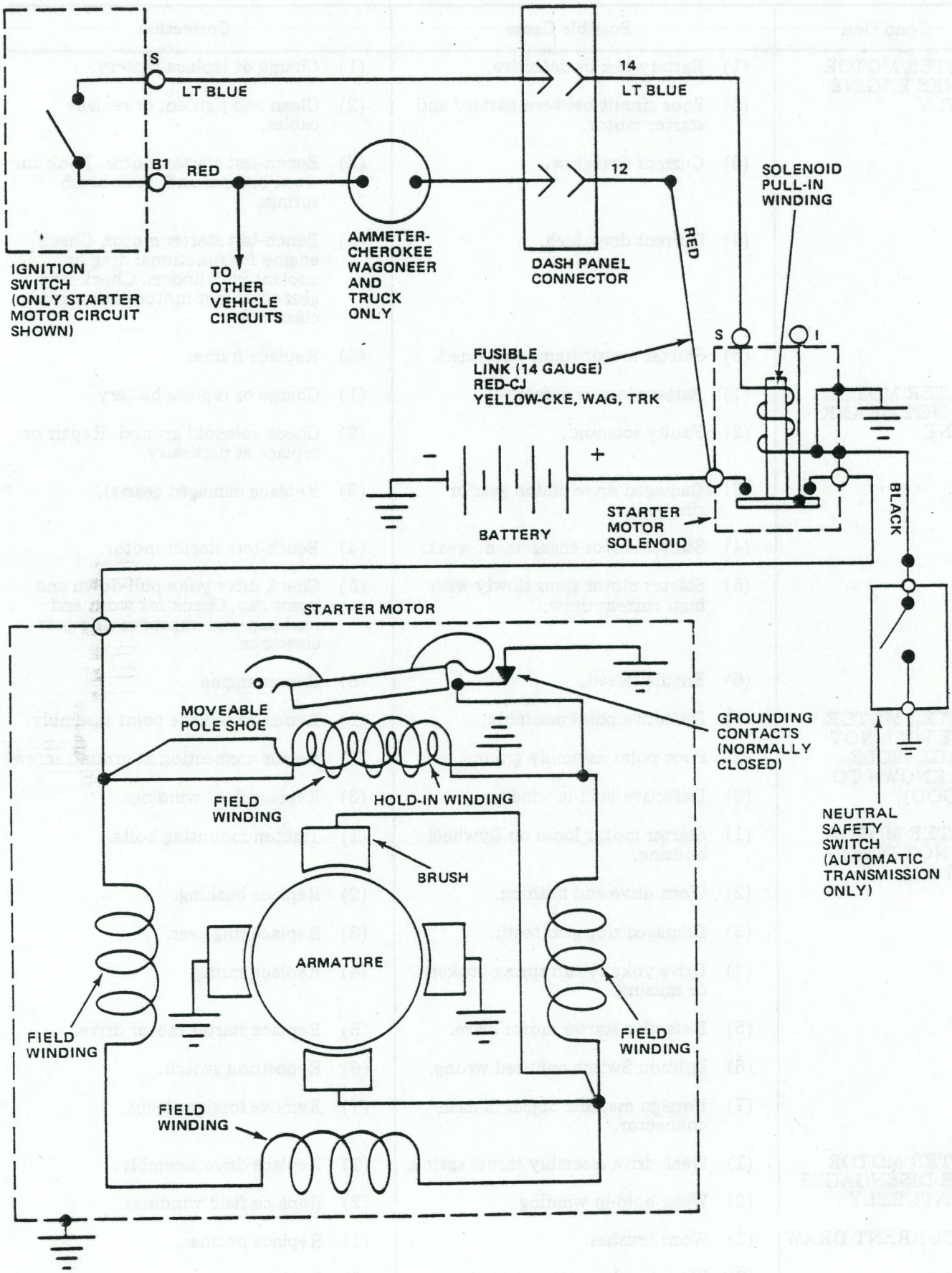

Fig. 1F-12 Six- and Eight-Cylinder Engine Starting System Schematic

Service Diagnosis

Condition	Possible Cause	Correction
STARTER MOTOR CRANKS ENGINE SLOWLY	(1) Battery low or defective.	(1) Charge or replace battery.
	(2) Poor circuit between battery and starter motor.	(2) Clean and tighten, or replace cables.
	(3) Current draw low.	(3) Bench-test starter motor. Look for worn brushes and weak brush springs.
	(4) Current draw high.	(4) Bench-test starter motor. Check engine for functional drag or coolant in cylinders. Check ring gear-to-starter motor pinion gear clearance.
	(5) Starter motor frame deformed.	(5) Replace frame.
STARTER MOTOR WILL NOT CRANK ENGINE	(1) Battery low or defective.	(1) Charge or replace battery.
	(2) Faulty solenoid.	(2) Check solenoid ground. Repair or replace as necessary.
	(3) Damaged drive pinion gear or ring gear.	(3) Replace damaged gear(s).
	(4) Starter motor engagement weak.	(4) Bench-test starter motor.
	(5) Starter motor spins slowly with high current draw.	(5) Check drive yoke pull-down and point gap. Check for worn end bushings and improper ring gear clearance.
	(6) Engine seized.	(6) Repair engine.
STARTER MOTOR DRIVE WILL NOT ENGAGE (SOLENOID KNOWN TO BE GOOD)	(1) Defective point assembly.	(1) Repair or replace point assembly.
	(2) Poor point assembly ground.	(2) Repair connection at ground screw.
	(3) Defective hold-in winding.	(3) Replace field windings.
STARTER MOTOR WILL NOT DISENGAGE	(1) Starter motor loose on flywheel housing.	(1) Tighten mounting bolts.
	(2) Worn drive end bushing.	(2) Replace bushing.
	(3) Damaged ring gear teeth.	(3) Replace ring gear.
	(4) Drive yoke return spring broken or missing.	(4) Replace spring.
	(5) Defective starter motor drive.	(5) Replace starter motor drive.
	(6) Ignition Switch adjusted wrong.	(6) Reposition switch.
	(7) Foreign metallic object in dash connector.	(7) Remove foreign object.
STARTER MOTOR DRIVE DISENGAGES PREMATURELY	(1) Weak drive assembly thrust spring.	(1) Replace drive assembly.
	(2) Weak hold-in winding.	(2) Replace field windings.
LOW CURRENT DRAW	(1) Worn brushes.	(1) Replace brushes.
	(2) Weak brush springs.	(2) Replace springs.

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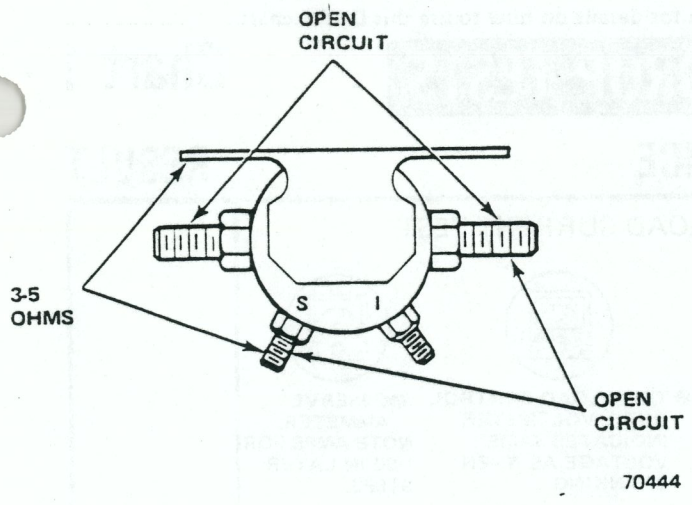


Fig. 1F-13 Ohmmeter Test of Starter Motor Solenoid

Starter Motor Cable and Ground Cable Tests (Voltage Drop)

The results of voltage drop tests will determine if there is excessive resistance in the high current circuit. When performing these tests, it is important that the voltmeter test lead probes be in contact with the terminals that the cables are connected to instead of with the cables themselves. For example, when testing between the battery and solenoid, the voltmeter probes must touch the battery post and the solenoid threaded stud.

Preliminary Preparation for Tests

(1) Remove ignition coil secondary wire from distributor and ground to engine.

(2) Place transmission in Neutral (manual transmission) or Park (automatic transmission) and set parking brake.

(3) Ensure battery is fully charged.

Test Procedure

Follow the steps as outlined in the Starter Motor Voltage Drop Tests DARS charts.

Full Load Current Test

(1) Prior to performing full load current test, battery must be fully charged as described in Chapter 1D—Batteries.

NOTE: *The lower the available voltage, the higher the current flow.*

(2) Disconnect and ground ignition coil secondary wire.

(3) Connect remote control starting switch between battery positive terminal and S-terminal on starter solenoid.

NOTE: *Do not consider the initial voltage at the beginning of engine cranking. A very hot or very cold engine may cause a current of 400 to 600 amperes for the first few revolutions. Note the voltage after the starter motor has obtained its maximum rpm.*

CAUTION: *Do not operate for more than 15 seconds.*

(4) Connect battery-alternator-starter motor tester leads as depicted in figure 1F-14. Operate remote control starting switch and note voltage indicated on voltmeter while starter motor is rotating engine.

(5) Release remote control starting switch.

(6) Turn load control knob toward INCREASE (clockwise) until voltmeter indication matches that obtained when starter motor was rotating engine.

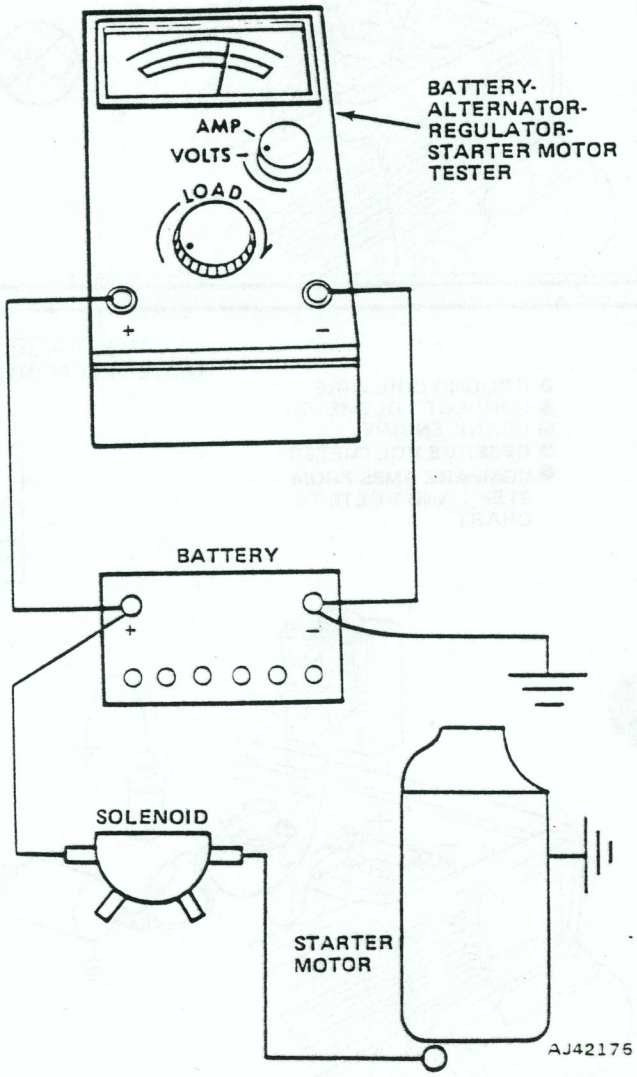


Fig. 1F-14 Starter Motor Full-Load Current Test

STARTER MOTOR VOLTAGE DROP TEST DIAGNOSIS AND REPAIR SIMPLIFICATION (DARS) CHARTS

Note: Refer to Chapter A – General Information for details on how to use this DARS chart.

STARTER MOTOR VOLTAGE DROP TESTS

Chart 1

STEP | **SEQUENCE** | **RESULT**

STARTER MOTOR FULL LOAD CURRENT TEST

- CLEAN AND CONNECT BATTERY CABLES

- REMOVE COIL WIRE FROM DISTRIBUTOR AND CONNECT TO GROUND

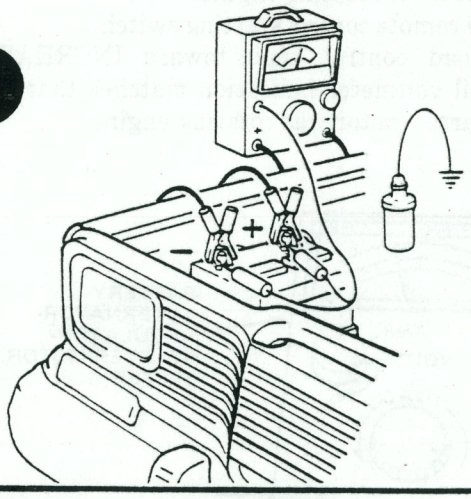
- CONNECT HEAVY LOAD TESTER

- CRANK ENGINE FOR THREE SECONDS AND OBSERVE VOLTMETER

- TURN LOAD CONTROL UNTIL VOLTMETER INDICATES SAME VOLTAGE AS WHEN CRANKING

- OBSERVE AMMETER. NOTE AMPS FOR USE IN LATER STEPS.

1



OK — 6 CYL. – 150-180 AMPS
8 CYL. – 160-210 AMPS → STOP

O.K — 6 CYL. – ABOVE 180 AMPS
8 CYL. – ABOVE 210 AMPS

- BATTERY CABLES AND SOLENOID NOT TESTED → **2**

OR

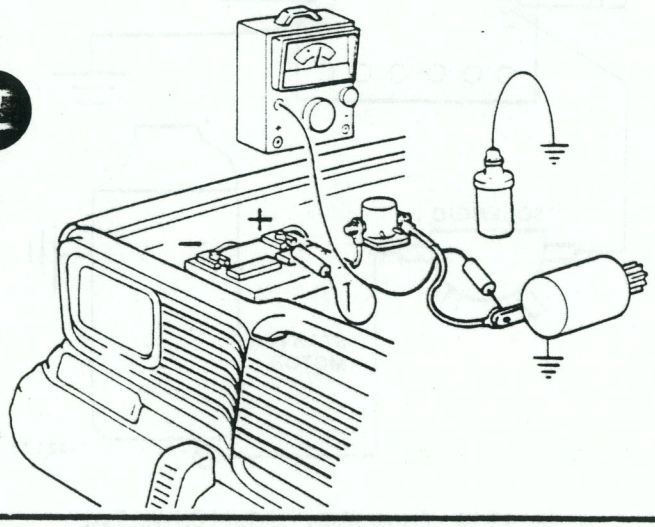
- BATTERY CABLE AND SOLENOID REPAIRS COMPLETED → REPAIR STARTER → STOP

VOLTAGE DROP TEST
(NOTE TEST POINTS IN ILLUSTRATION)

- GROUND COIL WIRE
- CONNECT VOLTMETER
- CRANK ENGINE
- OBSERVE VOLTMETER
- COMPARE AMPS FROM STEP 1 AND VOLTS TO CHART

MAXIMUM VOLTAGE DROP BY FULL LOAD AMPERAGE				
AMPS	150-210	215-295	300-420	425-600
VOLTS	0.5 V	0.7 V	1.0 V	1.5 V

2



OK → **5**
VOLTAGE AT OR BELOW MAXIMUM

O.K → **3**
VOLTAGE ABOVE MAXIMUM

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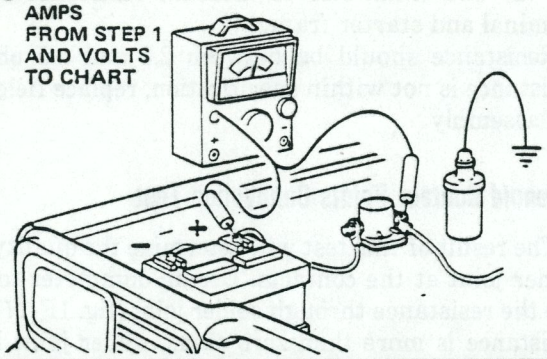
STEP	SEQUENCE	RESULT

3

VOLTAGE DROP TEST
(NOTE TEST POINTS IN ILLUSTRATION)

- GROUND COIL WIRE
- CONNECT VOLTMETER
- CRANK ENGINE
- OBSERVE VOLTMETER
- COMPARE AMPS FROM STEP 1 AND VOLTS TO CHART



MAXIMUM VOLTAGE DROP BY FULL LOAD AMPERAGE				
AMPS	150-210	215-295	300-420	425-500
VOLTS	0.3 V	0.5 V	0.6 V	0.9 V

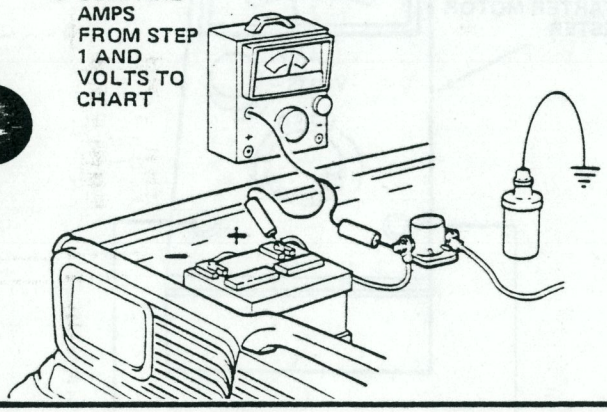
OK → VOLTAGE AT OR BELOW MAXIMUM → REPAIR SOLENOID-TO-STARTER MOTOR CABLE → 5

O.K → VOLTAGE ABOVE MAXIMUM → 4

4

VOLTAGE DROP TEST
(NOTE TEST POINTS IN ILLUSTRATION)

- GROUND COIL WIRE
- CONNECT VOLTMETER
- CRANK ENGINE
- OBSERVE VOLTMETER
- COMPARE AMPS FROM STEP 1 AND VOLTS TO CHART



MAXIMUM VOLTAGE DROP BY FULL LOAD AMPERAGE				
AMPS	150-210	215-295	300-420	425-600
VOLTS	0.2V	0.3V	0.4V	0.5V

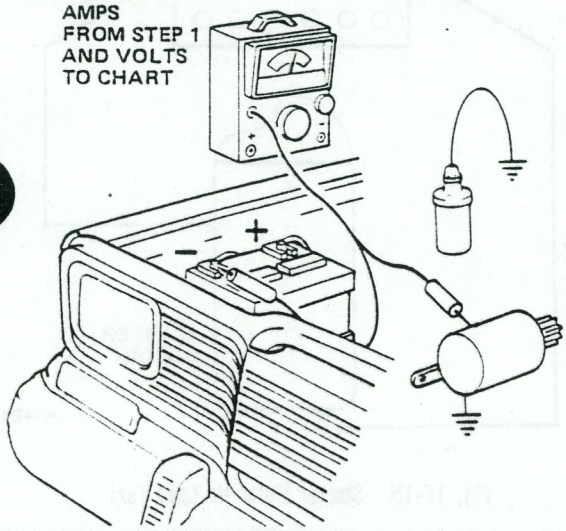
OK → VOLTAGE AT OR BELOW MAXIMUM → REPAIR SOLENOID → 5

O.K → VOLTAGE ABOVE MAXIMUM → REPAIR BATTERY-TO-SOLENOID CABLE → 5

5

VOLTAGE DROP TEST
(NOTE TEST POINTS IN ILLUSTRATION)

- GROUND COIL WIRE
- CONNECT VOLTMETER
- CRANK ENGINE
- OBSERVE VOLTMETER
- COMPARE AMPS FROM STEP 1 AND VOLTS TO CHART



MAXIMUM VOLTAGE DROP BY FULL LOAD AMPERAGE				
AMPS	150-210	215-295	300-420	425-600
VOLTS	0.2V	0.3V	0.4V	0.5V

OK → VOLTAGE AT OR BELOW MAXIMUM

- REPAIRS TO SOLENOID OR CABLES PERFORMED IN A PREVIOUS STEP → 1
- REPAIRS TO SOLENOID OR CABLES NOT REQUIRED IN A PREVIOUS STEP → REPAIR STARTER MOTOR → STOP

O.K → VOLTAGE ABOVE MAXIMUM → REPAIR ENGINE-TO-BATTERY CABLE → 1

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(7) Switch to AMP position and note current indicated on ammeter scale. This is current being used by starter motor under full-load conditions. If current is not within 150 to 180 amperes for six-cylinder engines or 160 to 210 amperes for eight-cylinder engines at room temperature, remove starter motor from engine for bench testing.

Neutral Safety Switch Test

(1) Insert voltmeter test lead probes into switch with all switch wire terminals connected. Refer to wiring diagrams for correct terminal connections.

NOTE: *Probe-type tips are required on voltmeter test leads. If not available, push cotter pins into switch connector to provide contacts for aligator jaw type test lead terminals.*

(2) Turn ignition switch to Start position.
(3) Voltmeter should indicate less than 0.1 volt.

OFF-VEHICLE TESTING

No-Load Test

The starter motor no-load test results will indicate faults such as open or shorted windings, worn bushings (rubbing armature) or bent armature shaft.

NOTE: *The tester load control knob must be in the DECREASE (extreme counterclockwise) position.*

(1) Operate starter motor with test equipment connected as diagramed in figure 1F-15. Note voltage indication.
(2) Determine exact starter motor rpm using mechanical tachometer (not shown).

NOTE: *To use a mechanical tachometer, remove the seal from the end of the drive end housing and clean the grease from the end of the armature shaft.*

(3) Disconnect starter motor from battery.
(4) Turn load control knob toward INCREASE (clockwise) until voltage indication matches that obtained with starter motor connected to battery.
(5) Switch to AMP position and note current. If less than specification, starter motor has high electrical resistance and should be repaired or replaced. If current is more than specification and starter motor rpm is less than specification, disassemble, clean, inspect and test starter motor as outlined in following paragraphs.

Hold-In Coil Winding Resistance Test

The result of this test will determine the resistance of the hold-in winding.

(1) Insert piece of paper between contact points to serve as insulator (fig. 1F-16).
(2) Use ohmmeter to measure resistance between terminal and starter frame.

Resistance should be between 2.0 and 3.5 ohms. If resistance is not within specification, replace field winding assembly.

Solenoid Contact Points Connection Test

The result of this test will determine the quality of the solder joint at the contacts. Use an ohmmeter to measure the resistance through solder joint (fig. 1F-17). If the resistance is more than zero ohms, solder joint has excessive resistance. Repair by heating joint with 600 watt soldering iron.

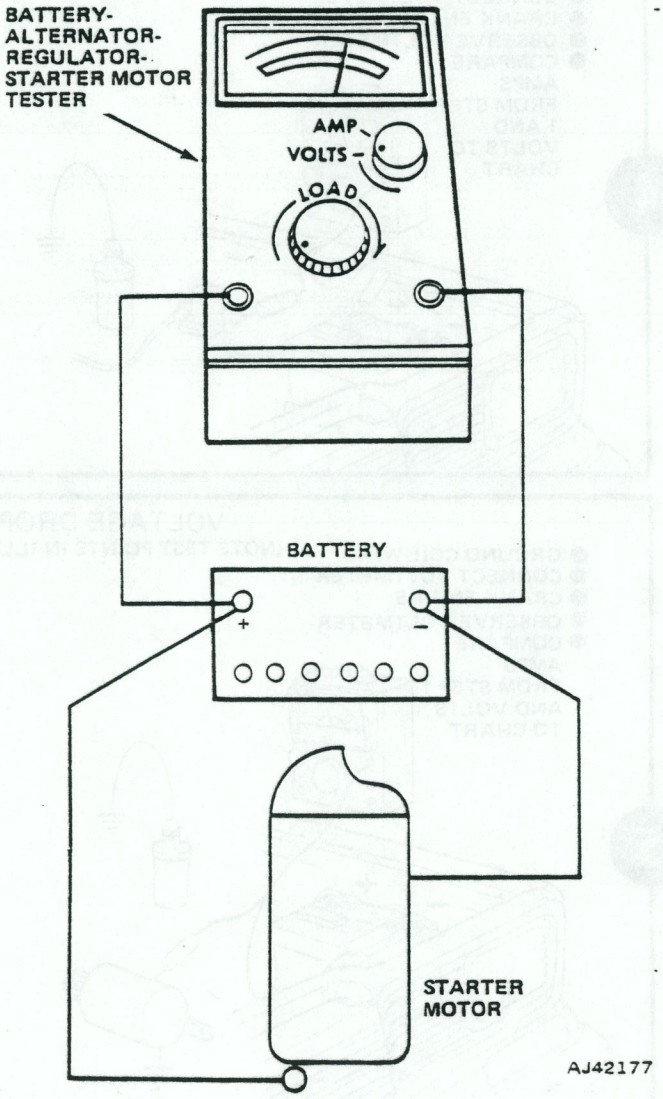


Fig. 1F-15 Starter Motor No-Load Test

Insulated Brush Connection Test

The result of this test will determine the quality of the solder joint between the insulated brush braided wire and the field windings. Use an ohmmeter to test the resistance through solder joint by touching probes to brush and to copper bus bar (fig. 1F-18). If resistance is more than zero ohms, solder joint has excessive resistance. Repair by heating joint with 600 watt soldering iron.

Terminal-to-Brush Continuity Test

The result of this test will determine the condition of all field winding solder joints.

(1) Insert piece of paper between contact points to serve as insulator (fig. 1F-19).

(2) Touch ohmmeter probes to terminal and to insulated brush.

If resistance is more than zero ohms, test all solder joints to determine which one(s) has/have excessive resistance. Repair faulty solder joint(s) by heating with a 600 watt soldering iron.

Terminal Bracket Insulation Test

The result of this test will determine if the terminal bracket is properly insulated from the end cap. Use an ohmmeter to test continuity between the bracket and cap (Fig. 1F-20). If the resistance is not infinite, the insulator is faulty. Repair by replacing the end cap.

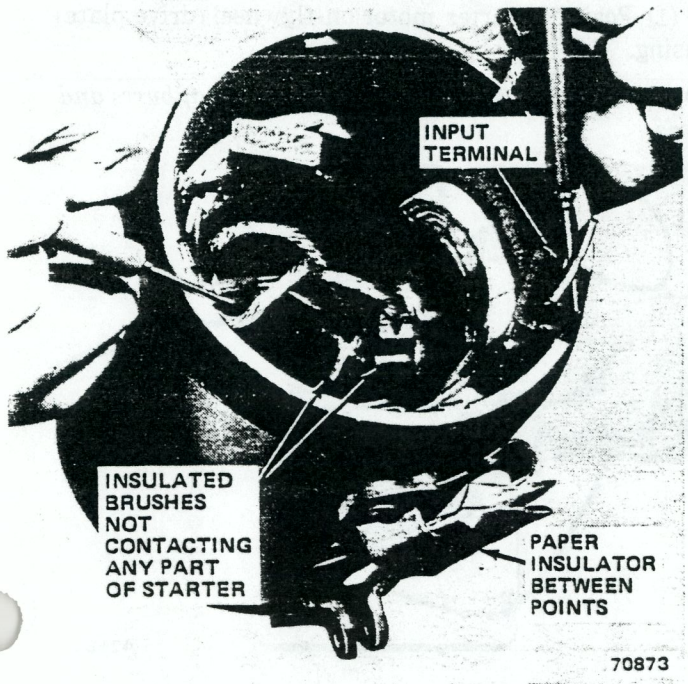


Fig. 1F-16 Hold-In Coil Winding Resistance Test

Armature Tests

Test the armature winding for a short circuit to ground (armature core), short circuit between windings and balance whenever the starter motor is overhauled. Follow the test equipment manufacturer's instructions or the following procedure.

Grounded Armature Winding Test

(1) Place armature in growler jaws and turn power switch to TEST position (fig. 1F-21).

(2) Touch one test lead probe to armature core, touch other lead probe to each commutator bar one at a time and observe test lamp. Test lamp should not light. If test lamp lights on any bar, armature winding is shorted to armature core and armature must be replaced.

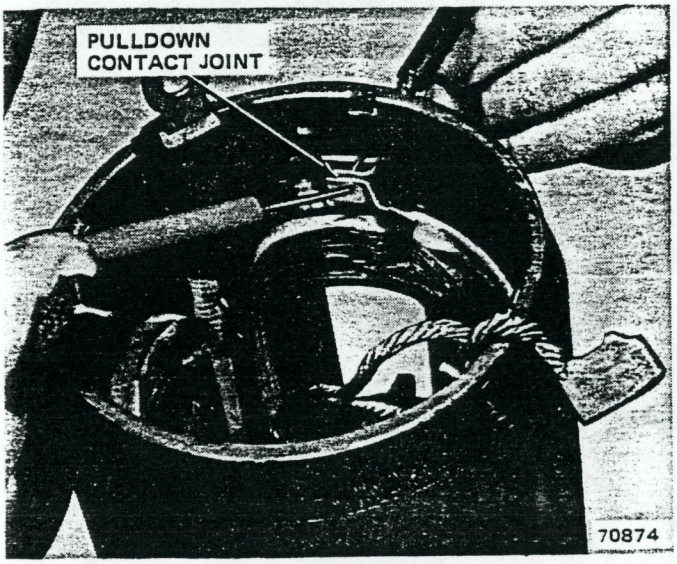


Fig. 1F-17 Solenoid Contact Points Connection Test

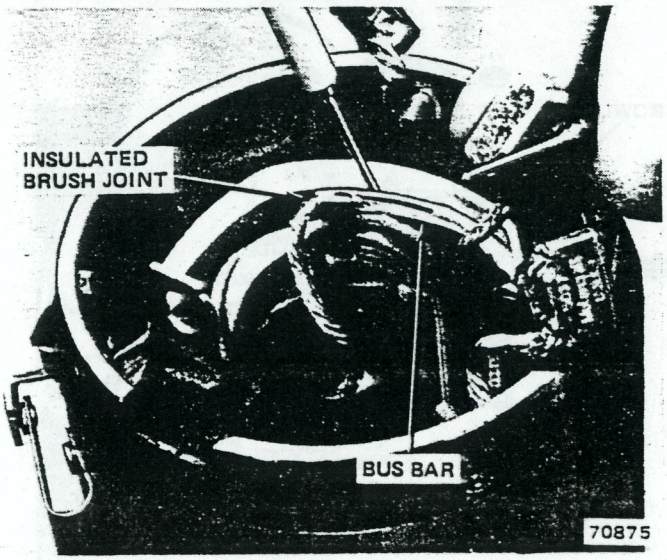


Fig. 1F-18 Insulated Brush Connection Test

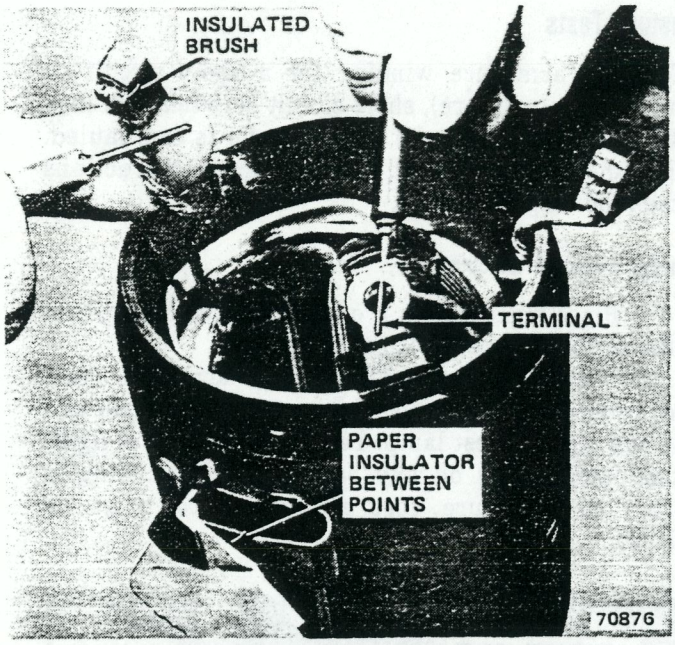


Fig. 1F-19 Terminal-To-Brush Continuity Test

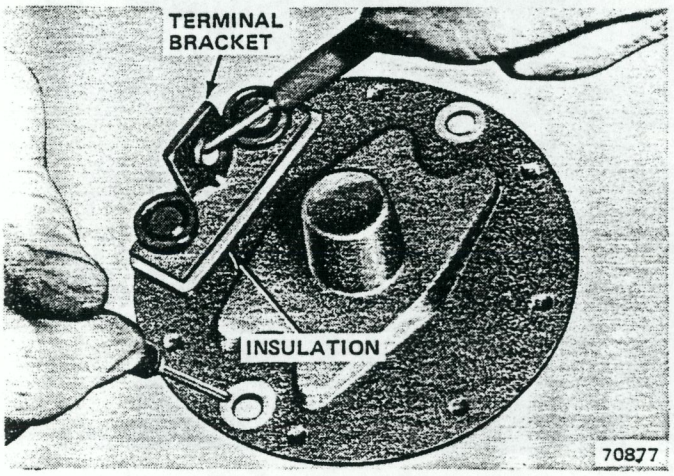


Fig. 1F-20 Terminal Bracket Insulation Test

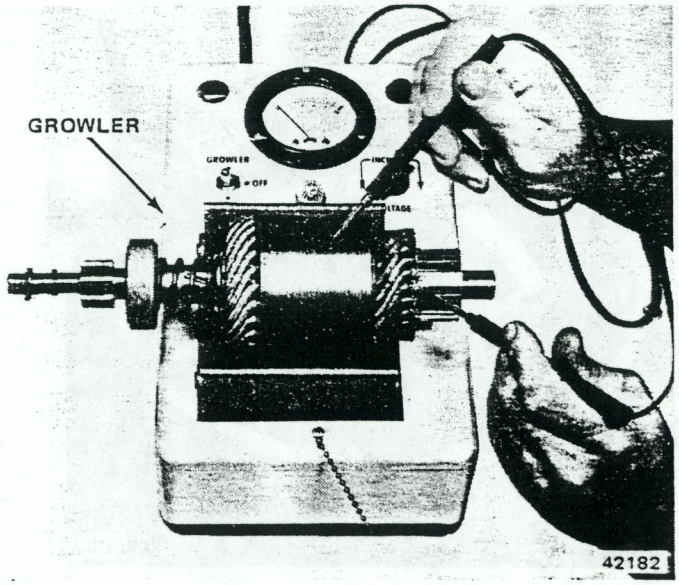


Fig. 1F-21 Grounded Armature Winding Test

Armature Winding Internal Short Test

CAUTION: *Never operate the growler in the growler test position without an armature in the jaws.*

(1) Place armature in growler jaws and turn power switch to GROWLER position (fig. 1F-22).

(2) Hold steel blade parallel to and touching armature core. Slowly rotate armature one or more revolutions in growler jaws. If steel blade vibrates at any area of core, winding is shorted at this area and armature must be replaced.

Armature Balance Test

(1) Place armature in growler jaws and turn power switch to GROWLER position (fig. 1F-23).

(2) Place contact fingers of meter test cable across adjacent commutator bars at side of commutator.

(3) Adjust voltage control until pointer indicates highest voltage on scale.

(4) Test each commutator bar with adjacent bar until all bars have been tested. Zero voltage indicates short circuit between commutator bars.

STARTER MOTOR REPLACEMENT

Removal

(1) Disconnect cable from starter motor terminal.

(2) Remove attaching screws and remove starter motor from flywheel (drive plate) housing.

Installation

(1) Position starter motor on flywheel (drive plate) housing.

NOTE: *Ensure mounting surfaces are free of burrs and debris.*

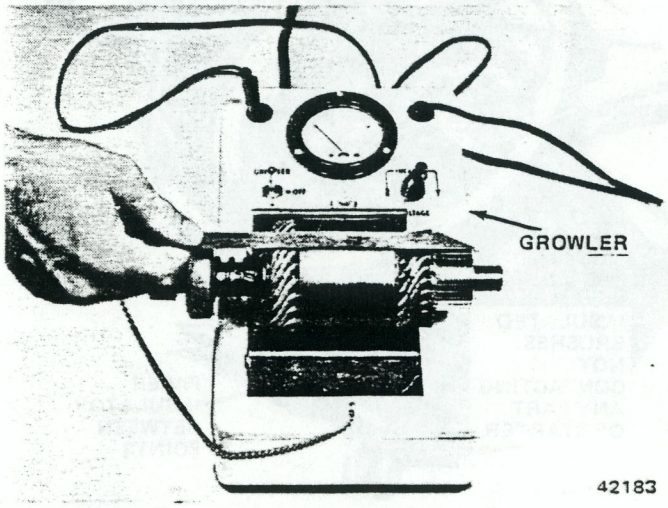


Fig. 1F-22 Armature Winding Internal Short Test

(2) Install mounting screws and tighten with 18 foot-pounds (24 N•m) torque.

(3) Clean terminal bracket on starter motor and terminal end of cable.

(4) Position cable on terminal bracket. Install screw and tighten with 55 inch-pounds (6 N•m) torque.

NOTE: *Initial torque may exceed this specification if the end plate is new. The terminal screw cuts threads in the terminal during installation.*

STARTER MOTOR OVERHAUL

Refer to figure 1F-24 for parts identification.

Disassembly

(1) Remove drive yoke cover and screw.

(2) Remove through-bolts and remove brush end plate.

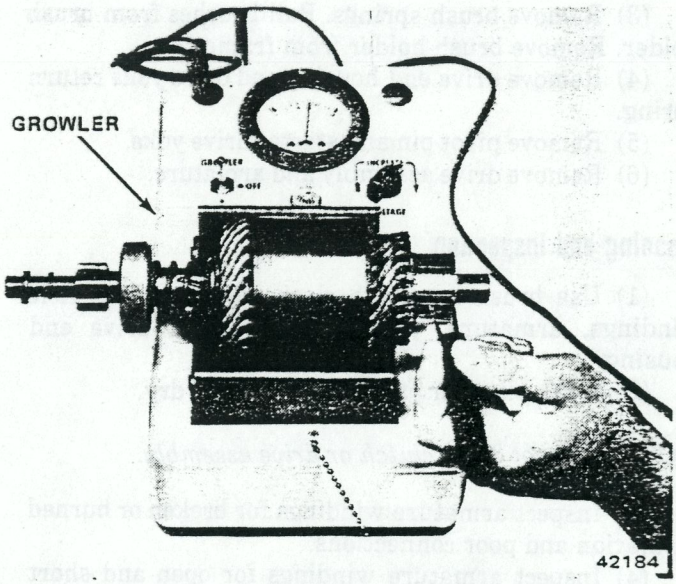


Fig. 1F-23 Armature Balance Test

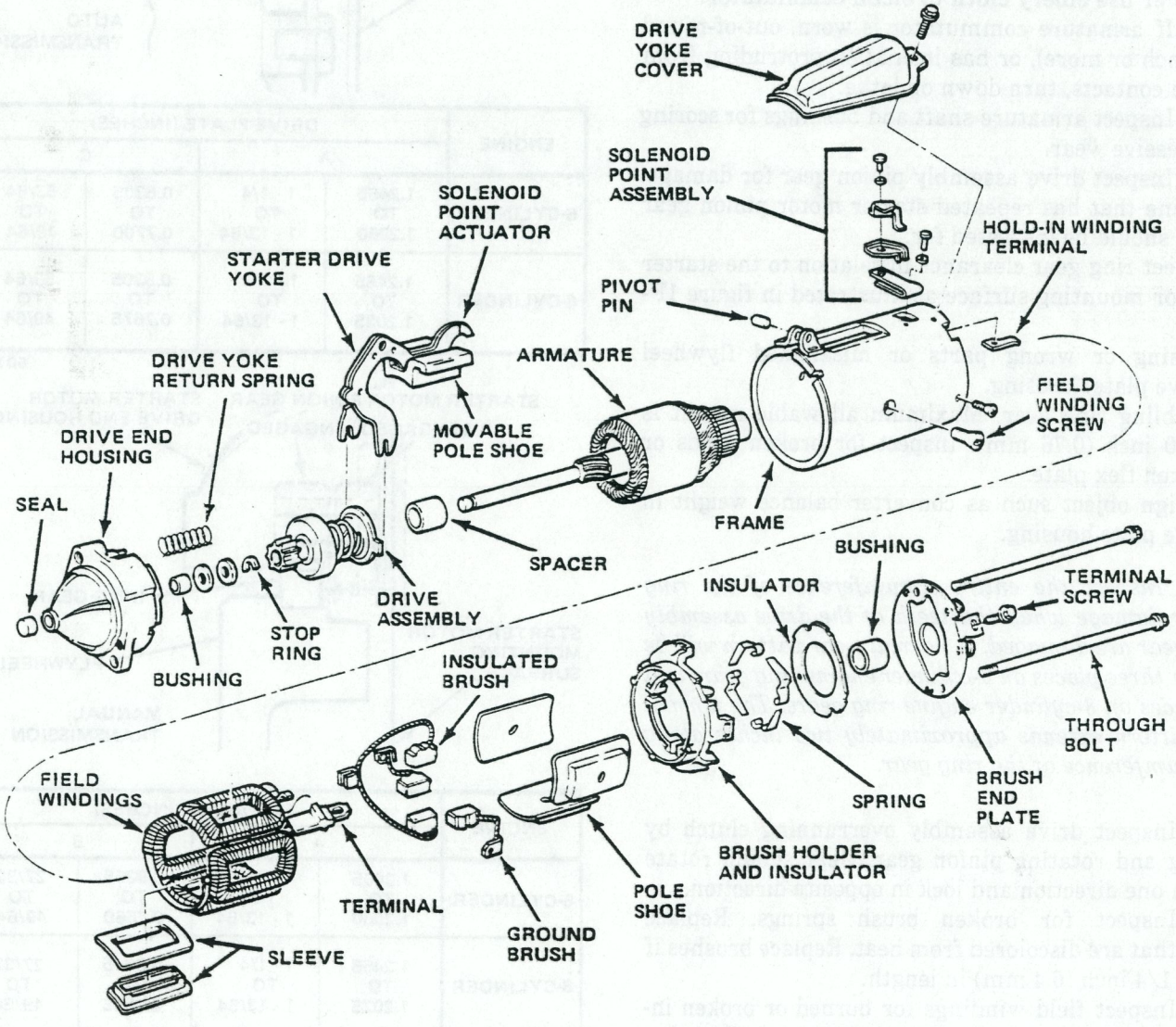


Fig. 1F-24 Parts Identification

(3) Remove brush springs. Pull brushes from brush holder. Remove brush holder from frame.

(4) Remove drive end housing and drive yoke return spring.

(5) Remove pivot pin and starter drive yoke.

(6) Remove drive assembly and armature.

Cleaning and Inspection

(1) Use brush or air to clean starter frame, field windings, armature, drive assembly and drive end housing.

(2) Wash all other parts in solvent and dry.

NOTE: *Do not wash clutch or drive assembly.*

(3) Inspect armature windings for broken or burned insulation and poor connections.

(4) Inspect armature windings for open and short circuits as outlined in Armature Tests.

(5) Clean dirty commutator with commutator paper. **Never use emery cloth to clean commutator.**

(6) If armature commutator is worn, out-of-round (0.005 inch or more), or has insulation protruding from between contacts, turn down on lathe.

(7) Inspect armature shaft and bushings for scoring and excessive wear.

(8) Inspect drive assembly pinion gear for damage. An engine that has repeated starter motor pinion gear failures should be inspected for:

- correct ring gear clearance in relation to the starter motor mounting surface as illustrated in figure 1F-25.
- missing or wrong parts or misaligned flywheel (drive plate) housing.
- wobbling ring gear. Maximum allowable runout is 0.030 inch (0.76 mm). Inspect for broken welds or broken flex plate.
- foreign object such as converter balance weight in drive plate housing.

NOTE: *Inspect the entire circumference of the ring gear for damage when the teeth of the drive assembly pinion gear are damaged. A normal wear pattern will be found in three places on 6-cylinder engine ring gears and four places on 8-cylinder engine ring gears. The normal wear pattern extends approximately two inches along the circumference of the ring gear.*

(9) Inspect drive assembly overrunning clutch by grasping and rotating pinion gear. Gear should rotate freely in one direction and lock in opposite direction.

(10) Inspect for broken brush springs. Replace springs that are discolored from heat. Replace brushes if worn to 1/4 inch (6.4 mm) in length.

(11) Inspect field windings for burned or broken insulation and for broken or loose connections. Examine field brush connections and wire insulation.

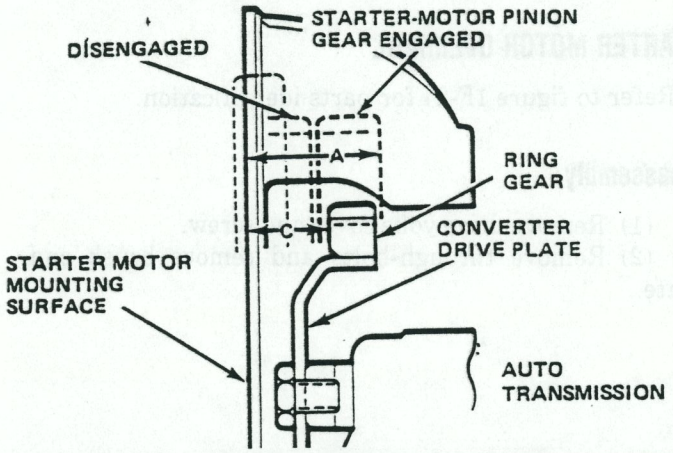
Field Winding Replacement

Remove armature and brush holder before proceeding with this procedure.

(1) Remove field winding screws using arbor press and Starter Pole Screw Wrench J-22516. Remove pole shoes.

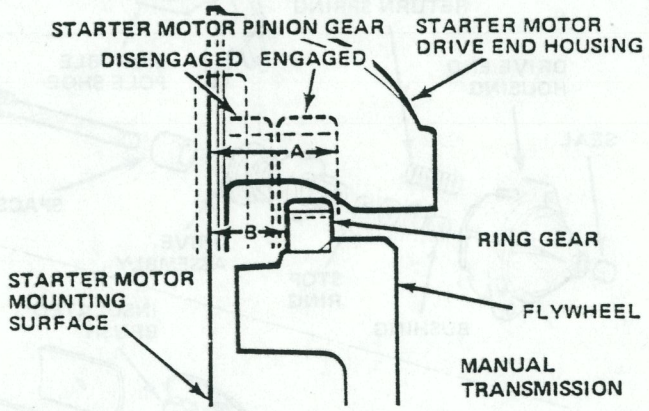
(2) Cut field winding strap as close as possible to solenoid point contact-to-field winding joint.

CAUTION: *Do not cut solenoid point contact.*



ENGINE	DRIVE PLATE (INCHES)			
	A		C	
6-CYLINDER	1.2465 TO 1.2060	1 - 1/4 TO 1 - 13/64	0.8305 TO 0.7700	53/64 TO 49/64
8-CYLINDER	1.2465 TO 1.2035	1 - 1/4 TO 1 - 13/64	0.8305 TO 0.7675	53/64 TO 49/64

60138



ENGINE	FLYWHEEL (INCHES)			
	A		B	
6-CYLINDER	1.2465 TO 1.2060	1 - 1/4 TO 1 - 13/64	0.8365 TO 0.7660	27/32 TO 49/64
8-CYLINDER	1.2465 TO 1.2035	1 - 1/4 TO 1 - 13/64	0.8365 TO 0.7635	27/32 TO 49/64

60137

Fig. 1F-25 Flywheel/Drive Plate-To-Ring Gear Clearance

(3) Cut hold-in winding wire at terminal strip.

(4) Straighten tabs of pull-down winding sleeve. Remove sleeve and flange.

(5) Remove field winding assembly from frame.

(6) Clean and tin surfaces of contact tab and field winding strap that are to be soldered.

(7) Install replacement field winding assembly in frame using original pole shoes and screws. Apply drop of Loctite or equivalent to screw threads. Tighten screws using arbor press and Starter Pole Screw Wrench J-22516.

(8) Install pull-down winding sleeve and flange. Have helper hold winding and sleeve assembly against frame while bending retaining tabs.

(9) Wrap hold-in winding wire around terminal strip and solder. Cut off excess wire.

(10) Solder field winding strap to contact strap. Use 600 watt soldering iron and rosin-core solder.

Solenoid Contact Point Assembly Replacement

Remove armature and brush holder before proceeding with this procedure.

(1) Cut upper contact as close as possible to contact point-to-field winding joint.

CAUTION: *Do not cut field winding strap.*

(2) Unsolder hold-in winding wire from terminal strip.

(3) Remove field winding screws using arbor press and Tool J-22516. Remove pole shoes.

(4) Cut rivets inside frame with chisel. Remove contact point assembly.

NOTE: *Ensure holes for second rivet are aligned before upsetting copper rivet.*

(5) Position replacement lower (movable) contact point on frame (fig. 1F-26). Position hold-in winding terminal strip inside frame. Insert *copper* rivet through contact, frame and terminal. Upset rivet.

NOTE: *Ensure upper contact point is positioned on shoulder of plastic insulator before upsetting rivet.*

(6) Install plastic insulator, upper contact point and fiber washer to remaining hole in frame. Insert *aluminum* rivet and upset.

(7) Install field winding assembly, pole shoes and screws. Apply a drop of Loctite or equivalent to each screw.

(8) Solder hold-in winding wire to terminal strip.

(9) Solder field winding strap to upper contact. Use 600 watt soldering iron and rosin-core solder.

Bushing Replacement

Drive End Bushing

(1) Support drive end housing and remove original bushing and seal.

(2) Install replacement bushing using armature and pinion as bushing driver. **Do not** install drive end housing seal at this time.

Commutator End Bushing

(1) Carefully remove original bushing with chisel.

(2) Drive replacement bushing into end plate until seated, using suitable socket or bushing driver.

Drive Assembly Replacement

(1) Pry stop ring off and remove starter motor drive assembly from armature shaft.

(2) Apply grease to armature shaft and end bushings. Service replacement drive assembly is prelubricated.

(3) Apply thin coating of Lubriplate or equivalent on armature shaft splines.

(4) When installing drive assembly, examine snap ring for tight fit on shaft. Slide drive assembly over shaft and install stop ring and original retainer.

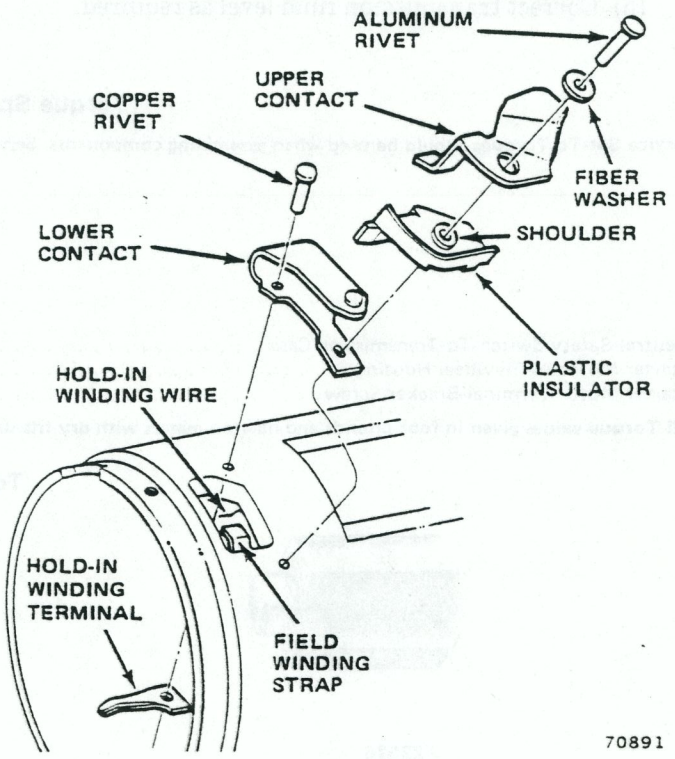


Fig. 1F-26 Solenoid Contact Points Replacement

Assembly

(1) Insert armature into frame. Install drive yoke and pivot pin. Drive yoke must engage lugs on drive assembly.

(2) Insert drive yoke return spring into recess in drive housing. Join housing to frame.

(3) Install brush holder. Ensure depression in holder aligns with rubber boot on terminal.

(4) Insert brushes into brush holder. Refer to figure 1F-27 for proper wire routing. Install brush springs.

(5) Install end plate. Align hole in terminal with hole in terminal bracket.

(6) Install through-bolts.

(7) Depress movable pole shoe and adjust contact point clearance by bending upper contact as required. Refer to Specifications.

(8) Install drive yoke cover and screw.

NEUTRAL SAFETY SWITCH REPLACEMENT

(1) Disconnect wiring connector and remove switch from transmission. Allow fluid to drain into container.

(2) Move selector lever to Park and Neutral positions. Inspect switch operating lever fingers to ensure they are properly centered in switch opening.

(3) Install switch and seal on transmission case. Tighten switch with 24 foot-pounds (6 N•m) torque.

(4) Test switch continuity.

(5) Correct transmission fluid level as required.

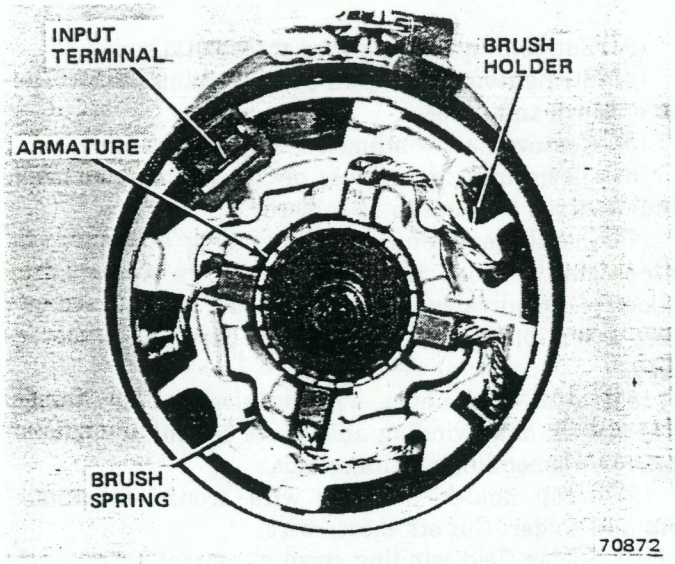


Fig. 1F-27 Brush Wire Routing

SPECIFICATIONS

Six- and Eight-Cylinder Engine Starter Motor Specifications

Usage	ALL
Brush Length	0.5 in. (12.7 mm)
Wear Limit	0.25 in. (6.35 mm)
No-Load Test (Free Speed)	
Volts	12
Amps	77
Min. RPM	8900
Max. RPM	9600
Contact Point Clearance	0.100-0.020 in. (2.5-0.5 mm)
	0.060 (1.5 mm) preferred

70878

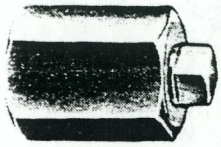
Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

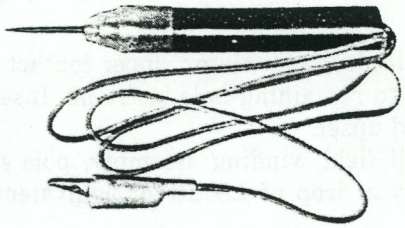
	USA (ft-lbs)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Neutral Safety Switch-To-Transmission Case	17	14-21	23	19-28
Starter Motor-to-Flywheel Housing	18	13-25	24	18-34
Starter Motor Terminal Bracket Screw	55 in-lbs	40-70 in-lbs	6	4.5-8

All Torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

Tools



J-22516
STARTER POLE
SCREW WRENCH



J-21008
CONTINUITY
TEST LAMP

70112

IGNITION SYSTEMS 1G

SECTION INDEX

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Four-Cylinder Engine Ignition System	1G-1	Spark Control Systems	1G-28
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FOUR-CYLINDER ENGINE IGNITION SYSTEM

	Page		Page
Diagnosis	1G-4	On-Vehicle Service	1G-4
General	1G-1	Specifications	1G-9
HEI System Components	1G-1		

GENERAL

The four-cylinder engine High Energy Ignition (HEI) System consists of the battery, the distributor with integral electronic module, the ignition switch, the spark plugs, and the primary and secondary wiring. Refer to Chapter 1D—Batteries for battery information.

HEI SYSTEM COMPONENTS

Distributor

The High Energy Ignition System distributor combines all ignition components into one unit (fig. 1G-1 and 1G-2). The external connections are for the ignition switch, tachometer, and spark plugs. The ignition switch terminal at the distributor has full battery voltage applied when the ignition switch is in the RUN and START positions. There is no ballast resistor or resistance wire between the switch and distributor.

The ignition coil is located in the distributor cap and connects to the rotor through a resistance brush.

The High Energy Ignition System functions basically the same as a conventional ignition system, but the electronic module and pick-up coil replace the contact points.

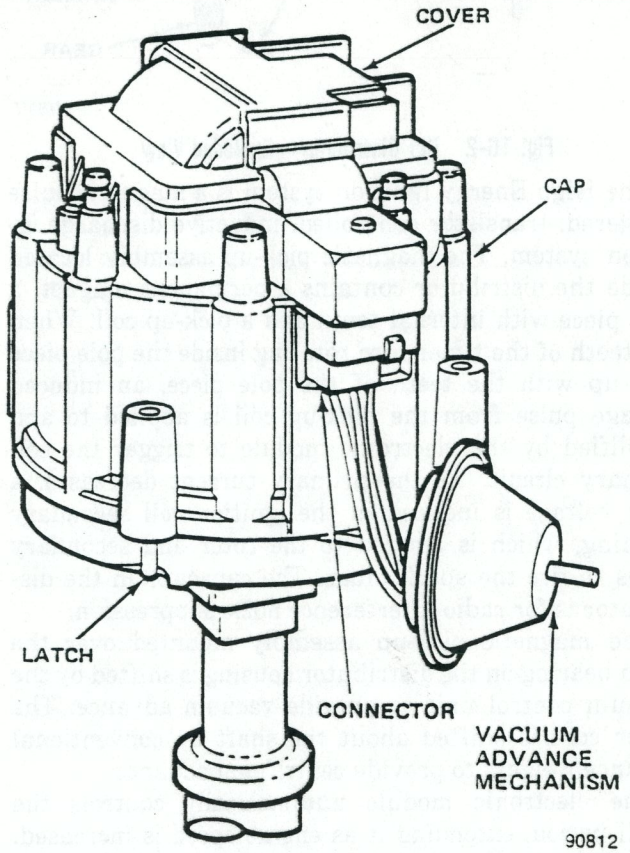


Fig. 1G-1 HEI Distributor

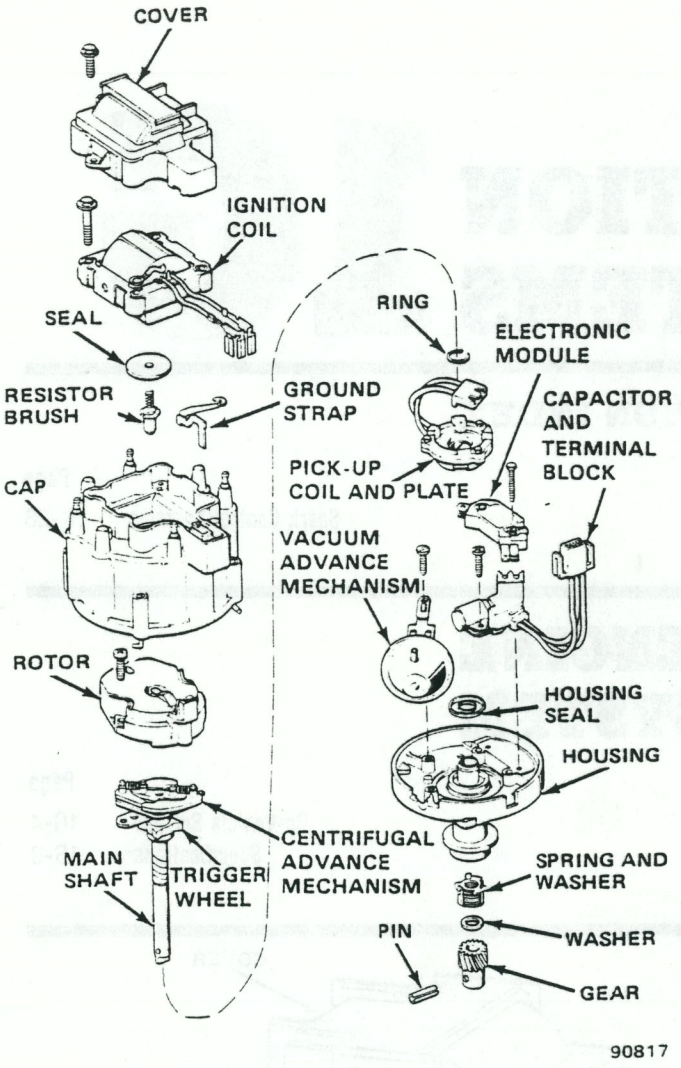


Fig. 1G-2 HEI Distributor—Exploded View

The High Energy Ignition system is a magnetic pulse triggered, transistor controlled, inductive discharge ignition system. The magnetic pick-up assembly located inside the distributor contains a permanent magnet, a pole piece with internal teeth and a pick-up coil. When the teeth of the timer core rotating inside the pole piece line up with the teeth of the pole piece, an induced voltage pulse from the pick-up coil is applied to and amplified by the electronic module to trigger the coil primary circuit. As the primary current decreases, a high voltage is induced in the ignition coil secondary winding, which is applied to the rotor and secondary wires to fire the spark plugs. The capacitor in the distributor is for radio interference noise suppression.

The magnetic pick-up assembly mounted over the main bearing on the distributor housing is shifted by the vacuum control unit to provide vacuum advance. The timer core is shifted about the shaft by conventional advance weights to provide centrifugal advance.

The electronic module automatically controls the dwell period, extending it as engine speed is increased. The HEI system also features a longer spark duration that is made possible by the increased amount of electromagnetic energy stored in the coil primary. This is desirable for igniting lean mixtures.

No periodic lubrication is required. Engine oil lubricates the lower bushing and an oil-filled reservoir provides lubrication for the upper bushing.

NOTE: *When conducting cylinder compression tests, disconnect ignition switch connecting wire (yellow) from HEI system.*

Ignition Timing

Timing specifications are listed in Chapter 1A—General Service and Diagnosis and on the Emission Control Information label located in the engine compartment. When using a timing light, connect an adapter between the No. 1 spark plug and the No. 1 spark plug wire, or use a light with an inductive type pick-up. **Do not pierce the spark plug wire.** Once the insulation of a spark plug wire has been broken, the high voltage will cause arcing to the nearest ground, and the spark plug will not fire properly. Always refer to the Emission Control Information label when adjusting the timing. Refer to figure 1G-3 when loosening the distributor holddown clamp.

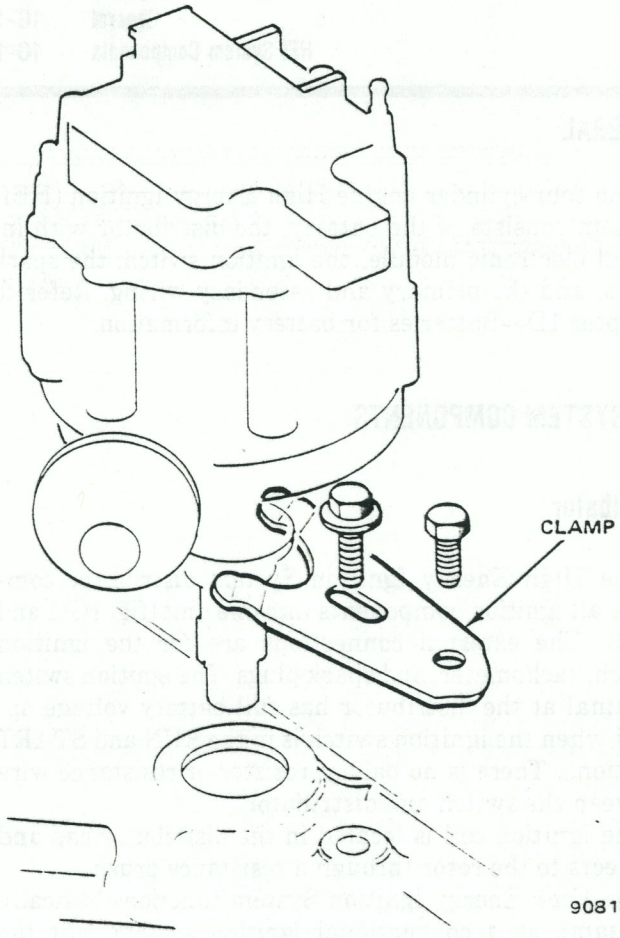


Fig. 1G-3 Distributor Holddown Clamp

A magnetic timing probe socket is located on the timing gear cover for use with special electronic timing equipment. Figure 1G-4 depicts the typical magnetic timing probe socket. Consult the manufacturer's instructions for use of this type equipment.

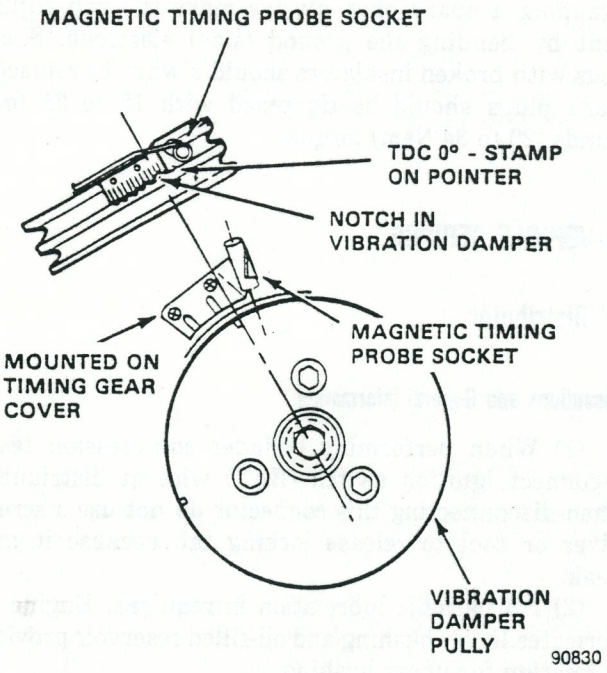


Fig. 1G-4 Magnetic Timing Probe Socket and Timing Degree Scale

Secondary Wiring

The spark plug wiring used with the HEI system is a carbon impregnated cord conductor encased in an 0.3125-inch (8 mm) diameter silicone rubber jacket. The silicone rubber jacket will withstand very high temperatures and also provides an excellent insulator for the higher voltage provided by the HEI system. The silicone rubber spark plug boots form a tight seal around the plug. **The boot should be twisted 1/2 turn before removing.** Care should also be exercised when connecting a timing light or other test equipment. Do not force anything between the boot and wiring or through the silicone rubber jacket. Connections should be made in parallel using an adapter. DO NOT pull on the wire to remove. Pull on the boot or use a tool designed for this purpose.

Spark Plugs

Resistor type, tapered seat spark plugs are used (fig. 1G-5). No gasket is used with tapered seat plugs. Refer to figure 1G-6 for an explanation of the spark plug code.

Refer to the Tune-Up Specifications listed in Chapter 1A for spark plug application and gap sizes. Always replace plugs with the correct plug type listed in the tune-up specifications.

Normal engine operation is usually a combination of idling, slow-speed, and high-speed driving. Occasional

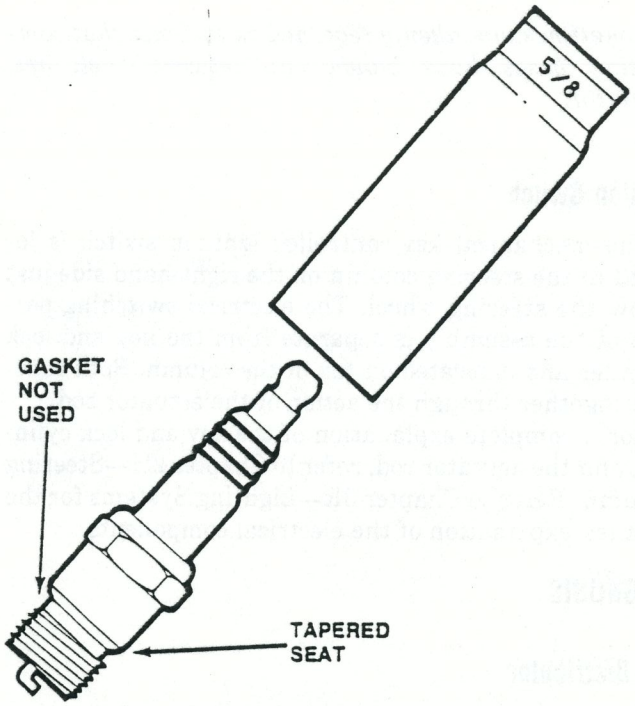
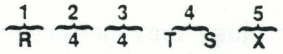


Fig. 1G-5 Tapered Seat Spark Plug



1 — R-INDICATES RESISTOR-TYPE PLUG.
2 — 4-INDICATES 14 mm THREADS.
3 — 4-HEAT RANGE.
4 — T-TAPERED SEAT.
S-EXTENDED TIP
5 — X-SPECIAL GAP.

90831

Fig. 1G-6 Spark Plug Code

high-speed driving is needed for good spark plug performance because it provides increased combustion heat that burns away deposits of carbon or oxide that have built up from frequent idling or continual stop-and-go driving.

The spark plugs are protected by insulating boots made of special heat-resistant silicone rubber that covers the spark plug terminal and extends downward over a portion of the porcelain insulator. These boots prevent arcing, which causes engine misfire. The dirt film that builds up on the exposed portion of the plug will not cause arcing.

NOTE: *Do not mistake corona discharge for arcing or as the result of a shorted insulator. Corona is a steady blue light haze appearing around the insulator, just above the shell crimp. It is the visible evidence of a high electrostatic voltage field and has no effect on ignition performance. Usually it can be detected only in darkness. This discharge may repel dust particles and leave a clear ring on the insulator just above the shell. This ring*

is sometimes mistakenly regarded as evidence that combustion gases have blown out between shell and insulator.

Ignition Switch

The mechanical key-controlled ignition switch is located in the steering column on the right-hand side just below the steering wheel. The electrical switching portion of the assembly is separate from the key and lock cylinder and is located on top of the column. Both function together through the action of the actuator rod.

For a complete explanation of the key and lock cylinder, and the actuator rod, refer to Chapter 2H—Steering Column. Refer to Chapter 3R—Lighting Systems for the detailed explanation of the electrical components.

DIAGNOSIS

HEI Distributor

Refer to Ignition System Troubleshooting Chart.

Spark Plugs

Faulty or dirty plugs may perform well at idling speed, but at higher speeds they frequently fail. Faulty plugs are identified in a number of ways: poor fuel economy, power loss, loss of speed, hard starting and, in general, poor engine performance.

Spark plugs may also fail because of carbon fouling, excessive gap, or a broken insulator.

Fouled plugs may be verified by inspecting for black carbon deposits. The black deposits are usually the result of slow-speed driving when sufficient engine operating temperature is seldom reached. Worn pistons and rings, faulty ignition, an over-rich air/fuel mixture and the use of spark plugs with too low of a heat range will also result in carbon deposits.

Excessive gap wear, on plugs with low mileage, indicates that the engine has been operating at high speeds continuously or with loads that are greater than normal, or that plugs that have too high of a heat range are being used. Electrode wear may also be the result of the plug being overheated. This can be caused by combustion gases leaking past the threads because of insufficient tightening of the spark plug. An excessively lean air/fuel mixture will also result in abnormal electrode wear.

A broken lower insulator is usually the result of improper installation or carelessness when regapping the plug. Broken upper insulators usually result from a poor fitting wrench or an outside blow. A cracked insulator may not be evident immediately, but will as soon as oil or moisture penetrates the crack. The crack will usually be located just below the crimped part of the shell and may not be visible.

Broken lower insulators usually result from carelessness when regapping and are generally visible. This type of break may also result from the plug operating too "hot," which may occur during periods of extended high-speed operation or with heavy engine loads. When regapping a spark plug, always make the gap adjustment by bending the ground (side) electrode. Spark plugs with broken insulators should always be replaced. Spark plugs should be tightened with 15 to 25 foot-pounds (20 to 34 N•m) torque.

ON-VEHICLE SERVICE

HEI Distributor

Precautions and General Information

(1) When performing cylinder compression tests, disconnect ignition switch (BAT) wire at distributor. When disconnecting this connector **do not** use a screwdriver or tool to release locking tab because it may break.

(2) No periodic lubrication is required. Engine oil lubricates lower bushing and oil-filled reservoir provides lubrication for upper bushing.

(3) Tachometer (TACH) terminal is located next to ignition switch (BAT) connector on distributor cap.

CAUTION: *The tachometer terminal must NEVER be connected to ground because damage to the electronic module and/or ignition coil can result.*

NOTE: *Some tachometers currently in use may NOT be compatible with the High Energy Ignition System. Consult the manufacturer of the tachometer if unsure.*

(4) Dwell is controlled by electronic module and cannot be manually adjusted.

(5) Centrifugal advance and vacuum advance mechanisms are similar to those used with conventional ignition systems.

(6) Insulating jacket material used to construct spark plug wires is very soft. It will withstand more heat and higher voltage, but is more susceptible to chafing and cutting. Spark plug wires must be routed correctly to prevent chafing or cutting. Refer to Spark Plug Wires. When removing spark plug wire from spark plug, twist boot on spark plug and pull **on boot** to remove wire, or use special tool designed to remove spark plug boots.

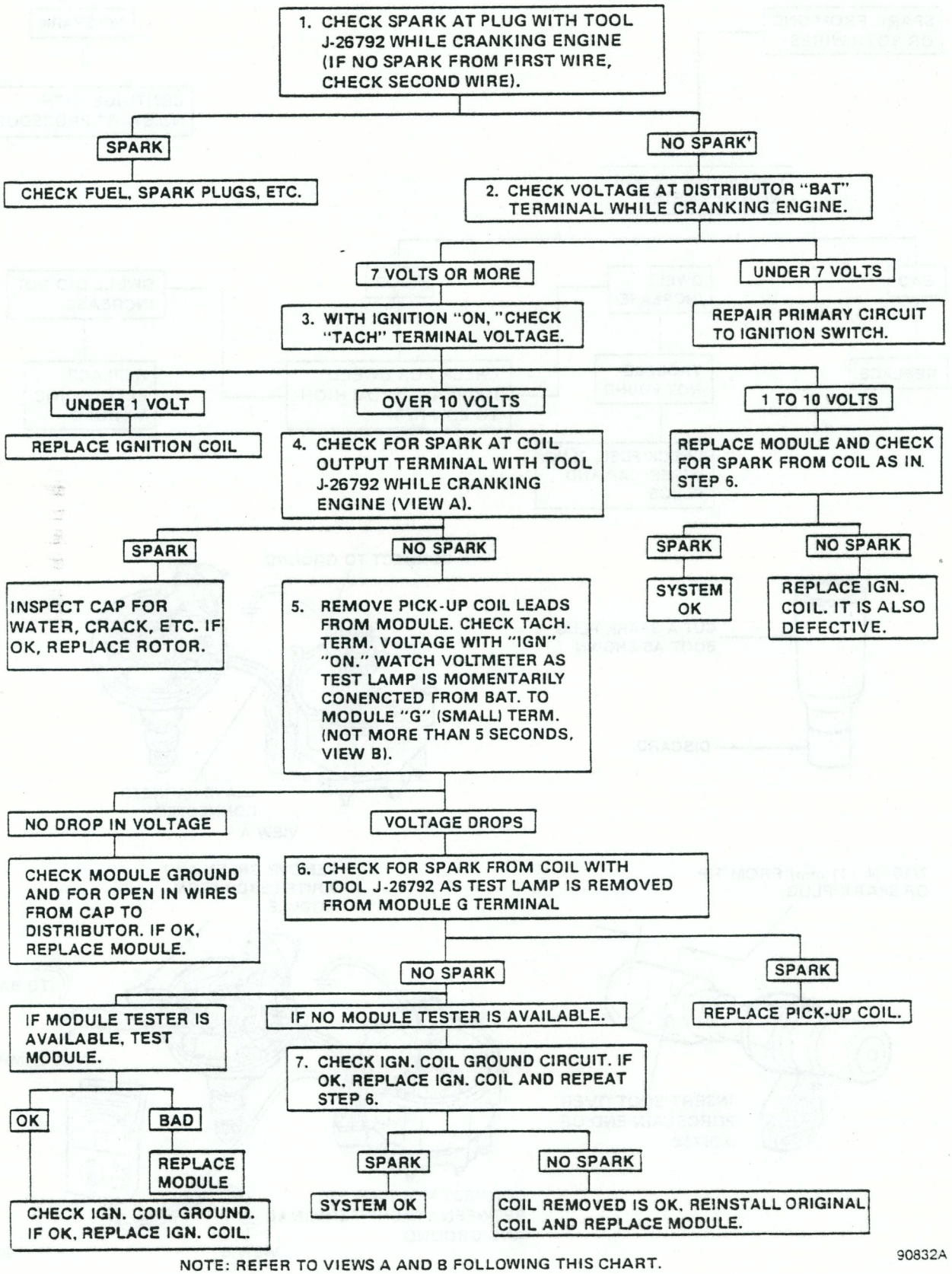
Replacement

(1) Disconnect ignition switch battery wire and tachometer connector, if equipped, from distributor cap. Also, release coil connectors from cap.

Ignition System Troubleshooting

ENGINE CRANKS, BUT WILL NOT START

NOTE: IF A TACHOMETER IS CONNECTED TO THE TACHOMETER TERMINAL, DISCONNECT IT BEFORE PROCEEDING WITH THE TEST.



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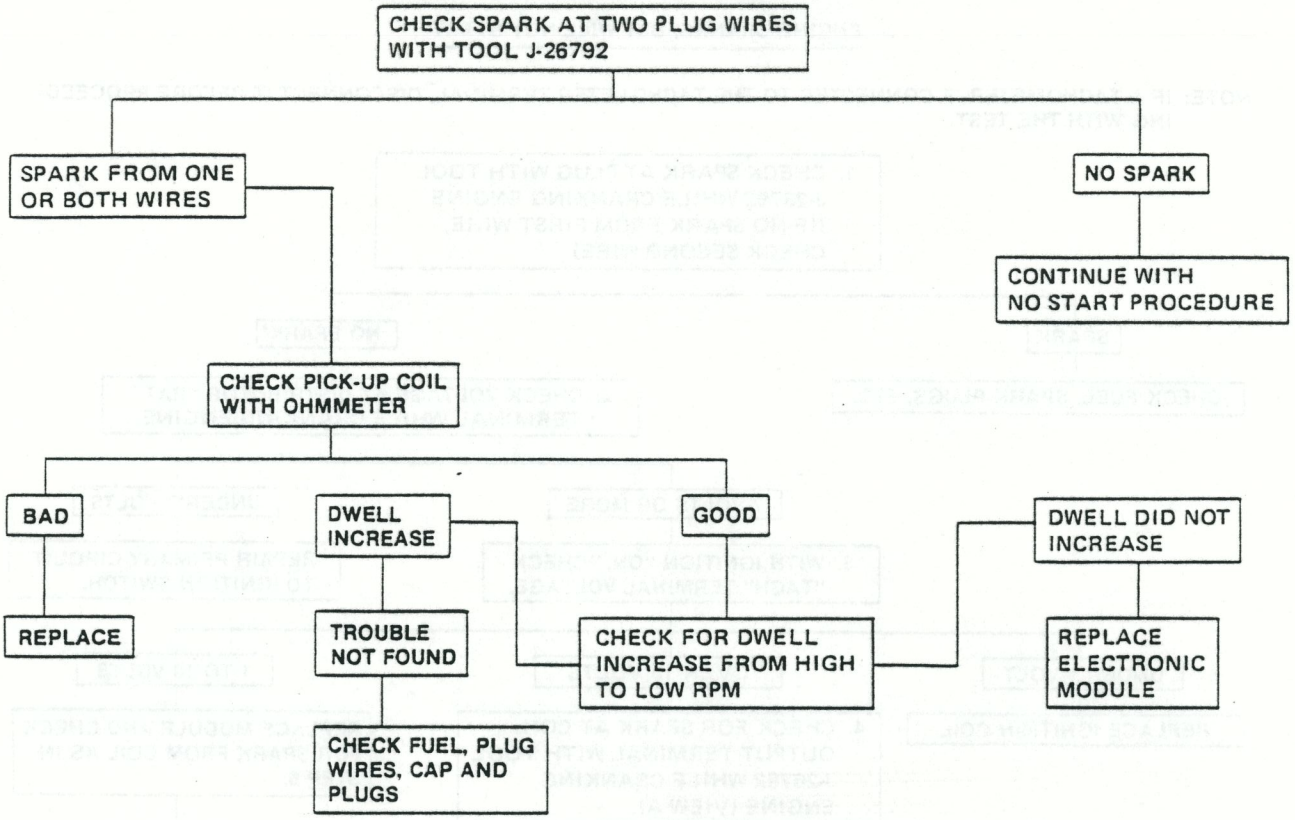
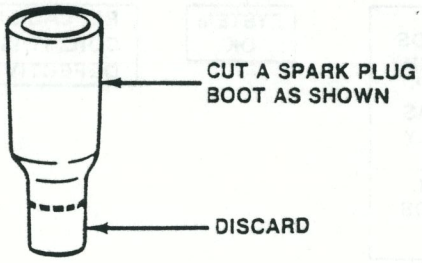
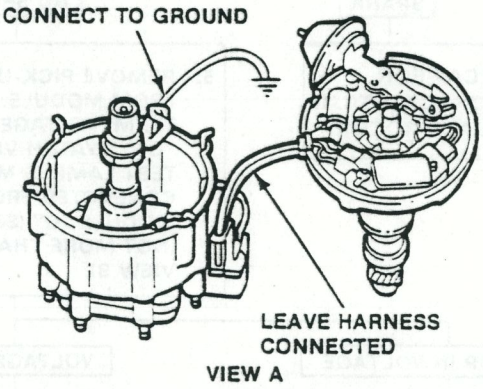
NOTE: REFER TO VIEWS A AND B FOLLOWING THIS CHART.

Ignition System Troubleshooting

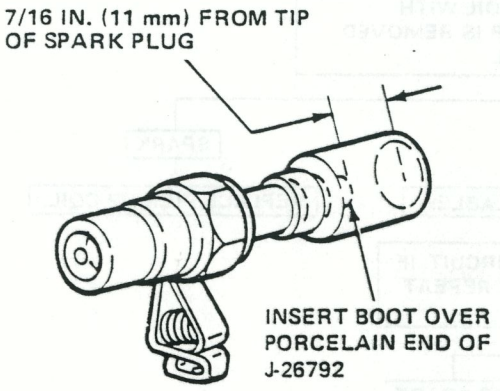
INTERMITTENT OPERATION OR MISFIRE

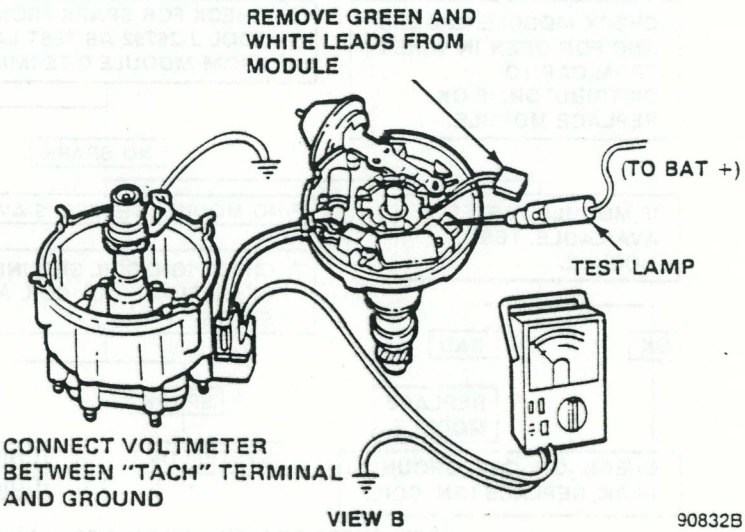






VIEW A





VIEW B

90832B

(2) Remove distributor cap by turning four latches counterclockwise (requires "stubby" screwdriver). Move cap out of way.

(3) Remove vacuum hose from vacuum advance unit.

(4) Remove distributor holddown clamp bolt and clamp (fig. 1G-3).

(5) Note position of rotor, then pull distributor up until rotor stops turning counterclockwise and again note position of rotor.

NOTE: *To ensure correct timing of the distributor, the distributor must be INSTALLED with the rotor correctly positioned as noted above.*

(6) If engine was accidentally cranked after distributor was removed, following procedure can be used for installing distributor:

(a) Remove No. 1 spark plug.

(b) Place finger over No. 1 spark plug hole and crank engine slowly until compression is felt.

(c) Align timing mark on vibration damper at 0° on graduated degree scale on timing gear cover.

(d) Turn rotor to point between No. 1 and No. 3 spark plug towers on distributor cap.

(e) Install distributor cap and spark plug wires.

(f) Install distributor and connect ignition switch wire and tachometer wire, if equipped.

(g) Check engine timing (refer to Ignition Timing).

Rotor

Replacement

(1) Remove distributor cap as described in Distributor Replacement.

(2) Remove rotor. Rotor is retained by two screws and has a slot that fits over square lug on advance weight base so that rotor can be installed in only one position.

Electronic Module

It is not necessary to remove the distributor from the engine to replace the module. Refer to figure 1G-7.

Replacement

(1) Remove distributor cap and rotor.

(2) Remove two module attaching screws and lift module up.

(3) Disconnect two pick-up coil wires from module. (Observe wire colors because they must not be interchanged.) Disconnect harness connector.

(4) Do not wipe grease from module or distributor base if same module is to be installed. If replacement module is to be installed, package of silicone grease will be included with it. Spread grease on metal face of module and on distributor base where module seats. This grease is necessary for module cooling.

(5) To install, reverse removal procedure.

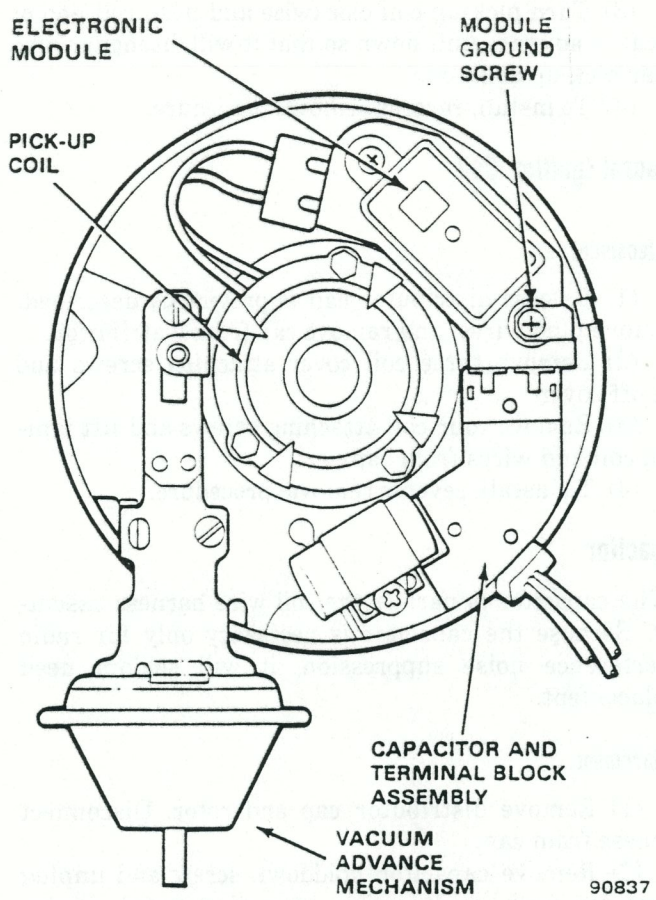


Fig. 1G-7 Distributor Base and Components

Pick-Up Coil

Replacement

(1) Remove distributor from engine. Mark distributor shaft and gear so that they may be reassembled in same position (refer to Distributor Replacement).

(2) Drive out roll pin and remove gear.

(3) Remove distributor shaft with rotor and advance weights.

(4) Remove thin "C" washer on top of pick-up coil assembly, remove pick-up coil wires from module, and remove pick-up coil assembly. Do not remove three screws.

(5) To install, reverse removal procedure. Note alignment marks when installing gear.

Vacuum Advance Unit

Replacement

(1) Remove distributor cap and rotor as previously described.

(2) Remove two vacuum advance unit attaching screws.

(3) Turn pick-up coil clockwise and push rod end of vacuum advance unit down so that it will disengage and clear pick-up coil plate.

(4) To install, reverse removal procedure.

Integral Ignition Coil

Replacement

(1) Release distributor cap as previously described. Remove plug wires, and remove cap from distributor.

(2) Remove three coil cover attaching screws and lift off cover.

(3) Remove four coil attaching screws and lift ignition coil and wires from cap.

(4) To install, reverse removal procedure.

Capacitor

The capacitor is part of the coil wire harness assembly. Because the capacitor is necessary only for radio interference noise suppression, it will seldom need replacement.

Replacement

(1) Remove distributor cap and rotor. Disconnect harness from cap.

(2) Remove capacitor holddown screw and unplug connector from module. For ease of removal, loosen module screws.

(3) To install, reverse procedure above. Ensure attaching screw is inserted through ground tab.

Ignition Timing

(1) Refer to Emission Control Information label located in engine compartment and use specifications listed on label.

(2) With ignition off, connect timing light to No. 1 spark plug. Install jumper wire between spark plug wire and spark plug or use timing light with inductive type pick-up. **DO NOT** pierce spark plug wire or attempt to insert jumper wire between boot and spark plug wire. Connect timing light power terminals according to manufacturer's instructions.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(3) Start engine and aim timing light at timing degree scale. Index on vibration damper will line up with one timing degree mark. If change is necessary, loosen distributor holddown clamp bolt at base of distributor (fig. 1G-3). While observing scale with timing light, slightly rotate distributor until index aligns with correct timing degree mark. Tighten holddown bolt and recheck timing.

(4) Turn off engine and remove timing light. Reconnect No. 1 spark plug wire, if removed.

Spark Plug Wires

Use care when removing spark plug wire boots from spark plugs. Twist the boot 1/2 turn before removing and pull on the **boot only** to remove the wire.

When replacing spark plug wires, route the wires correctly and secure in the proper retainers. Failure to route the wires properly can cause radio to have ignition noise, crossfiring of the plugs or short circuit the wires to ground.

Refer to figure 1G-8 for correct spark plug wire routing.

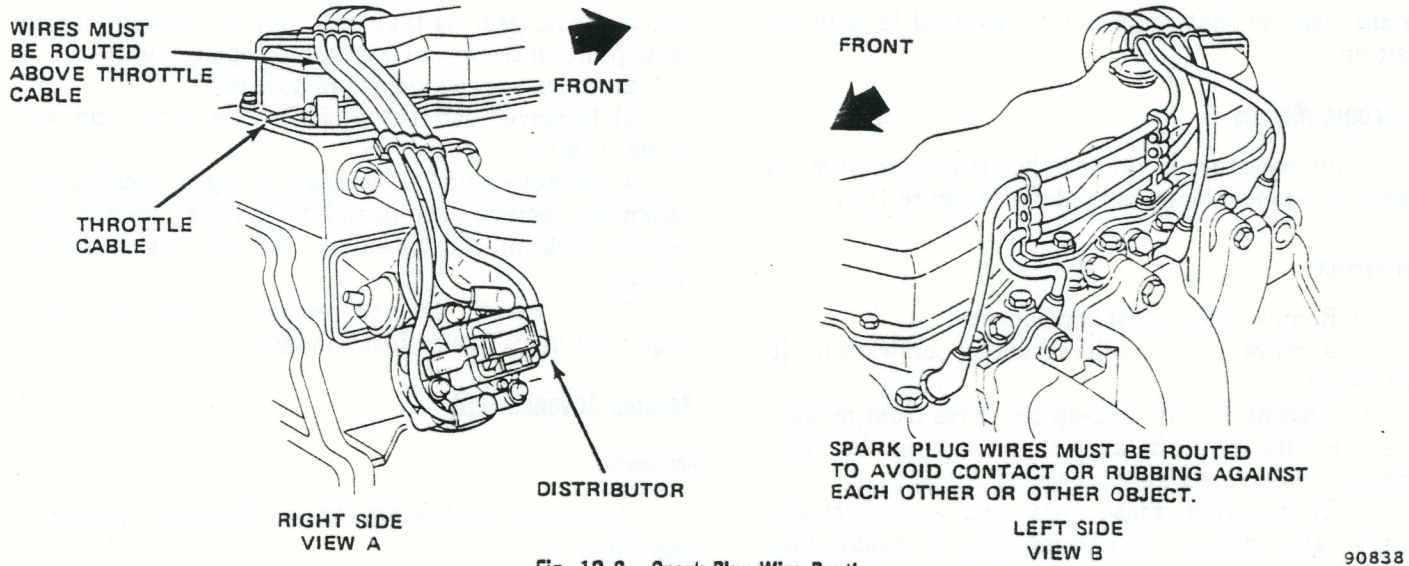
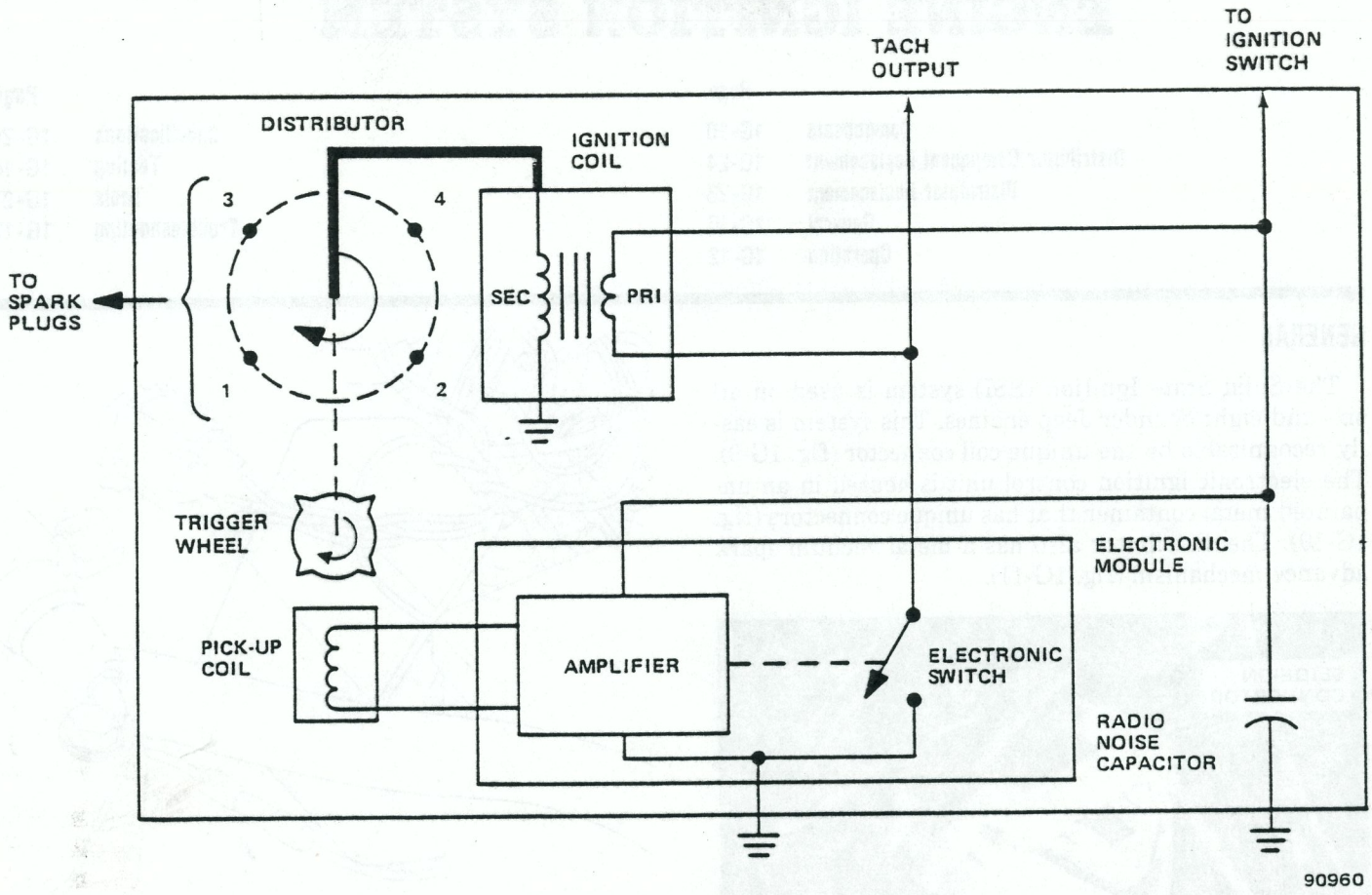


Fig. 1G-8 Spark Plug Wire Routing

SPECIFICATIONS



HEI System Schematic

Distributor and Coil Specifications

Distributor Pick-Up Coil Resistance	500 to 1500 ohms
Coil	
Primary Resistance	Zero or nearly zero on Low Scale
Secondary Resistance	Less than infinite on High Scale

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Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft-lbs)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Distributor Clamp Screw	17	15-20	23	20-27
Spark Plugs	20	15-25	27	20-34

All Torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

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SIX- AND EIGHT-CYLINDER ENGINE IGNITION SYSTEM

	Page		Page
Components	1G-10	Specifications	1G-26
Distributor Component Replacement	1G-24	Testing	1G-16
Distributor Replacement	1G-23	Tools	1G-27
General	1G-10	Troubleshooting	1G-12
Operation	1G-12		

GENERAL

The Solid State Ignition (SSI) system is used on all six- and eight-cylinder Jeep engines. This system is easily recognizable by the unique coil connector (fig. 1G-9). The electronic ignition control unit is housed in an unpainted metal container that has unique connectors (fig. 1G-10). The distributor also has a metal vacuum spark advance mechanism (fig. 1G-11).

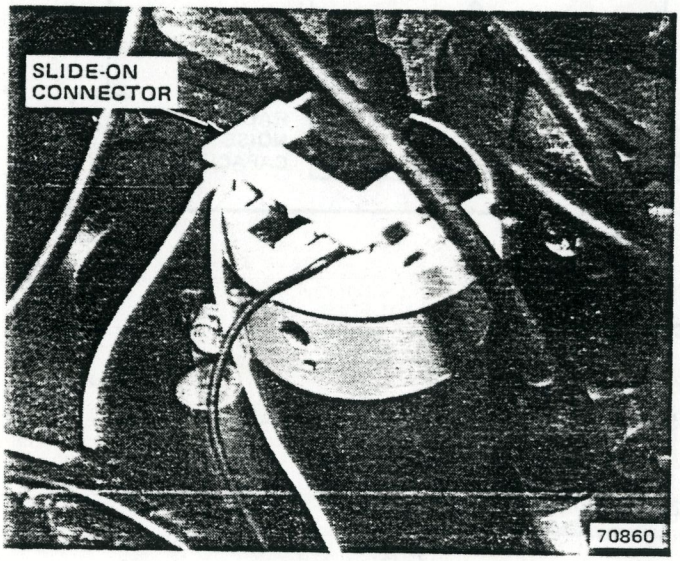

Fig. 1G-9 Coil Connector

COMPONENTS

The SSI system consists of the following major components: ignition switch, electronic ignition control unit, ignition coil, primary resistance wire and bypass, distributor, secondary wires and spark plugs.

NOTE: *When disconnecting SSI system connectors, pull apart with firm, straight pull. Do not attempt to pry apart with a screwdriver. When connecting, press together firmly to overcome hydraulic pressure caused by the grease.*

NOTE: *If connector locking tabs weaken or break off, do not replace associated component. Bind connectors together with tape or harness tie strap to assure good electrical connection.*

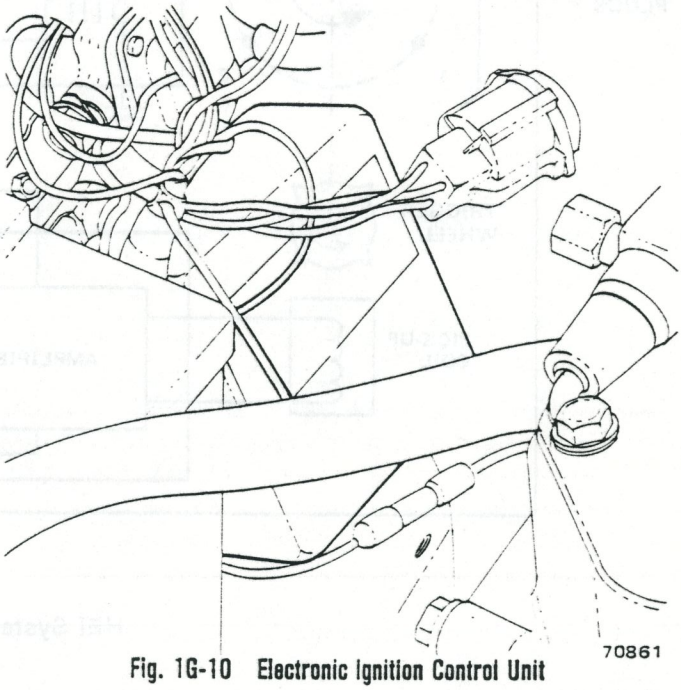

Fig. 1G-10 Electronic Ignition Control Unit

Electronic Ignition Control Unit

The electronic ignition control unit is a solid-state, moisture-resistant module. The component parts are permanently sealed in a potting material to resist vibration and adverse environmental conditions. All connections are weatherproof. The control unit also incorporates reverse polarity and transient voltage protection.

NOTE: *The unit is not repairable and must be replaced as a unit if service is required.*

Ignition Coil

The ignition coil is oil-filled and hermetically sealed (standard construction). The coil has two windings wound on a soft iron core. The primary winding consists of comparatively few turns of heavy gauge wire. The secondary winding consists of many turns of fine gauge wire.

The function of the ignition coil in the SSI system is to transform battery voltage applied to the primary winding to high voltage for the secondary circuit.

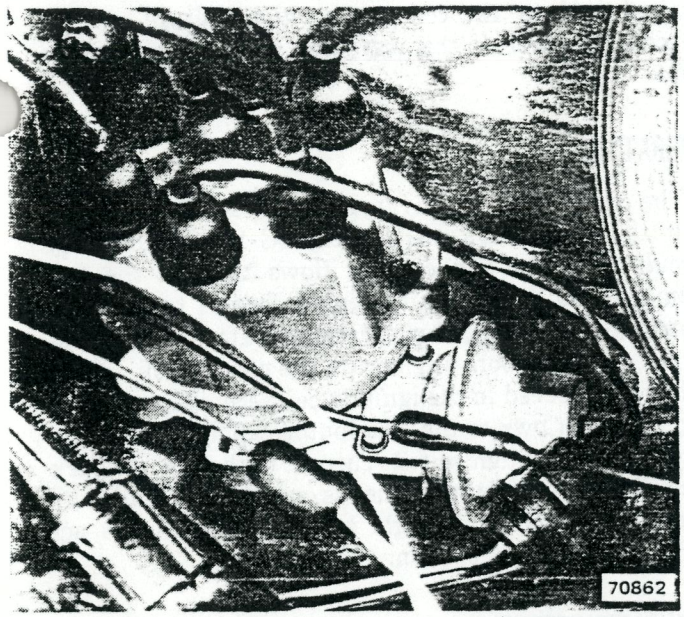

Fig. 1G-11 Distributor Vacuum Spark Advance Mechanism

The ignition coil does not require special service other than maintaining the terminals and connectors clean and tight.

When an ignition coil is suspected of being defective, test it on the vehicle. A coil may break down after the engine has heated it to a high temperature. *It is important that the coil be at operating temperature when tested.* Perform the test according to the test equipment manufacturer's instructions.

Coil Connector

The coil terminals and coil connector are of unique design (fig. 1G-9). The connector is removed from the coil by grasping both sides and pulling connector away from coil (fig. 1G-12).

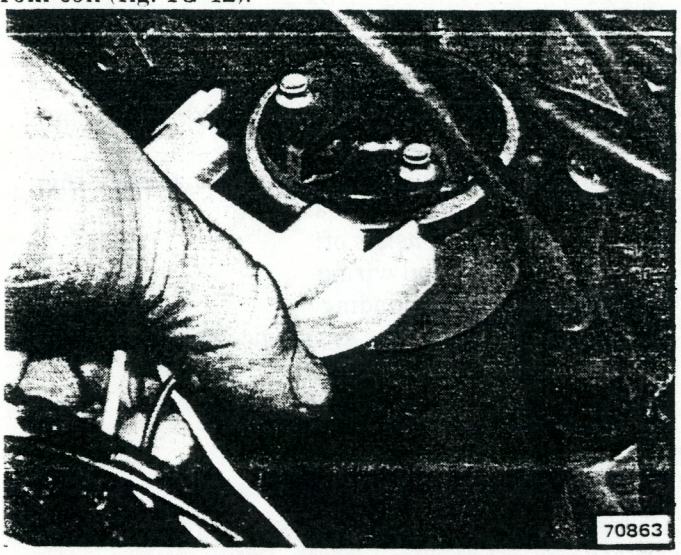

Fig. 1G-12 Removing Coil Connector

When a tachometer is required for engine testing or tune-up, connect it using an alligator jaw type connector as illustrated in figure 1G-13.

Resistance Wire

A wire having 1.35 ± 0.05 ohms resistance is provided in the ignition wiring to supply less than full battery voltage to the coil after the starter motor solenoid is deenergized. During engine starting, the resistance wire is bypassed and full battery voltage is applied to the coil. The bypass is accomplished at the I-terminal on the starter motor solenoid. The bypass switch is energized only while the starter motor circuit is in operation.

Distributor

The distributor consists of three groups of components: pick-up coil and trigger wheel, spark advance assembly, and cap and rotor.

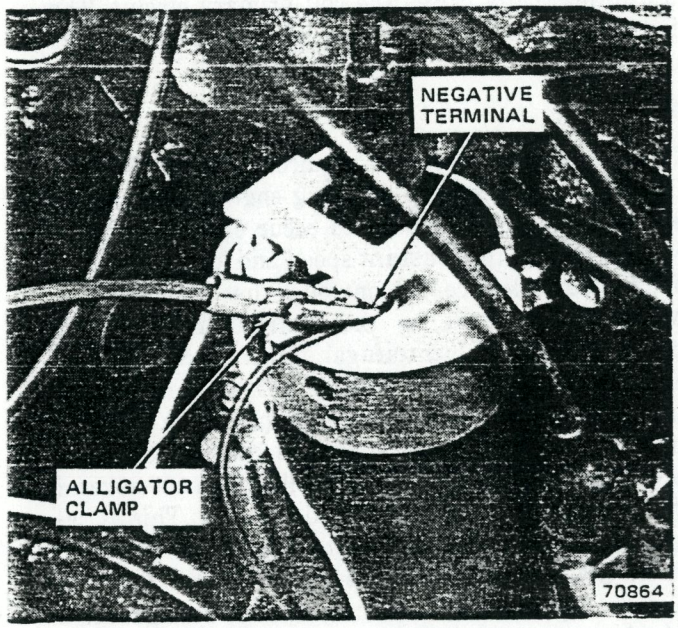

Fig. 1G-13 Tachometer Connection

Pick-up Coil and Trigger Wheel

Current flowing through the ignition coil primary winding creates an electromagnetic field around the primary and secondary windings. When the circuit is opened and current flow stops, the electromagnetic field collapses and induces high voltage into the secondary winding. The circuit is opened and closed electronically by the control unit. The distributor pick-up coil and trigger wheel provide the input signal for the control unit.

The trigger wheel, mounted on the distributor shaft, has one tooth for each engine cylinder. The wheel is mounted so that the teeth rotate past the pick-up coil one at a time.

The pick-up coil, a coil of fine gauge wire mounted on a permanent magnet, has a magnetic field that is intensified by the presence of ferrous metal. The pick-up coil reacts to the trigger wheel teeth as they pass. As a trigger wheel tooth approaches and passes the pole piece

of the pick-up coil, it reduces the reluctance (compared to air) to the magnetic field and increases field strength. Field strength decreases as the tooth moves away from the pole piece. This build-up and reduction of field strength induces an alternating current into the pick-up coil, which triggers the control unit. The control unit opens and closes the coil primary circuit according to the position of the trigger wheel teeth.

There are no contacting surfaces between the trigger wheel and pick-up coil. Because there is no wear, the dwell angle requires no adjustment. The dwell angle is determined electronically by the control unit and is non-adjustable. When the ignition coil circuit is switched open, an electronic timer in the control unit keeps the circuit open only long enough for the electromagnetic field to collapse and the induced voltage to discharge. It then automatically closes the coil primary circuit. The period of time the circuit is closed is referred to as *dwell.*

Spark Advance

Efficient engine operation requires each spark to occur at the correct instant. Varying engine speed or engine load requires the spark to occur either earlier or later than it does for constant speed and load operation.

Mechanical advance is controlled by engine speed. Flyweights connected to the distributor shaft are thrown outward by centrifugal force. Higher engine rpm throws the weights further out. Calibrated-rate springs are used to control this movement. The outward motion of the flyweights causes the rotor and trigger wheel to be advanced on the distributor shaft several degrees in the direction of normal rotation. This is referred to as *centrifugal spark advance.*

When the engine is operating with a light load, the carburetor throttle plates restrict airflow. This causes a relatively lean mixture to enter the combustion chambers. Ignition must occur earlier because the lean mixture requires a longer time to burn. The vacuum spark advance unit is used for this purpose. When carburetor ported or manifold vacuum is high, the vacuum advance unit moves the pick-up coil several degrees opposite to the direction the distributor is rotating. This causes the pick-up coil to react to the presence of trigger wheel teeth earlier. This is referred to as *vacuum spark advance.* With low vacuum operating conditions, such as wide open throttle acceleration, a spring in the vacuum unit pushes the pick-up coil back to a position of no advance.

Cap and Rotor

The central tower on the distributor cap receives the high voltage current from the ignition coil. The current flows through a carbon button in the cap into a spring-loaded contact on the rotor. The rotor tip aligns with a contact in the cap that corresponds to the cylinder to be ignited just as the coil output high voltage current reaches the rotor. In this way, each spark plug is fired in turn.

OPERATION

The control unit is activated when the ignition switch is in the Start or On position (fig. 1G-14). The primary circuit is closed and current flows through the coil primary winding. When the engine begins turning the distributor, the trigger wheel teeth rotate past the pick-up coil. As each tooth aligns with the pick-up coil, a high voltage is induced in the ignition coil secondary winding and current flows to the distributor cap and rotor. The rotor routes the high voltage current to the proper spark plug. The timing of the ignition is constantly changed by the vacuum and centrifugal advance mechanisms according to engine operation.

TROUBLESHOOTING

For troubleshooting purposes, ignition system problems are considered in three categories: complete failure, intermittent failure and spark knock.

Complete failure is always a no-spark situation. The engine will not start. If a complete failure occurs when the engine is operating, it will not restart.

Intermittent failure is temporary. The engine may not start on the first try, but will eventually start. If an intermittent failure occurs when the engine is operating, it may falter and possibly stop. If it stalls, it will restart and will continue to operate intermittently.

Spark knock is not actually an ignition system failure. The engine will start and will continue to operate. If not corrected, spark knock can cause extensive internal engine component damage.

Complete Failure Diagnosis

The first step to perform is a thorough visual inspection for obvious defects.

The next step in diagnosing a failure is to identify the circuit—primary or secondary—at fault.

The primary circuit consists of:

- Battery to ignition coil wiring
- Ignition coil primary winding
- All wires connected to the electronic ignition control unit and distributor pick-up coil
- Electronic ignition control unit
- Distributor

The secondary circuit consists of:

- Ignition coil secondary winding
- All high voltage wires connected to the distributor cap, coil and spark plugs
- Distributor cap
- Distributor rotor
- Spark plugs

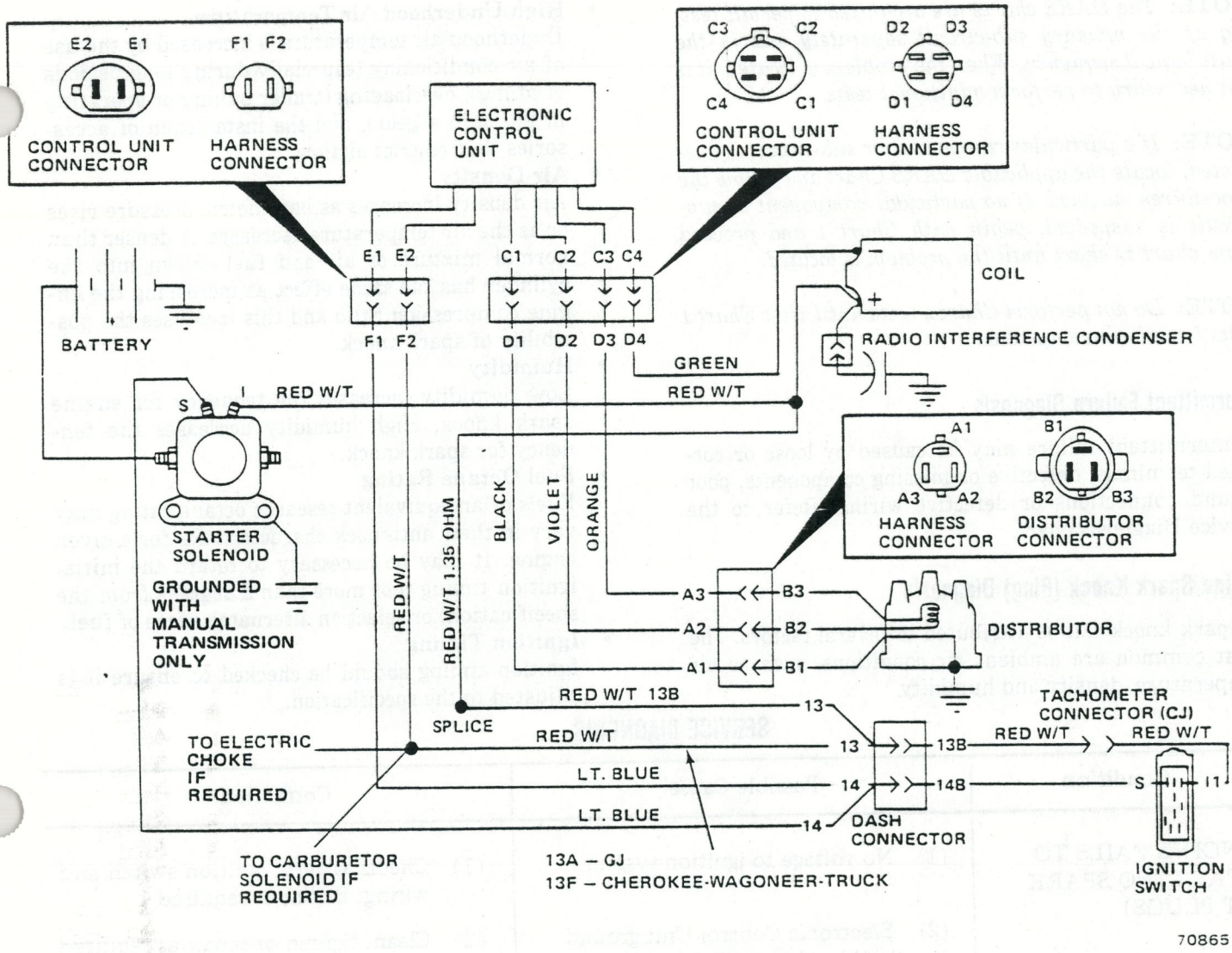

Fig. 1G-14 SSI System Schematic

Secondary Circuit Diagnosis

CAUTION: *When disconnecting a high voltage wire from a spark plug or the distributor cap, twist the rubber boot slightly to break it loose. Grasp the boot, not the wire, and pull off with steady, even force.*

(1) Disconnect ignition coil wire from center tower of distributor cap. Use insulated pliers to hold wire terminal approximately 1/2 inch from engine block or intake manifold.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(2) Crank engine and observe wire terminal for arc.
- (a) If no arc occurs, proceed with step (5).
- (b) If arc occurs, proceed with step (3).

CAUTION: *Do not remove wires from spark plugs for cylinders 1 or 5 of a six-cylinder engine or cylinders 3 or 4 of an eight-cylinder engine when performing this test, otherwise pick-up coil may be damaged.*

(3) Connect ignition coil wire to distributor cap. Remove wire from one spark plug.

(4) Use insulated pliers to hold wire 1/2 inch from engine cylinder head while cranking engine. Observe wire terminal for arc.
- (a) If arc occurs, inspect for fuel system problems or incorrect ignition timing.
- (b) If no arc occurs, inspect for defective rotor or distributor cap, or defective spark plug wires.

(5) If no arc occurs from ignition coil wire terminal, test coil secondary winding resistance. It should not exceed 10,000 ohms. Replace if required.

(6) Read following notes and proceed to SSI System Diagnosis and Repair Simplification (DARS) Chart 1.

NOTE: *The DARS charts are organized to permit testing of the primary sub-circuit separately and in the most logical sequence. When the problem is located, it is not necessary to perform additional tests.*

NOTE: *If a particular component or sub-circuit is suspected, locate the applicable DARS Chart and follow the procedures outlined. If no particular component or sub-circuit is suspected, begin with Chart 1 and proceed from chart to chart until the problem is located.*

NOTE: *Do not perform Chart 4 tests until after Chart 1 tests have been completed.*

Intermittent Failure Diagnosis

Intermittent failure may be caused by loose or corroded terminals, defective or missing components, poor ground connections or defective wiring. Refer to the Service Diagnosis chart.

Engine Spark Knock (Ping) Diagnosis

Spark knock can be attributed to several factors. The most common are ambient air conditions, such as air temperature, density and humidity.

- **High Underhood Air Temperature**
  Underhood air temperature is increased by the use of air conditioning (especially during long periods of idling), overloading (trailer pulling or operating in too high a gear), and the installation of accessories that restrict airflow.
- **Air Density**
  Air density increases as barometric pressure rises or as the air temperature decreases. A denser than normal mixture of air and fuel drawn into the cylinder has the same effect as increasing the engine compression ratio and this increases the possibility of spark knock.
- **Humidity**
  Low humidity increases the tendency for engine spark knock. High humidity decreases the tendency for spark knock.
- **Fuel Octane Rating**
  Fuels of an equivalent research octane rating may vary in their antiknock characteristics for a given engine. It may be necessary to retard the initial ignition timing (not more than 2 degrees from the specification) or select an alternate source of fuel.
- **Ignition Timing**
  Ignition timing should be checked to ensure it is adjusted to the specification.

SERVICE DIAGNOSIS

Condition	Possible Cause	Correction
ENGINE FAILS TO START (NO SPARK AT PLUGS)	(1) No voltage to ignition system	(1) Check battery, ignition switch and wiring. Repair as required
	(2) Electronic Control Unit ground lead inside distributor open, loose or corroded	(2) Clean, tighten or repair as required
	(3) Primary wiring connectors not fully engaged	(3) Clean and fully engage connectors
	(4) Coil open or shorted	(4) Test coil. Replace if faulty.
	(5) Electronic Control Unit defective	(5) Replace Electronic Control Unit
	(6) Cracked distributor cap	(6) Replace cap
	(7) Defective rotor	(7) Replace rotor
ENGINE BACKFIRES BUT FAILS TO START	(1) Incorrect ignition timing	(1) Check timing. Adjust as required
	(2) Moisture in distributor	(2) Dry cap and rotor
	(3) Distributor cap faulty	(3) Check cap for loose terminals, cracks and dirt. Clean or replace as required
	(4) Ignition wires connected in wrong firing order.	(4) Connect in correct order.

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SERVICE DIAGNOSIS (Continued)

Condition	Possible Cause	Correction
ENGINE RUNS ONLY WITH KEY IN START POSITION	(1) Open in resistance wire or excessive resistance	(1) Repair resistance wire
ENGINE CONTINUES TO RUN WITH KEY OFF	(1) Defective starter solenoid	(1) Replace solenoid
	(2) Defective ignition switch	(2) Replace ignition switch
ENGINE DOES NOT OPERATE SMOOTHLY AND/OR ENGINE MISFIRES AT HIGH SPEED	(1) Spark plugs fouled or faulty	(1) Clean and gap plugs. Replace as required
	(2) Ignition wires faulty.	(2) Check wires. Replace as required.
	(3) Spark advance system(s) faulty	(3) Check operation. Repair as required
	(4) I-terminal shorted to starter terminal in solenoid	(4) Replace solenoid
	(5) Trigger wheel pin missing	(5) Install pin
	(6) Ignition wires connected in wrong firing order.	(6) Connect wires correctly.
EXCESSIVE FUEL CONSUMPTION	(1) Incorrect ignition timing	(1) Check timing. Adjust as required
	(2) Spark advance system(s) faulty	(2) Check operation. Repair as required
ERRATIC TIMING ADVANCE	(1) Faulty vacuum or centrifugal advance assembly	(1) Check operation. Replace if required
TIMING NOT AFFECTED BY VACUUM	(1) Defective vacuum advance unit	(1) Replace vacuum advance unit
	(2) Pick-up coil pivot corroded.	(2) Clean pivot
INTERMITTENT OPERATION	(1) Loose or corroded terminals	(1) Tighten terminals, remove corrosion, apply electrical grease
	(2) Defective pick-up coil.	(2) Perform pick-up coil test.
	(3) Defective control unit	(3) Perform control unit tests
	(4) Loose ground connector in distributor	(4) Clean and tighten ground connection
	(5) Wires to distributor shorted together or to ground	(5) Check for frayed, pinched or burned wires
	(6) Trigger wheel pin missing	(6) Install new pin.

90065B

SSI SYSTEM DIAGNOSIS AND REPAIR SIMPLIFICATION (DARS) CHART

Note: Refer to Chapter A – General Information for details on how to use this DARS chart.

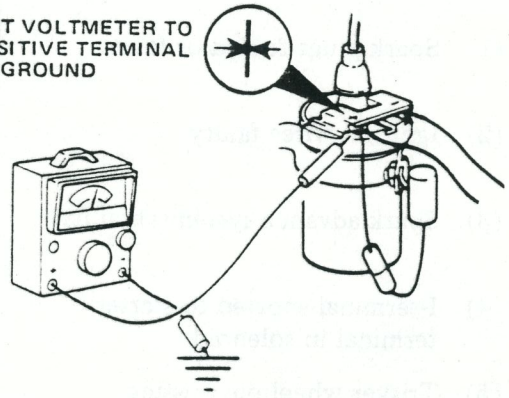
IGNITION COIL PRIMARY CIRCUIT

FUNCTION: PROVIDES BATTERY FEED TO COIL AND COIL GROUND

Chart 1

STEP **SEQUENCE** **RESULT**

REFER TO FIGURE 1G-14 FOR SCHEMATIC



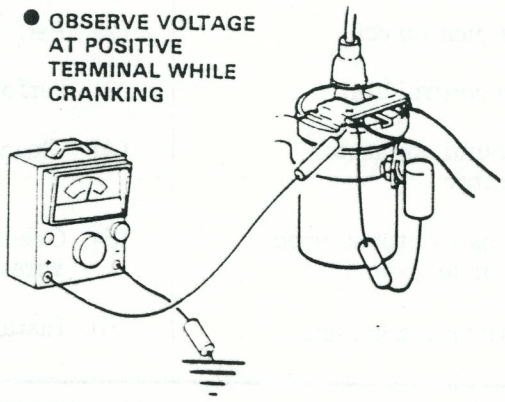
- CONNECT VOLTMETER TO COIL POSITIVE TERMINAL AND TO GROUND
- TURN IGNITION ON

1

- VOLTAGE ACCEPTABLE (6V ± .5V) — OK → **2**
- VOLTAGE NOT ACCEPTABLE (BATTERY VOLTAGE) — O.K → **4**
- VOLTAGE NOT ACCEPTABLE (BELOW 6V) — O.K → DISCONNECT CAPACITOR WIRE TERMINAL
  - VOLTAGE ACCEPTABLE (6V ± .5V) — OK → REPLACE CAPACITOR → STOP
  - VOLTAGE NOT ACCEPTABLE — O.K → **6**

2

- TURN IGNITION SWITCH TO START
- OBSERVE VOLTAGE AT POSITIVE TERMINAL WHILE CRANKING



- VOLTAGE ACCEPTABLE (BATTERY VOLTAGE) — OK → STOP
- VOLTAGE NOT ACCEPTABLE (LESS THAN BATTERY VOLTAGE) — O.K → **3**

80699

Chart 1

STEP | **SEQUENCE** | **RESULT**

3

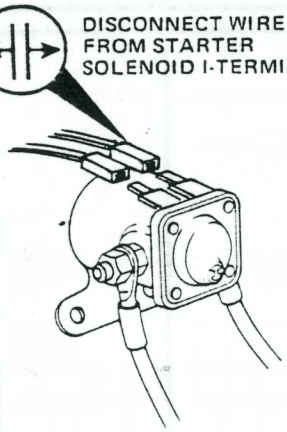
CHECK FOR SHORT OR OPEN IN WIRE ATTACHED TO STARTER SOLENOID 1-TERMINAL

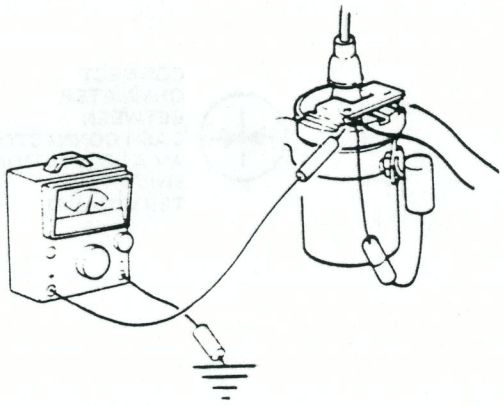
CHECK SOLENOID AS OUTLINED IN CHAPTER 1F

REPAIR AS REQUIRED → STOP

4

- DISCONNECT WIRE FROM STARTER SOLENOID I-TERMINAL
- IGNITION REMAINS ON
- OBSERVE VOLTAGE AT COIL POSITIVE TERMINAL





VOLTAGE DROPS TO 6V ± .5V → OK → REPLACE STARTER SOLENOID → STOP

VOLTAGE REMAINS AT BATTERY VOLTAGE → O.K. → CONNECT JUMPER BETWEEN COIL NEGATIVE TERMINAL AND GROUND

- VOLTAGE DROPS TO 6V ± .5V → OK → **5**
- O.K. → VOLTAGE DOES NOT DROP → REPAIR DEFECTIVE RESISTANCE WIRE → **2**

5

CHECK:

- CONTINUITY BETWEEN COIL NEGATIVE TERMINAL AND CONNECT TERMINAL D4

OK → CONTINUITY OK → REPLACE CONTROL UNIT → STOP

- DI TO GROUND

O.K. → CONTINUITY NOT OK → LOCATE AND REPAIR OPEN → **2**

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Chart 1

STEP | SEQUENCE | RESULT

6

- TURN IGNITION OFF

CONNECT OHMMETER BETWEEN COIL POSITIVE TERMINAL AND DASH CONNECTOR AV

RESISTANCE TOO HIGH (1.40 OHMS OR MORE) → REPAIR RESISTANCE WIRE → STOP

OK → RESISTANCE ACCEPTABLE (1.35 ± .05 OHMS) → **7**

7

CONNECT OHMMETER BETWEEN DASH CONNECTOR AV AND IGNITION SWITCH TERMINAL I1

- IGNITION REMAINS OFF

OK → RESISTANCE ACCEPTABLE (LESS THAN 0.1 OHM) → REPLACE IGNITION SWITCH OR REPAIR SWITCH WIRE FROM BATTERY → STOP

O.K → RESISTANCE TOO HIGH (MORE THAN 0.1 OHM) → ✓

- POOR TERMINAL CONNECTIONS AT DASH CONNECTOR OR IGNITION SWITCH
- DEFECTIVE WIRING

→ REPAIR DEFECT → STOP

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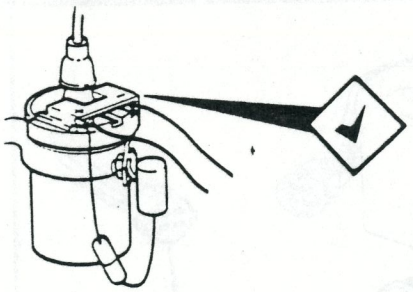
COIL TEST

Chart 2

STEP | SEQUENCE | RESULT

1

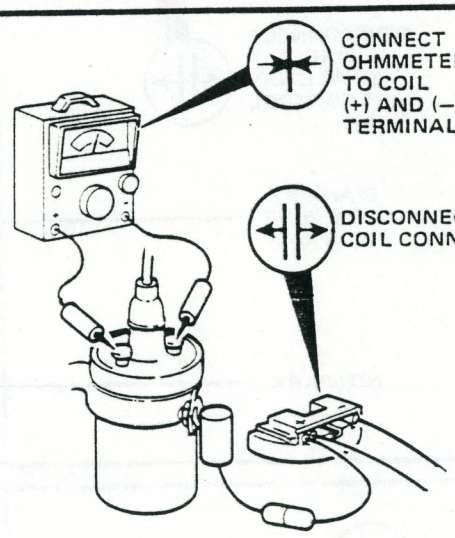


INSPECT COIL FOR OIL LEAKS, OTHER EXTERIOR DAMAGE, AND CARBON TRACKS

OK → **2**

O.K → REPLACE COIL → STOP

2



CONNECT OHMMETER TO COIL (+) AND (–) TERMINALS

DISCONNECT COIL CONNECTOR

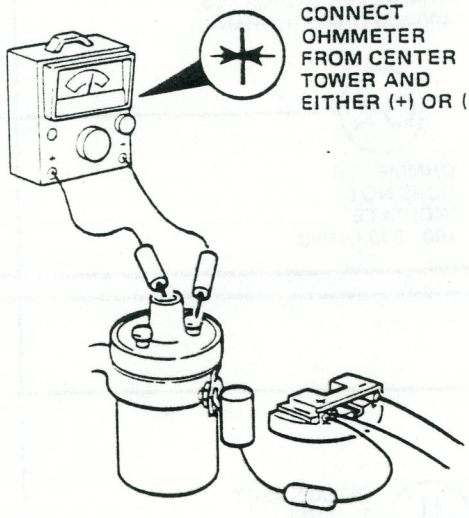
OK → **3**

RESISTANCE ACCEPTABLE
(1.13 TO 1.23 OHMS AT 75°F OR 24°C)
(1.5 OHMS AT 200°F OR 93°C)

O.K → REPLACE COIL → STOP

RESISTANCE NOT WITHIN LIMITS

3



CONNECT OHMMETER FROM CENTER TOWER AND EITHER (+) OR (–)

OK → STOP

RESISTANCE ACCEPTABLE
(7700 - 9300 OHMS @ 75°F OR 24°C)
(12,000 OHMS @ 200°F OR 93°C)

O.K → REPLACE COIL → STOP

RESISTANCE NOT WITHIN LIMITS

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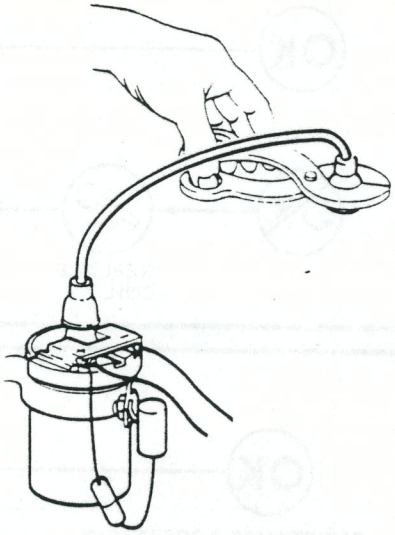
SENSOR CHECK AND CONTROL UNIT CHECK

Chart 3

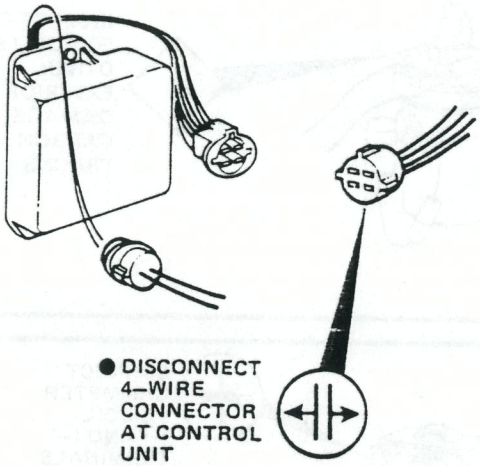
STEP | SEQUENCE | RESULT

1

● TURN IGNITION ON



● DISCONNECT COIL WIRE FROM CENTER TOWER OF DISTRIBUTOR AND HOLD 1/2 - INCH FROM ENGINE WITH INSULATED PLIERS

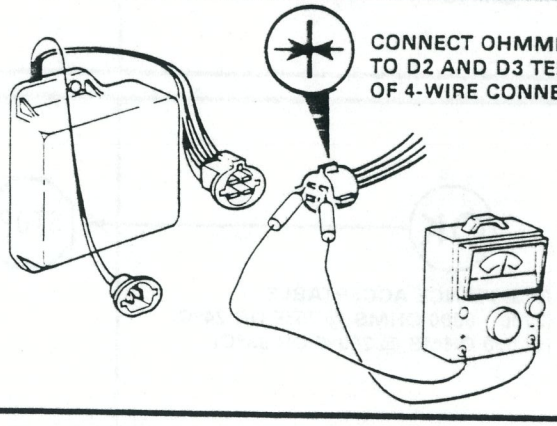


● DISCONNECT 4—WIRE CONNECTOR AT CONTROL UNIT

SPARK AT COIL WIRE (NORMAL) → **2**

NO SPARK → **5**

2



CONNECT OHMMETER TO D2 AND D3 TERMINAL OF 4-WIRE CONNECTOR

OK → **6**

OHMMETER INDICATES 400-800 OHMS (NORMAL)

O.K → **3**

OHMMETER DOES NOT INDICATE 400 - 800 OHMS

3

● DISCONNECT AND RECONNECT 3 - WIRE CONNECTOR AT DISTRIBUTOR

OK → OHMMETER NOW INDICATES 400 - 800 OHMS → **6**

O.K → OHMMETER REMAINS OUTSIDE 400 - 800 OHMS → DISCONNECT 3 - WIRE CONNECTOR AT DISTRIBUTOR → **4**

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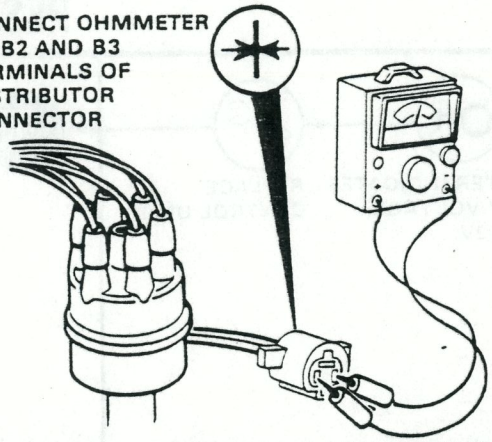
Chart 3

STEP | SEQUENCE | RESULT

4

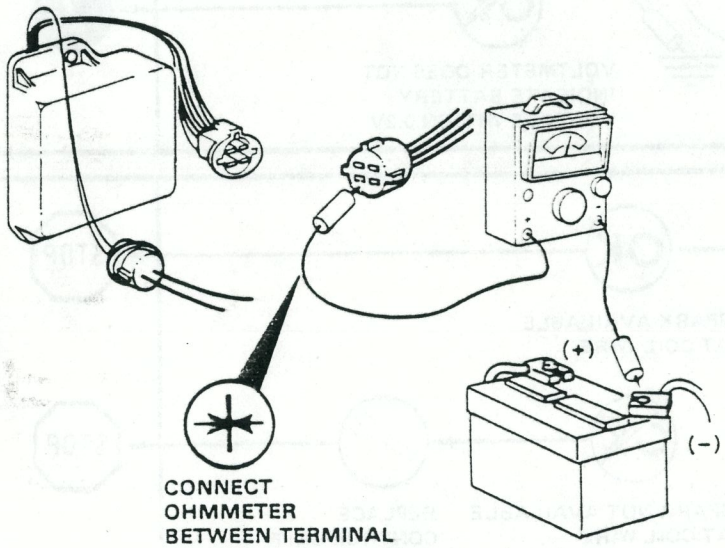


CONNECT OHMMETER TO B2 AND B3 TERMINALS OF DISTRIBUTOR CONNECTOR

OK → OHMMETER INDICATES 400 - 800 OHMS → REPAIR OR REPLACE HARNESS BETWEEN 3 - WIRE AND 4 - WIRE CONNECTOR → STOP

O.K → OHMMETER DOES NOT INDICATE 400 - 800 OHMS → REPLACE PICK-UP COIL → STOP

5



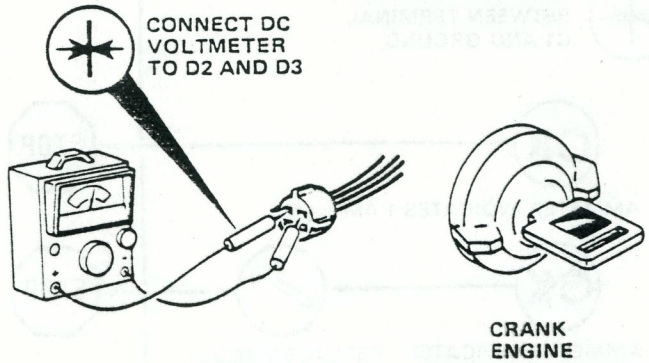
CONNECT OHMMETER BETWEEN TERMINAL D1 AND BATTERY NEGATIVE TERMINAL

OK → OHMMETER INDICATES ZERO (NOT ABOVE 0.002 OHM) → 2

O.K → OHMMETER INDICATES ABOVE 0.002 OHM → LOCATE AND REPAIR SOURCE OF BAD GROUND
- GROUND CABLE RESISTANCE
- DISTRIBUTOR–TO–BLOCK RESISTANCE
- GROUND SCREW IN DISTRIBUTOR TO D1 TERMINAL

→ STOP

6



CONNECT DC VOLTMETER TO D2 AND D3

CRANK ENGINE

OK → VOLTMETER FLUCTUATES, INDICATING PROPER PICK-UP COIL AND TRIGGER WHEEL OPERATION → STOP

O.K → VOLTMETER DOES NOT FLUCTUATE → LOCATE AND REPAIR FAULT
- DEFECTIVE TRIGGER WHEEL
- DISTRIBUTOR NOT TURNING
- MISSING TRIGGER WHEEL PIN

→ STOP

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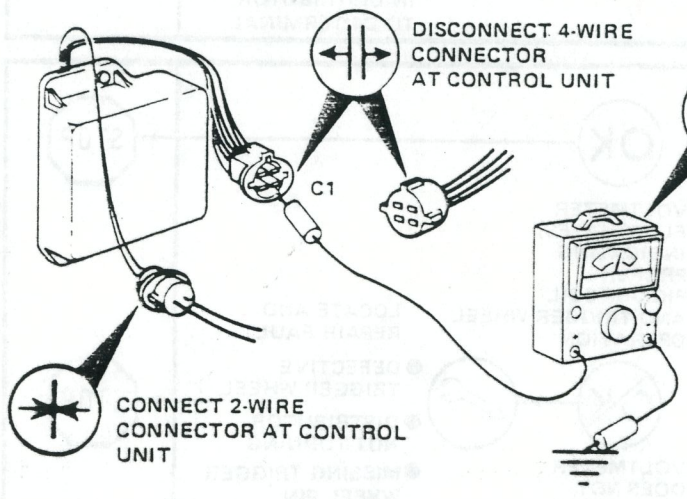
IGNITION FEED TO ELECTRONIC CONTROL UNIT

NOTE: DO NOT PERFORM CHART 4 WITHOUT PERFORMING CHART 1

Chart 4

STEP	SEQUENCE	RESULT
1	● TURN IGNITION ON UNPLUG 2-WIRE CONNECTOR AT MODULE AND CONNECT VOLTMETER BETWEEN TERMINAL F-2 AND GROUND OK → VOLTMETER INDICATES BATTERY VOLTAGE WITHIN 0.2V. REPLACE CONTROL UNIT O.K → VOLTMETER DOES NOT INDICATE BATTERY VOLTAGE WITHIN 0.2V	3 2
2	LOCATE AND REPAIR CAUSE OF VOLTAGE REDUCTION ● CORRODED DASH CONNECTOR ● IGNITION SWITCH OK → SPARK AVAILABLE AT COIL WIRE O.K → SPARK NOT AVAILABLE AT COIL WIRE REPLACE CONTROL UNIT	STOP STOP
3	DISCONNECT 4-WIRE CONNECTOR AT CONTROL UNIT C1 CONNECT 2-WIRE CONNECTOR AT CONTROL UNIT CONNECT AMMETER BETWEEN TERMINAL C1 AND GROUND OK → AMMETER INDICATES 1 AMP ± 0.1 O.K → AMMETER INDICATES HIGHER OR LOWER REPLACE MODULE	STOP STOP



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Ignition Coil Tests

The ignition coil can be tested on any conventional coil tester or with an ohmmeter. A coil tester is preferable because it can be used to detect faults that are impossible to detect with an ohmmeter.

Primary Winding Resistance Test

(1) Remove connector from negative (-) and positive (+) terminals of coil.

(2) Set ohmmeter for low scale and adjust pointer to zero.

(3) Connect ohmmeter to coil negative (-) and positive (+) terminals. Resistance should be 1.13 to 1.23 ohms at 75°F (24°C). If coil temperature is above 200°F (93°C), 1.50 ohms is acceptable.

Secondary Winding Resistance Test

(1) Remove ignition wire from center terminal of ignition coil.

NOTE: *Ignition switch must be off.*

(2) Set ohmmeter for x1000 scale and adjust pointer to zero.

(3) Connect ohmmeter to brass contact in center terminal and to either primary winding terminal. Resistance should be 7700 to 9300 ohms at 75°F (24°C). A maximum of 12,000 ohms is acceptable if coil temperature is 200°F (93°C) or more.

Current Flow Test

(1) Remove connector from ignition coil.

(2) Depress plastic barb and withdraw positive (+) terminal wire from connector. Barb is visible from coil side of connector.

(3) Repeat for negative (-) terminal wire.

(4) Connect ammeter between positive (+) terminal and disconnected positive (+) terminal wire.

(5) Connect jumper wire from coil negative (-) terminal to known good ground.

(6) Turn ignition switch to ON position.

(7) Current flow should be approximately 7 amps and should not exceed 7.6 amps.

(8) If current flow is more than 7.6 amps, replace ignition coil.

(9) Leave ammeter connected to coil positive (+) terminal. Remove jumper wire from negative (-) terminal. Connect coil green wire to negative (-) terminal. Current flow should be approximately 4 amps.

If current flow is less than 3.5 amps, inspect for poor connections in 4-wire (control unit) and 3-wire (distributor) connectors or poor ground at ground screw inside distributor. If current flow is greater than 5 amps, the control unit is defective.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(10) Start engine. Normal current flow with engine operating is 2.0 to 2.4 amps. If current flow is not within specifications, control unit is defective.

Ignition Coil Output Tests

(1) Connect oscilloscope to ignition coil. Refer to test equipment manufacturer's instructions.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(2) Start engine and observe secondary spark voltage.

CAUTION: *Do not remove wires from spark plugs for cylinders 1 or 5 of a six-cylinder engine or cylinders 3 or 4 of an eight-cylinder engine when performing the next test because the pick-up coil may be damaged.*

CAUTION: *Do not operate engine with spark plug disconnected for more than 30 seconds or catalytic converter may be damaged.*

(3) Remove one spark plug wire from distributor cap. Observe voltage applied to disconnected spark plug wire on oscilloscope. This voltage, referred to as open circuit output voltage, should be 24,000 volts (24 kV) minimum with engine speed of 1000 rpm.

DISTRIBUTOR REPLACEMENT

Removal

(1) Unfasten distributor cap retaining screws. Remove distributor cap with ignition coil and spark plug wires connected and position aside.

(2) Disconnect distributor vacuum advance hose.

(3) Disconnect distributor primary wiring connector.

(4) Scribe mark on distributor housing in line with tip of rotor. Scribe mark on distributor housing near clamp and continue scribe mark on engine block in line with distributor mark. Note position of rotor and distributor housing in relation to surrounding engine parts as reference points for installing distributor.

(5) Remove distributor holddown bolt and clamp.

(6) Withdraw distributor carefully from engine block.

Installation

(1) Clean distributor mounting area of engine block.

(2) Install replacement distributor mounting gasket in counterbore of engine block.

(3) Position distributor shaft in engine block. If engine was not rotated while distributor was removed, perform the following:

(a) Align rotor tip with mark scribed on distributor housing during removal. Turn rotor approximately 1/8-turn counterclockwise past scribe mark.

CAUTION: *Ensure that the distributor shaft fully engages the oil pump gear shaft. It may be necessary to slightly rotate (bump) the engine while applying downward hand force on the distributor body to fully engage the distributor shaft with the oil pump drive gear shaft.*

(b) Slide distributor down into engine block. Align scribe mark on distributor housing with matching scribe mark on engine block.

NOTE: *It may be necessary to move the rotor and shaft slightly to start gear into mesh with camshaft gear and to engage oil pump drive tang, but rotor should align with scribe mark when distributor is down in place.*

(c) Install distributor holddown clamp, bolt and lockwasher, but do not tighten bolt.

(4) If engine was rotated while distributor was removed, it will be necessary to establish timing as follows:

(a) Remove No. 1 spark plug. Hold finger over spark plug hole and rotate engine until compression pressure is felt. Slowly continue to rotate engine until timing index on vibration damper pulley aligns with top dead center (TDC) mark on timing degree scale. Always rotate engine in direction of normal rotation. Do not turn engine backward to align timing marks.

(b) Turn distributor shaft until rotor tip points in direction of No. 1 terminal in distributor cap. Turn rotor 1/8-turn counterclockwise past position of No. 1 terminal.

(c) Slide distributor shaft down into engine and position distributor vacuum advance mechanism in approximately same location (in relation to surrounding engine parts) as when removed. Align scribe mark on distributor housing with corresponding scribe mark on engine block.

NOTE: *It may be necessary to rotate the oil pump shaft with a long, flat-blade screwdriver to engage oil pump drive tang, but rotor should align with the position of No. 1 terminal when distributor shaft is down in place.*

(d) Install distributor holddown clamp, bolt and lockwasher, but do not tighten bolt.

CAUTION: *If distributor cap is incorrectly positioned on distributor housing, cap or rotor may be damaged when engine is rotated.*

(5) Install distributor cap (with ignition wires) on distributor housing. Ensure pick-up coil wire rubber grommet in distributor housing aligns with depression in distributor cap and that cap fits on rim of distributor housing.

NOTE: *Two different diameter screws are used to retain distributor cap.*

(6) Apply Jeep Silicone Dielectric Compound, or equivalent, to connector terminal blades and cavities. Connect distributor primary wiring connector. Press firmly to overcome hydraulic pressure caused by silicone compound.

NOTE: *If connector locking tabs weaken or break off, bind connectors together with harness tie strap or tape to assure good electrical connection.*

CAUTION: *Do not puncture spark plug wires or boots to make connection. Use proper adapters.*

(7) Connect timing light to No. 1 spark plug.

NOTE: *The timing case cover has a socket adjacent to the timing degree scale for use with a magnetic timing probe. Ignition timing may be checked by inserting the probe through the hole until it rests on the vibration damper. The probe is calibrated to compensate for probe socket location, which is 9.5° ATDC. Eccentricity of the damper will properly space the magnetic probe. The timing degrees are indicated on a meter.*

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(8) Operate engine at 500 rpm and observe vibration damper index and timing degree scale with timing light. Rotate distributor housing as needed to align timing index on vibration damper pulley with correct mark on timing degree scale. Refer to Chapter 1A—General Service and Diagnosis for ignition timing specifications. When ignition timing is correct, tighten distributor holddown bolt and recheck timing to ensure it did not change.

(9) Disconnect timing light and connect vacuum hose to distributor vacuum advance mechanism.

DISTRIBUTOR COMPONENT REPLACEMENT

When replacing the pick-up coil, trigger wheel or vacuum advance mechanism, it is not necessary to remove the distributor from the engine. It is necessary to check

ignition timing if the pick-up coil or vacuum advance mechanism is replaced. Refer to figure 1G-15 for parts identification.

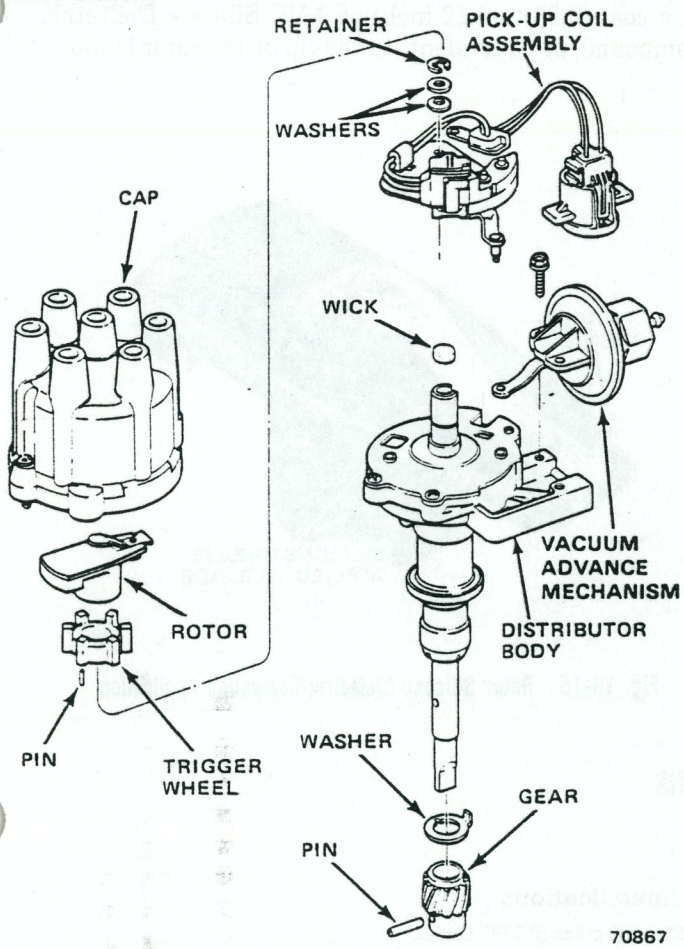

Fig. 1G-15 SSI Distributor Components—Six-Cylinder Engine

Trigger Wheel and/or Pick-up Coil

Removal

(1) Place distributor in suitable holding device, if removed from engine.

(2) Remove cap.

(3) Remove rotor.

(4) Remove trigger wheel with trigger wheel puller J-28509, or equivalent. Use flat washer to prevent puller from contacting inner shaft. Alternately, two screwdrivers can be used to remove trigger wheel from shaft. Remove pin.

(5) Six-cylinder engine—remove pick-up coil retainer and washers from pivot pin on base plate.

(6) Eight-cylinder engine—remove pick-up coil snap ring from central shaft. Remove retainer from vacuum advance mechanism-to-pick-up coil drive pin and move vacuum advance mechanism lever aside.

(7) Remove ground screw from harness tab.

(8) Lift pick-up coil assembly from distributor housing.

(9) If vacuum advance mechanism is to be replaced, remove screws and lift unit out of distributor housing. Do not remove vacuum advance mechanism unless replacement is required.

Installation

(1) If vacuum advance mechanism was removed, install it on distributor housing with attaching screws.

NOTE: *If replacement vacuum advance mechanism is installed, refer to Vacuum Advance Mechanism for calibration procedure.*

(2) Position pick-up coil assembly into distributor housing.

(3) Ensure pin on pick-up coil fits into hole in vacuum advance mechanism link (six-cylinder engines). Attach vacuum advance mechanism lever and retainer to pick-up coil pin (eight-cylinder engines).

(4) Install washers and retainer onto pivot pin to secure pick-up coil assembly to base plate (six-cylinder engines). Install snap ring (eight-cylinder engines).

(5) Position wiring harness in slot in distributor housing. Install ground screw through tab and tighten.

(6) Install trigger wheel on shaft with hand pressure. Long portion of teeth must be upward. When trigger wheel and slot in shaft are properly aligned, use suitable drift and small hammer to tap pin into locating groove in trigger wheel and shaft. If distributor is not installed in engine, support shaft while installing trigger wheel pin.

(7) Install rotor. Install distributor cap.

Vacuum Advance Mechanism

Removal

(1) Remove vacuum hose from vacuum advance mechanism.

(2) Six-cylinder engine—remove attaching screws and remove vacuum advance mechanism from distributor housing. It is necessary to tilt mechanism to disengage link from pick-up coil pin protruding through distributor housing. It may be necessary to loosen base plate screws for necessary clearance.

(3) Eight-cylinder engine—remove distributor cap. Remove retainer from pick-up coil pin. Remove attaching screws and lift vacuum advance mechanism from distributor housing.

Installation

(1) If replacement vacuum advance mechanism is to be installed, calibrate as follows:

(a) Insert Allen wrench into vacuum hose tube of original vacuum advance mechanism. Count number of **clockwise** turns necessary to bottom adjusting screw.

(b) Turn adjusting screw of replacement vacuum advance mechanism clockwise to bottom. Turn counterclockwise same number of turns counted in step (a).

(2) Six-cylinder engine—install vacuum advance mechanism on distributor housing. Ensure that vacuum advance link is engaged with pick-up coil pin. Install retaining screws. Tighten base plate screws, if loosened.

(3) Eight-cylinder engine—install vacuum advance mechanism on distributor housing. Install retaining screws. Position vacuum advance lever onto pick-up coil pin and install retainer. Install distributor cap.

(4) Check timing and adjust if required.

(5) Connect vacuum hose to vacuum advance mechanism.

Rotor

Inspect the rotor during precision tune-ups as outlined in Chapter 1A—General Service and Diagnosis.

A unique feature of the SSI system is the silicone dielectric compound applied to the rotor blade during manufacture. Radio interference is greatly reduced by the presence of a small quantity of this dielectric on the rotor blade. After a few thousand miles, the dielectric becomes charred by the high voltage current carried by the rotor (fig. 1G-16). This is normal. Do not scrape the residue from the rotor blade.

When installing a replacement rotor, always apply a thin coat (0.03 to 0.12 inch) of AMC Silicone Dielectric Compound, or equivalent, to the tip of the rotor blade.

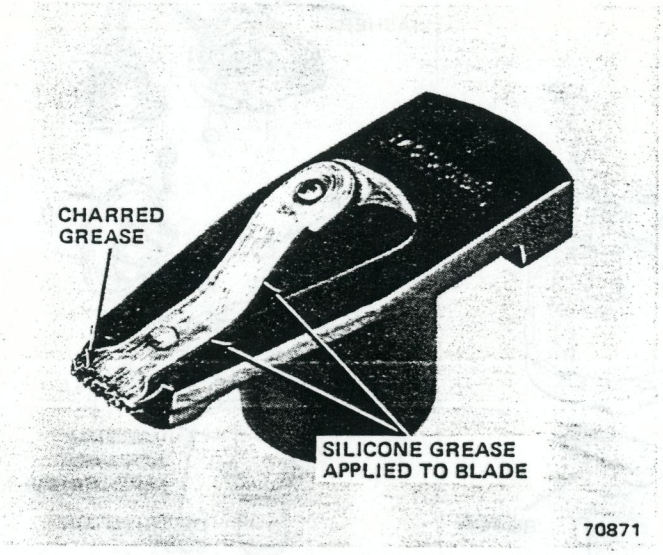

Fig. 1G-16 Rotor Silicone Dielectric Compound Application

SPECIFICATIONS

SSI Distributor and Coil Specifications

Distributor Pick-Up Coil Resistance	400 to 800 ohms @ 75°F (24°C)
Coil	
Primary Resistance	1.13 to 1.23 ohms @ 75°F (24°C)
	1.5 ohms @ 200°F (93°C)
Secondary Resistance	7700 to 9300 ohms @ 75°F (24°C)
	12,000 ohms @ 200°F (93°C)
Minimum Open Circuit Output at 1000 rpm	24 kv
Spark Plugs	
Required Voltage at 1000 rpm	5 to 16 kv
Maximum Variation Between Cylinders	3 to 5 kv

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Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use-Recheck Torques should be used for checking a pre-torqued item.

	USA (ft-lbs)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Distributor Clamp Screw	13	10-18	18	13-24
Spark Plugs	28	22-33	38	30-45

All Torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

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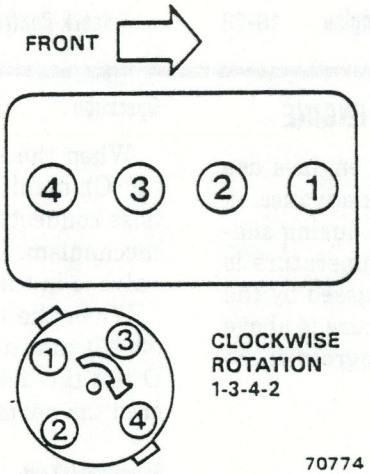
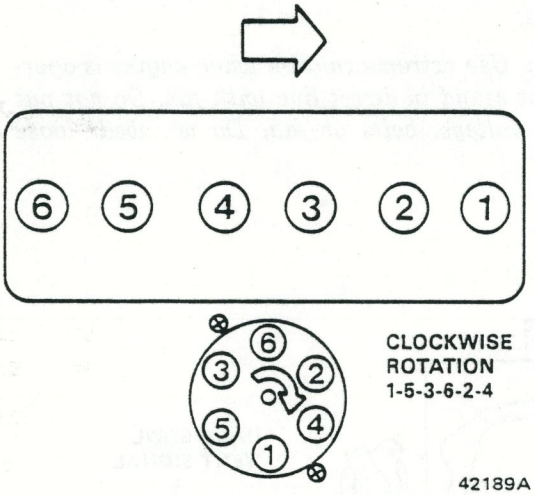
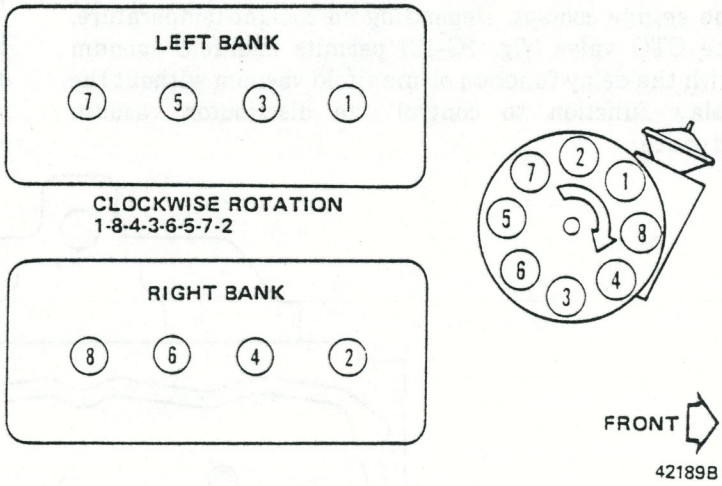
Distributor Wiring Sequence and Firing Order



FOUR CYLINDER ENGINE

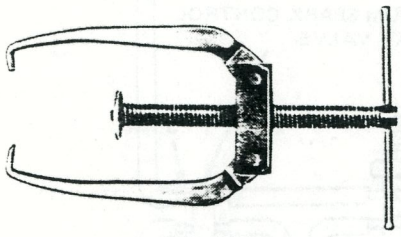


SIX CYLINDER ENGINE

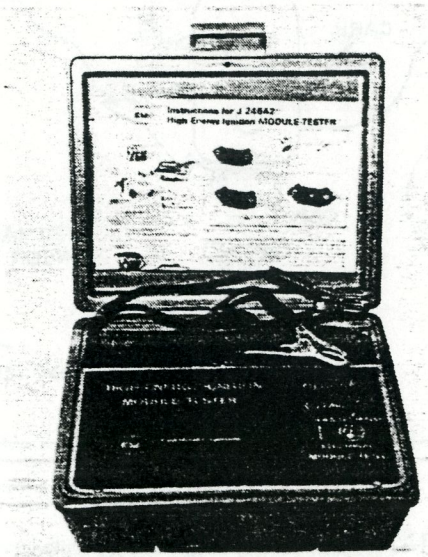


EIGHT CYLINDER ENGINE

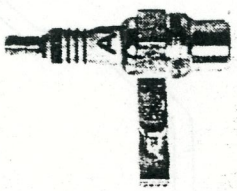
Tools



J-28509
TRIGGER WHEEL
PULLER



J-24642 HEI MODULE TESTER



J-26792 HEI
SPARK TESTER

SPARK CONTROL SYSTEMS

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SPARK CONTROL SYSTEM—FOUR-CYLINDER ENGINE

California and 49-State four-cylinder CJ engines use only manifold vacuum for distributor spark advance. A delay valve maintains the vacuum advance during sudden throttle openings when the coolant temperature is below 120°F (49°C). The delay valve is bypassed by the spark CTO valve when the coolant temperature is above 120°F (49°C). Refer to figure 1G-17 for a diagram of the system.

Spark Coolant Temperature Override (CTO) Valve

The spark CTO valve is screwed into the thermostat housing to allow the thermal sensor to be in contact with the engine coolant. Depending on coolant temperature, the CTO valve (fig. 1G-18) permits manifold vacuum with the delay function or manifold vacuum without the delay function to control the distributor vacuum advance.

Operation

When the engine coolant temperature is below 120°F (49°C), manifold vacuum at port 1 is applied to port D. A hose connects port D with the distributor spark advance mechanism. The delay valve is in the circuit when the valve is in this position.

When the engine coolant temperature reaches 120°F (49°C), manifold vacuum at port 2 is also applied to port D but the delay valve is bypassed. This may be considered the normal operating mode.

Functional Test

(1) Disconnect vacuum hose from distributor vacuum advance mechanism. Connect vacuum gauge to vacuum hose.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

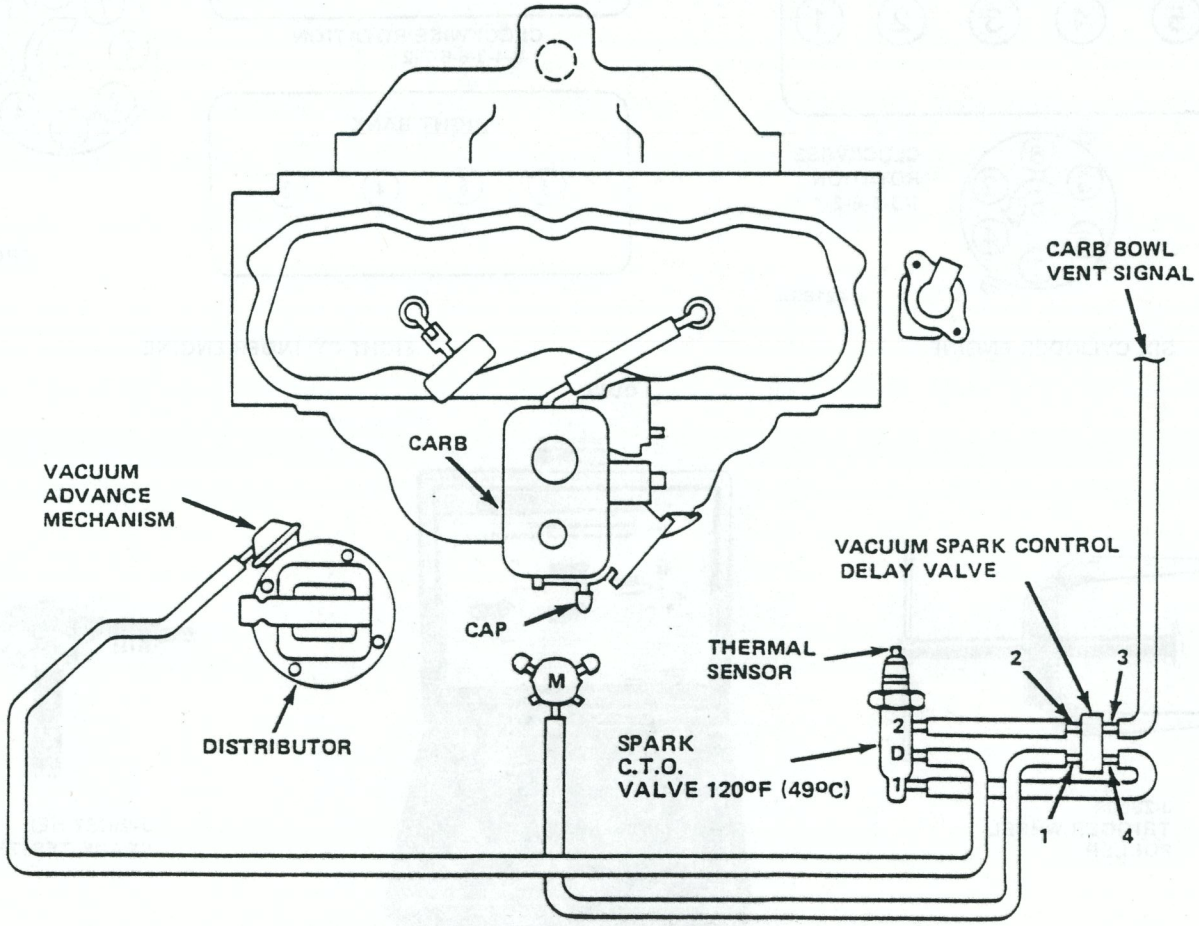

Fig. 1G-17 Spark Control System—Four-Cylinder Engines

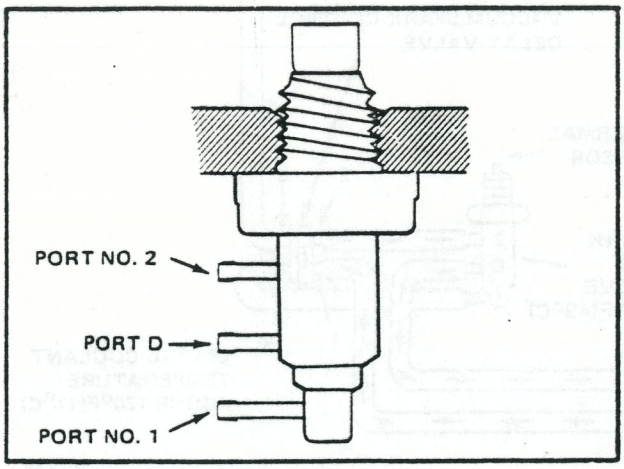

Fig. 1G-18 Spark CTO Valve

(2) Start engine.

(3) With engine coolant temperature below 120°F (49°C), manifold vacuum should be indicated on gauge.

(4) Disconnect vacuum hose from port 4 of delay valve and cap port (air tight).

(5) Manifold vacuum should not be indicated on gauge with engine coolant temperature below 120°F (49°C).

(6) Allow engine coolant temperature to reach 120°F (49°C). Manifold vacuum should be indicated on gauge.

NOTE: *The 120°F (49°C) CTO valve switching temperature is a nominal value. The actual switching temperature may vary slightly from unit to unit.*

(7) Stop engine.

(8) Remove cap from port 4 of delay valve and connect vacuum hose.

(9) Remove gauge and connect hose to distributor advance mechanism.

(10) If defective, replace valve.

Spark CTO Valve Replacement

WARNING: *If engine has been recently operated, use care to prevent scalding by hot coolant. System is pressurized.*

(1) Drain coolant from radiator until level is below CTO valve.

(2) Identify vacuum hoses and disconnect from CTO valve.

(3) Place drain pan under engine directly below CTO valve.

(4) With 7/8-inch open end wrench, remove CTO valve from thermostat housing.

(5) Install CTO valve.

(6) Connect vacuum hoses to valve.

(7) Install coolant.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(8) Start engine and inspect for coolant leaks.

(9) Test CTO valve as outlined in Functional Test.

Vacuum Spark Control Delay Valve

A vacuum spark control delay valve is added to the vacuum advance circuit to provide improved driveability when the engine is cold (fig. 1G-19). Ports 1 and 2, and ports 3 and 4 are connected internally.

When vacuum is greater at port 4 than at port 1 (e.g., sudden acceleration), air must flow through the orifice to equalize the pressure. This creates a momentary delay that prevents a sudden decrease in the spark advance. When the vacuum is greater at port 1 than at port 4, air flows freely through the unseated check valve and the pressure is instantly equalized.

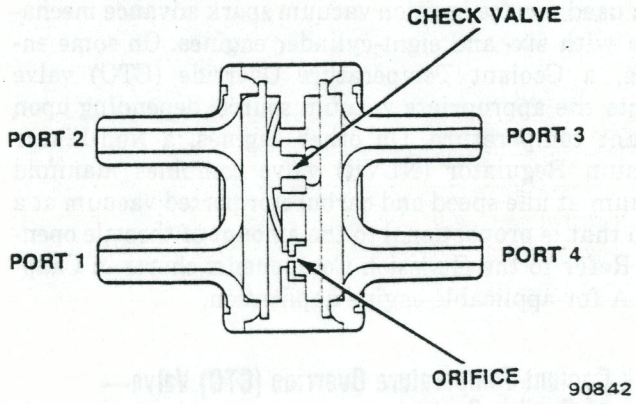

Fig. 1G-19 Vacuum Spark Control Delay Valve

Functional Test

(1) Connect tee fitting at port 1 and port 4.

(2) Connect vacuum gauge to each tee fitting.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(3) Start engine.

(4) Observe gauges. Vacuum should be equal.

(5) When throttle is suddenly depressed, vacuum at port 1 will instantly decrease but vacuum at port 4 should be maintained momentarily.

(6) Stop engine.

(7) If defective, replace delay valve.

(8) Remove gauges and tee fittings.

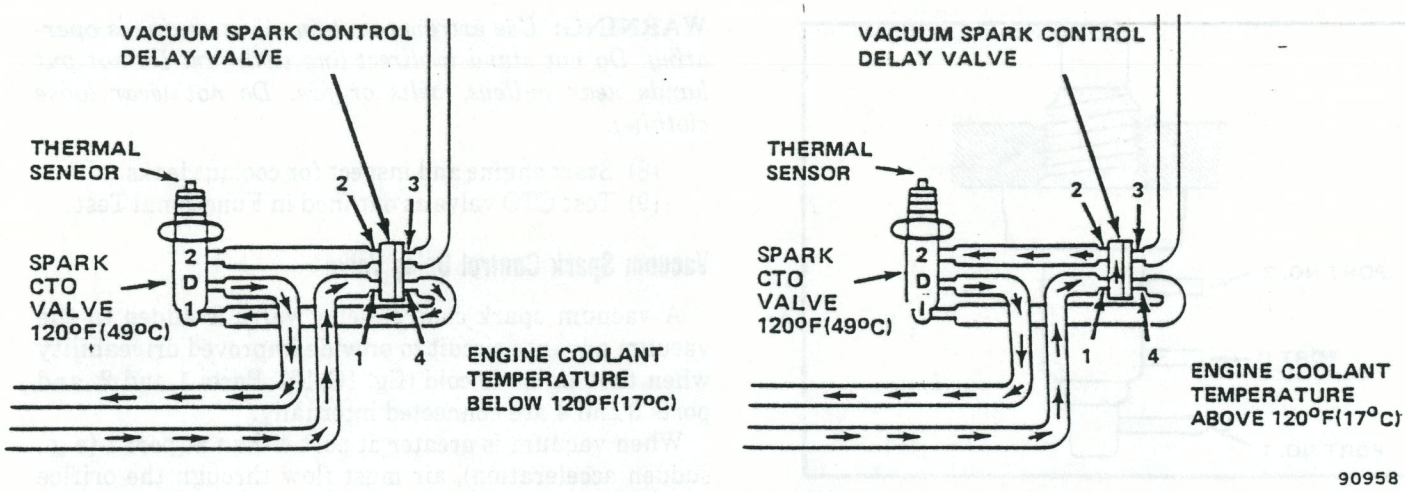

Fig. 1G-20 Spark Control System Operation

SPARK CONTROL SYSTEM—SIX- AND EIGHT-CYLINDER ENGINES

Manifold vacuum and carburetor ported vacuum are both used for the ignition vacuum spark advance mechanism with six- and eight-cylinder engines. On some engines, a Coolant Temperature Override (CTO) valve selects the appropriate vacuum source, depending upon coolant temperature. On other engines, a Non-Linear Vacuum Regulator (NLVR) valve combines manifold vacuum at idle speed and carburetor ported vacuum at a ratio that is proportional to the amount of throttle opening. Refer to the Emission Components charts in Chapter 1A for applicable engine application.

Spark Coolant Temperature Override (CTO) Valve—Standard Cooling System

General

On six- and eight-cylinder engines with a spark CTO valve, the distributor vacuum spark advance is controlled by carburetor ported vacuum after the engine coolant warms to a predetermined temperature. Warm-up driveability is improved by controlling the spark advance by manifold vacuum while the engine is cold. This is accomplished by the spark control system (fig. 1G-21). The CTO valve is screwed into the intake manifold coolant passage on six-cylinder engines, and into the thermostat housing or intake manifold coolant passage on eight-cylinder engines. A thermal sensor in the CTO valve is in contact with engine coolant (fig. 1G-22). Depending on coolant temperature, the CTO valve permits either manifold vacuum or carburetor ported vacuum to control distributor vacuum advance.

NOTE: *Some engine applications utilize a standard cooling system CTO valve in conjunction with a heavy duty cooling system CTO valve. Refer to Vacuum Diagrams for actual applications.*

Operation

When coolant temperature is below 149°F (65°C), manifold vacuum is exposed at port 1 and is applied to port D. A hose connects port D with the distributor spark vacuum advance mechanism diaphragm. In this operating mode, full vacuum advance is obtained.

When engine coolant reaches 149°F (65°C), valve is moved upward, blocking manifold vacuum at port 1. Carburetor ported vacuum is exposed at port 2 and is applied to port D. The distributor spark vacuum advance mechanism diaphragm is now controlled by ported vacuum. This may be regarded as the normal operating mode.

Functional Test

Connect a vacuum gauge to the center port (D) of the CTO valve. Below 149°F (65°C) manifold vacuum should be indicated on gauge. Above 149°F (65°C) carburetor ported vacuum should be indicated on gauge. Defective valves must be replaced.

NOTE: *Ported vacuum is not available with the throttle closed. Ported vacuum is only available when the throttle is opened to achieve an engine speed of approximately 1000 rpm.*

Spark Coolant Temperature Override (CTO) Valve—Heavy-Duty Cooling System

General

This is a single function valve that is utilized in conjunction with a heavy-duty cooling system to prevent overheating during high ambient temperatures. It is connected to the engine coolant passage in the same place as the CTO valve used with standard cooling systems.

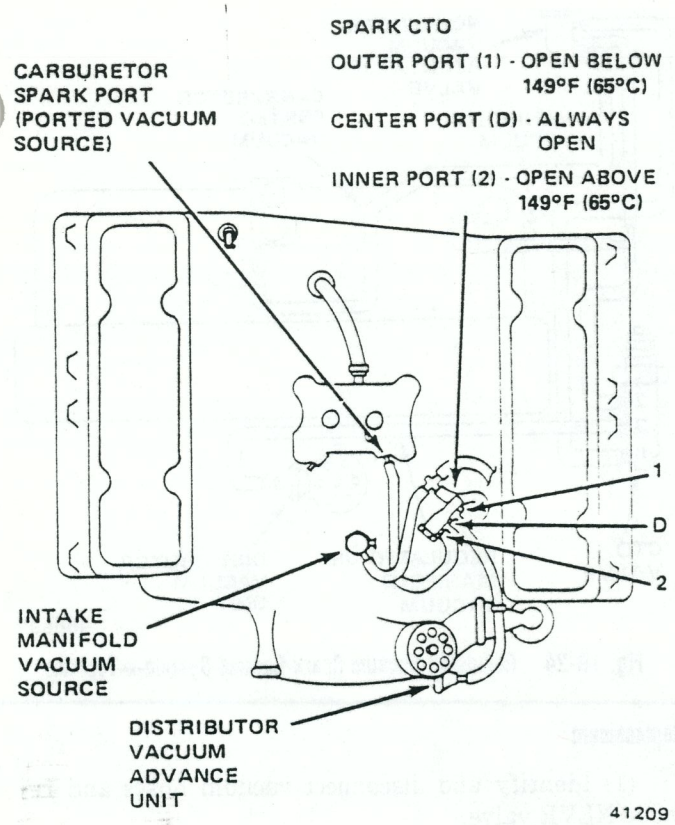

Fig. 1G-21 Spark Control System—Typical—Six- and Eight-Cylinder Engines With Standard Cooling System

NOTE: *Some engine applications utilize a heavy-duty cooling system CTO valve in conjunction with a standard cooling system CTO valve. Refer to Vacuum Diagrams for actual applications.*

Operation

When the coolant temperature is below the switching temperature (220°F [104°C]), ported vacuum is exposed at port 1 and applied to port D to allow ported vacuum to control the distributor vacuum advance. When the coolant temperature reaches 220°F (104°C), port 1 closes and port 2 is connected to port D to allow manifold vacuum to control the distributor vacuum advance. With manifold vacuum applied to the vacuum advance mechanism, engine idle speed is increased thereby improving engine cooling efficiencies and reducing idle speed boiling tendencies.

Functional Test

(1) Connect vacuum gauge to port D (Dist.) of the heavy-duty cooling system CTO valve. Below 220°F (104°C), carburetor ported vacuum should be indicated on gauge.

(2) Above 220°F (104°C), port 1 (Carb.) closes and port 2 (Manifold) is connected to port D (Dist.). Manifold vacuum should now be indicated on gauge.

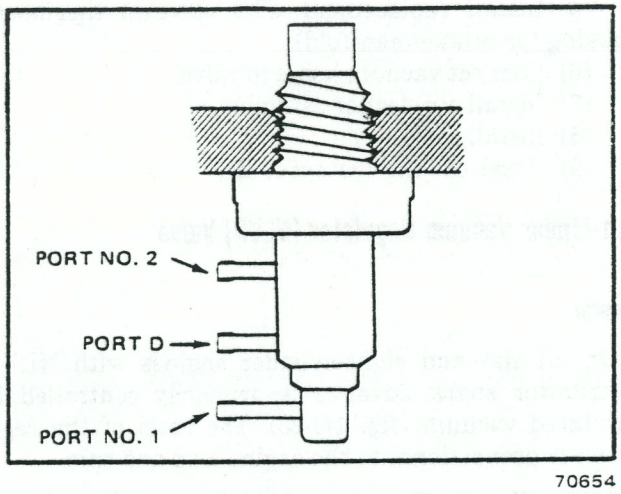

Fig. 1G-22 Spark CTO Valve

Spark CTO Valve Replacement—Six-Cylinder Engine

WARNING: *If engine has been recently operated, use care to prevent scalding by hot coolant. System is pressurized.*

(1) Drain coolant from radiator. Use clean container so that coolant can be reused.

(2) Identify vacuum hoses and disconnect from spark CTO valve.

(3) Place drain pan under engine below CTO valve.

WARNING: *Use care to prevent scalding by hot coolant leaking from block when removing the valve.*

(4) Using 7/8-inch open end wrench, remove valve from intake manifold.

Installation—Six-Cylinder

(5) Install replacement valve.

(6) Connect vacuum hoses to valve.

(7) Install coolant.

NOTE: *Remove temperature gauge sending unit from cylinder head to aid in venting air while filling the cooling system.*

Spark CTO Valve Replacement—Eight-Cylinder Engine

WARNING: *If engine has been recently operated, use care to prevent scalding by hot coolant. System is pressurized.*

(1) Drain coolant from radiator. Use clean container so coolant can be reused.

(2) Remove air cleaner assembly.

(3) Identify vacuum hoses and disconnect from CTO valve.

(4) Using 7/8-inch open end wrench, remove CTO valve from thermostat housing (or intake manifold).

(5) Install replacement CTO valve in thermostat housing (or intake manifold).
(6) Connect vacuum hoses to valve.
(7) Install air cleaner assembly.
(8) Install coolant.
(9) Purge cooling system of air.

Non-Linear Vacuum Regulator (NLVR) Valve

General

On all six- and eight-cylinder engines with NLVR, distributor spark advance is primarily controlled by regulated vacuum (fig. 1G-23). The ratio of the regulation is proportional to the engine load and rpm.

NOTE: *The NLVR valve operates in conjunction with a spark CTO valve.*

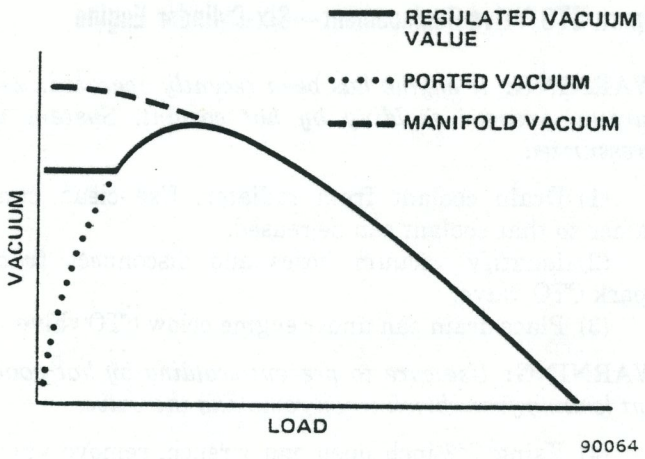

Fig. 1G-23 Non-Linear Vacuum Regulator Valve Operation

Operation

The NLVR valve has two input ports (from manifold vacuum and carburetor ported vacuum sources) and one outlet port (to CTO valve). Under no-load or low-load engine conditions, the NLVR valve provides regulated vacuum (fig. 1G-24). Under these conditions, manifold vacuum is high and ported vacuum is either non-existent or very low. The NLVR valve provides a vacuum that is somewhere between the two vacuum levels. This is determined by the calibration of the valve. As engine load increases and ported vacuum increases above the regulated value, the regulator valve switches to ported vacuum.

Functional Test

Connect a vacuum gauge to the distributor port (D) of the NLVR valve. With the engine at idle speed, a vacuum of approximately 7 in. Hg (24 kPa) should be indicated on the gauge. As the throttle is opened and engine speed increases, ported vacuum from the carburetor should be indicated on the vacuum gauge.

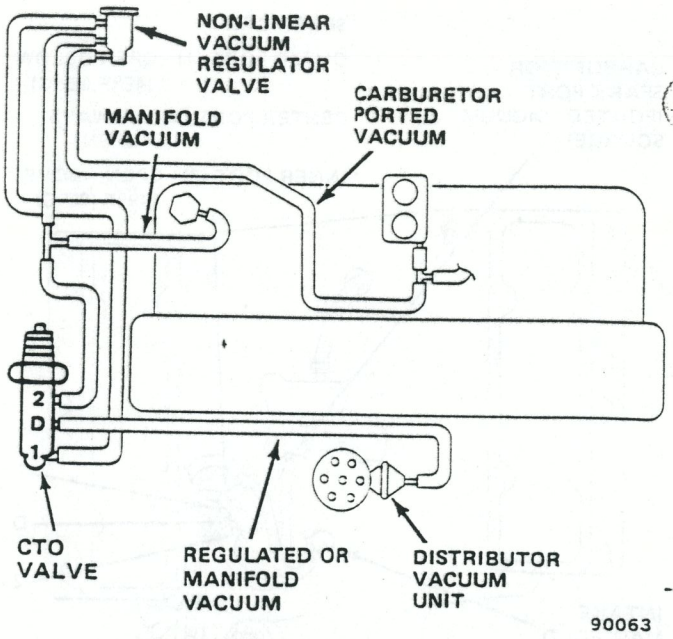

Fig. 1G-24 Regulated Vacuum Spark Control System—Typical

Replacement

(1) Identify and disconnect vacuum hoses and remove NLVR valve.

(2) Connect vacuum hoses to replacement valve.

NOTE: *Ensure vacuum hoses are connected to correct valve ports.*

Forward Delay Valve

Certain engines employ a one-way forward delay valve in the vacuum advance circuit to improve driveability and also reduce undesirable hydrocarbon (HC) emission.

The valve functions to delay the effects of sudden increases in vacuum during quick throttle closings and thereby prevent sudden spark advance during deceleration.

Functional Test

(1) Connect external vacuum source to port on black (or red) side of delay valve.

(2) Connect one end of 24-inch section of rubber hose to vacuum gauge and other end to port on colored side of valve.

(3) With elapsed time device in view and a constant 10 in. Hg (34 kPa) of vacuum applied, note time required for gauge pointer to move from 0 to 8 in. Hg (0 to 27 kPa).

(4) Compare time to acceptable time limits listed in Forward Delay Valve Time Limits Chart.

Forward Delay Valve Time Limits

VALVE BODY COLOR	DELAY TIME IN SECONDS	
	MIN.	MAX.
BLACK/PURPLE	0.3	0.7
BLACK/GRAY	0.6	1.6
BLACK/BROWN	1.0	3.0
RED/BLUE	1.9	5.7
BLACK/WHITE	2.7	9.3
BLACK/YELLOW	4.5	13.2
BLACK/GREEN	8.0	26.0

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NOTE: *While testing delay valves use care to prevent oil or other foreign material from entering vacuum ports.*

(5) Replace valve if it fails test, otherwise, install original with black (or red) side toward vacuum source.

NOTE: *In addition to the valves listed in the chart, certain engine applications employ a two-way delay valve. The body is orange and the minimum and maximum delay time limits are 0.2 to 0.4 seconds.*

Reverse Delay Valve

Along with the forward delay valve, a reverse delay valve is used with certain engines to improve cold engine driveability and to reduce undesirable hydrocarbon (HC) emission.

When an engine is started, manifold vacuum applied to the distributor vacuum advance mechanism advances ignition timing. When the engine is accelerated manifold vacuum decreases causing the ignition timing to be retarded. To prevent the sudden retarding of ignition timing during acceleration, a one-way reverse delay valve is inserted in the vacuum line to delay the effects of the decrease in manifold vacuum.

Functional Test

(1) Connect external vacuum source to port on colored (nonwhite) side of delay valve.

(2) Connect one end of 24-inch section of rubber hose to vacuum gauge and other end to port on white side of valve.

(3) With elapsed time device in view and a constant 10 in. Hg (34 kPa) of vacuum applied, note time required for gauge pointer to move from 0 to 8 in. Hg (0 to 27 kPa).

(4) Compare time to acceptable time limits listed in Reverse Delay Valve Time Limits Chart.

Reverse Delay Valve Time Limits

VALVE BODY COLOR	DELAY TIME IN SECONDS	
	MIN.	MAX.
WHITE/PURPLE	0.3	0.7
WHITE/GRAY	0.6	1.6
WHITE/GOLD	0.8	2.3
WHITE/BROWN	1.0	3.0
WHITE/YELLOW	4.5	13.2
WHITE/RED	14.0	47.2

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NOTE: *While testing delay valves use care to prevent oil or other foreign matter from entering vacuum ports.*

(5) Replace valve if it fails test, otherwise, install original with colored (nonwhite) side toward vacuum source.

SPECIFICATIONS

SPARK CONTROL SYSTEM SPECIFICATIONS
SPARK CTO VALVE CONTINUITY

ENGINE	STANDARD COOLING		HEAVY DUTY COOLING	
	1 To D	2 To D	1 To D	2 To D
4-151	Below 120°F (49°C)	Above 120°F (65°C)	———	———
6-258	Below 149°F (65°C)	Above 149°F (65°C)	Below 220°F (104°C)	Above 220°F (104°C)
8-304	Below 149°F (65°C)	Above 149°F (65°C)	Below 220°F (104°C)	Above 220°F (104°C)
8-360	Below 149°F (65°C)	Above 149°F (65°C)	Below 220°F (104°C)	Above 220°F (104°C)

NOTE: TEMPERATURES ARE NORMAL VALUES

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NOTES

CRUISE COMMAND 1H

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SIX-CYLINDER ENGINE SYSTEM

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GENERAL

The Jeep six-cylinder engine electronic Cruise Command operation is limited to speeds above 30 mph (48 km/h). At any speed above 30 mph (48 km/h), the unit will maintain the selected vehicle speed within 3.5 mph (5.6 km/h) on upgrades not exceeding 3 percent (most interstate highways). A change greater than 3.5 mph (3.6 km/h) may be experienced with vehicles having an economy axle ratio or when driving in unusually steep terrain, or at high altitudes.

To activate the system, move the slide switch to the ON position and accelerate to the desired speed. Depress the SET button on the end of the turn signal switch lever and release. The system will be activated when the SET button is released.

The driver may regain normal control by moving the slide switch to the OFF position or by lightly depressing the brake pedal. If the brake method is used, the previously selected vehicle speed will remain in memory and may be regained by momentarily sliding the switch to the RESUME/ACCEL position when the speed is above 30 mph (48 km/h). The memory is erased by turning the unit OFF or by turning the ignition switch Off.

If a lower speed is desired while cruising at a selected speed, depress the SET pushbutton and hold until the vehicle decelerates to the new speed. When the button is released, the new selected speed will be maintained.

If a higher speed is desired, accelerate to the desired speed, depress the SET button and release.

A higher speed may also be attained by moving the RESUME/ACCEL slide switch to the left and holding. The vehicle will accelerate until the switch is released. When released, the vehicle will decelerate until the speed control resumes controlling the throttle at the previously set speed. If the speed control is ON but not set at a cruise speed, when the RESUME/ACCEL switch is released the vehicle will decelerate as the throttle moves to the curb idle position.

WARNING: *Do not use the Cruise Command when driving on slippery or congested roads.*

COMPONENTS

The Cruise Command is a closed loop electro-mechanical servo system that consists of the following components: electronic regulator, speed sensor, servo, control switch assembly (fig. 1H-1), and the release mechanisms, which consist of a vacuum dump valve, vacuum storage can and check valve.

Electronic Regulator

The electronic regulator receives an input voltage that represents vehicle speed from the speed sensor, which is

driven by the speedometer cable. The regulator (located under the instrument panel) has a low speed circuit that prevents operation below 30 mph (48 km/h).

The regulator is sealed by the manufacturer and cannot be serviced internally, although an external adjustment is possible.

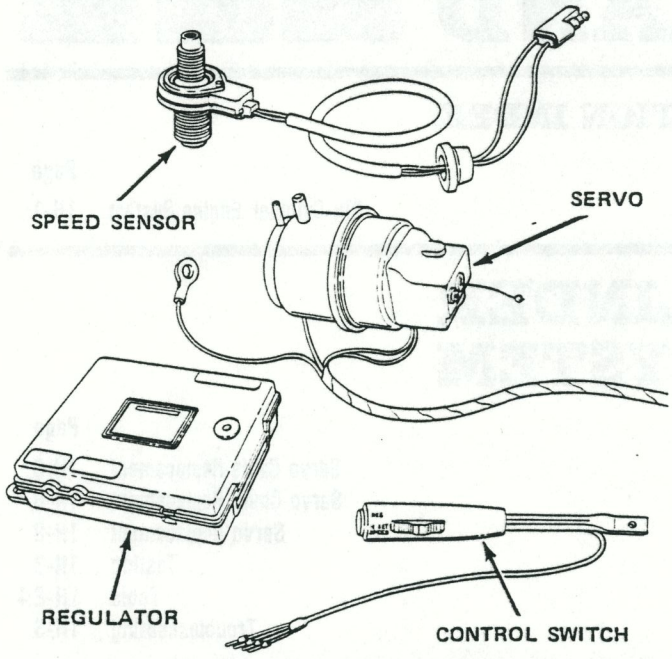

Fig. 1H-1 Electronic Cruise Command Components

Speed Sensor

The speed sensor is a tach-generator installed between upper and lower speedometer cables. It converts speedometer cable revolutions into a speed analog voltage input for the regulator.

Servo

The servo, mounted in the engine compartment, is controlled by the regulator and, in turn, uses manifold vacuum to control the throttle. A bead-link chain connects the servo cable to the throttle linkage.

Control Switch Assembly

The control switch assembly is an integral part of the turn signal switch lever. It functions as a communication link between the driver and the regulator assembly.

Release System

The release system deenergizes the Cruise Command by two methods and both are activated when the brake pedal is depressed. The valves that control vacuum in the servo are electrically controlled by the regulator. When the brake pedal is depressed, current flow through the brake lamps causes the regulator to deactivate the servo. The vacuum charge valve is closed and the servo vent valve is opened. To further ensure immediate servo release, a brake pedal-activated mechanical vacuum vent switch (operating independently of the electrical valves) admits atmospheric pressure into the servo whenever the brake pedal is depressed. A hissing sound may be heard momentarily.

OPERATION

Servo

The selected vehicle speed is maintained by the servo, which controls the carburetor throttle position according to regulator output. Two solenoid-controlled valves are used to control manifold vacuum applied to the servo (fig. 1H-2). In the deactivated state, the charge valve blocks manifold vacuum, while the vent valve admits atmospheric pressure. The spring relaxes the diaphragm and throttle position is unaffected. When the charge valve is energized, manifold vacuum moves the diaphragm and opens the throttle. Throttle position is maintained for any speed above 30 mph (48 km/h) by balancing the vacuum charge and vacuum vent. The controlled voltage that accomplishes this is provided by the regulator.

NOTE: *Manifold vacuum is applied to the vacuum storage can through the one-way valve whenever the engine is operating. As the Cruise Command depletes the vacuum in the can, it is replaced as needed. The can functions as a storage reservoir and provides relatively steady vacuum even when engine manifold vacuum is temporarily low.*

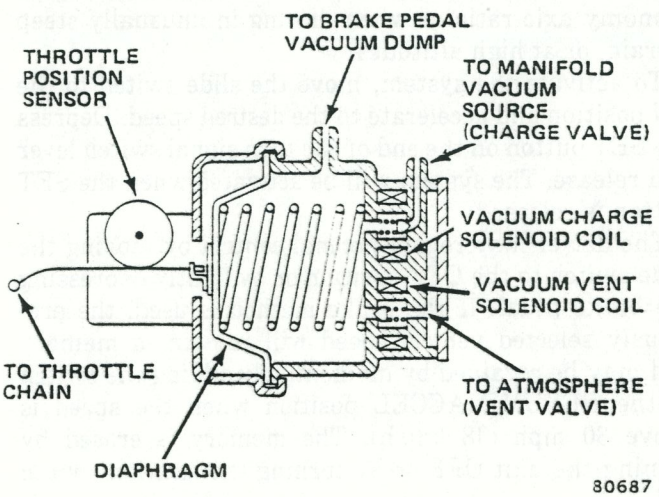

Fig. 1H-2 Servo Assembly

Electronic Regulator

The electronic regulator is a sealed black box that contains several electronic circuits.

The speed sensor, driven by the speedometer cable, is a tach-generator that functions as the source for the vehicle speed analog voltage. The AC voltage generated by the sensor is applied to the amplifier section of the regulator, which amplifies and shapes it. The amplified voltage signal is further modified by the frequency-to-DC converter, which transforms the variable AC voltage into a DC voltage that is proportional to the vehicle speed.

The DC voltage is supplied to three circuits for further action. The low speed switch compares the amplitude of the DC voltage with a reference voltage that is equivalent to 30 mph (48 km/h). If the DC voltage amplitude is greater than the reference, the engage/resume/accelerate circuit of the system is activated. The vehicle speed DC voltage is also applied to the high and low comparators and to the memory.

When the SET button is depressed, the memory stores the DC voltage for future reference. Two reference voltages are produced by the memory, one represents the set speed plus 1/4 mph (0.4 km/h) and the other represents set speed minus 1/4 mph (0.4 km/h). The plus reference voltage is applied to the high comparator and the minus reference voltage is applied to the low comparator.

If the DC voltage amplitude from the DC converter (representing vehicle speed) remains between the plus and minus reference voltages, the regulator maintains the charge valve in the closed position. The vent valve is also maintained in the closed position. In this condition, the throttle position remains fixed.

NOTE: *In the closed position, the charge valve solenoid is deenergized and the vent valve solenoid is energized.*

Whenever a grade is encountered, road speed decreases, speed sensor output decreases and the DC voltage amplitude from the DC converter also decreases a proportional amount. This creates an error voltage that will be detected by the low comparator. When the amplitude of this voltage drops below the low comparator reference voltage (set speed minus 1/4 mph or 0.4 km/h), the charge valve is energized, the diaphragm moves to pull the throttle cable and chain and the throttle is opened further. As the throttle moves, a throttle-position sensor inside the servo is activated to provide feedback to both comparators. Without it, the throttle would continue to be opened further than necessary to maintain the set speed. The throttle-position sensor feedback voltage eliminates the error voltage by increasing the DC voltage input to the comparators. When this voltage is increased to an amplitude that is between the high and low reference voltages, the charge valve is deenergized (closed) and maintains the throttle in its new position. In this manner, changes in throttle position are proportional to the amount that vehicle speed differs from the set speed. For over-speed conditions (such as descending a hill), the operation is similar, except the high comparator and vent valve are involved. The high comparator detects the DC voltage amplitude increase (error voltage) from the DC converter and deenergizes (opens) the vent valve, admitting atmospheric pressure. The throttle begins to close. The throttle closing activates the throttle-position sensor and the feedback eliminates the error voltage when the vehicle speed decreases to the set speed and the input to the comparators is again between the two speed reference voltages.

The high and low comparators operate only when the engage/resume/accelerate circuit is activated. This is accomplished by depressing the SET button or by moving the slide switch to RESUME/ACCEL. When the SET button is depressed and released, the memory is updated to store the current vehicle speed voltage. The engage/resume/accelerate circuit is deactivated by depressing the brake pedal or by the vehicle speed voltage falling below the low speed reference voltage (30 mph or 48 km/h).

TROUBLESHOOTING

To troubleshoot the Cruise Command system, refer to the Service Diagnosis Chart and Testing.

Refer to Chapter 3C—Instrument Panels and Components for details of speedometer cable and gear relacement.

TESTING

Perform the following tests as part of the service diagnosis to determine the cause of the malfunction and the correction required.

Control Switch Continuity Test

Use a 12-volt test lamp to test control switch continuity. Connect the tester to the wires indicated in the Control Switch Continuity Test (fig. 1H-3).

Circuitry Tests

Wire Harness Connector

Perform the following tests as part of the service diagnosis to determine the cause and correction of a Cruise Command malfunction. Refer to figure 1H-4 for wiring diagram.

(1) Disconnect wire harness connector at regulator. Use suitable thin tool to depress tab inside hole on regulator marked "Terminal Release."

(2) Verify that each wire is installed in correct location. Refer to figures 1H-4 and 1H-5.

Service Diagnosis

Condition	Possible Cause	Correction
SYSTEM DOES NOT ENGAGE IN "ON" POSITION	(1) Restricted vacuum or no vacuum.	(1) Locate blockage or leak and repair.
	(2) Control switch defective.	(2) Replace switch.
	(3) Regulator defective.	(3) Replace regulator.
	(4) Speed sensor defective.	(4) Replace sensor.
	(5) Brake lamps defective.	(5) Replace brake lamps.
	(6) Brake light switch defective.	(6) Replace switch.
	(7) Brake light switch disconnected.	(7) Connect wire to switch.
	(8) Open circuit between brake light switch and brake lamps.	(8) Repair open circuit.
	(9) Dump valve improperly adjusted.	(9) Adjust dump valve.
RESUME FEATURE INOPERATIVE	(1) Bad ground.	(1) Check ground wire at servo.
	(2) Control switch defective.	(2) Replace switch.
ACCELERATE FUNCTION INOPERATIVE	(1) Accelerate circuit in regulator inoperative.	(1) Replace Regulator.
	(2) Control Switch Defective.	(2) Replace Switch.
SYSTEM RE-ENGAGES WHEN BRAKE IS RELEASED	(1) Regulator defective.	(1) Replace regulator.
	(2) Dump valve not opening.	(2) Adjust or replace valve.
	(3) Kink in dump valve hose.	(3) Reroute to remove kink.
	(4) Brake light switch defective.	(4) Adjust or replace switch.
CARBURETOR DOES NOT RETURN TO IDLE	(1) Improper linkage adjustment.	(1) Adjust properly.
	(2) Improper chain adjustment.	(2) Adjust chain.
ROAD SPEED CHANGES MORE THAN 2 MPH WHEN SETTING SPEED	(1) Centering adjustment set wrong.	(1) Adjust centering screw.
ENGINE ACCELERATES WHEN STARTED	(1) No slack in bead chain.	(1) Adjust chain.
	(2) Vacuum connections reversed at servo.	(2) Check connection and correct.
	(3) Servo defective.	(3) Replace servo.

Service Diagnosis (Continued)

Condition	Possible Cause	Correction
SYSTEM DISENGAGES ON LEVEL ROAD WITHOUT APPLYING BRAKE	(1) Loose wiring connection.	(1) Tighten connections.
	(2) Loose vacuum connection.	(2) Check vacuum connections.
	(3) Servo linkage broken.	(3) Repair linkage.
	(4) Defective stop lamp switch.	(4) Replace switch.
ERRATIC OPERATION	(1) No polarity.	(1) Check connection of sensor wires.
	(2) Servo defective.	(2) Replace servo.
	(3) Regulator defective.	(3) Replace regulator.
VEHICLE CONTINUES TO ACCELERATE WHEN PUSH BUTTON IS RELEASED	(1) Servo defective.	(1) Replace servo.
	(2) Regulator defective.	(2) Replace regulator.
SYSTEM ENGAGES, LOSES SET SPEED SLOWLY	(1) Vacuum leak at hose connection or in hose.	(1) Check hoses and connections.
	(2) Vacuum leak at dump valve on brake pedal.	(2) Replace dump valve.

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Speed Sensor Test

(1) Disconnect wire harness connector at speed sensor.

(2) Connect voltmeter set on low AC scale to wire terminals from speed sensor.

(3) Raise front and rear wheels of vehicle off ground and support vehicle with safety stands.

(4) Operate engine (wheels spinning freely) at 30 mph (48 km/h) and note voltage. Voltage should be approximately 0.9 volt. Increases of 0.1 volt per each 10 mph (16 km/h) increase in speed should also be indicated.

(5) Turn off engine and slowly halt wheels.

(6) Disconnect voltmeter.

(7) Connect speed sensor wire harness.

(8) Remove safety stands and lower vehicle.

Cruise Command System Diagnosis

A Cruise Command System diagnosis can be quickly and accurately performed with the Cruise Command Tester (AM-PC-1-R).

(1) Remove harness connector from regulator.

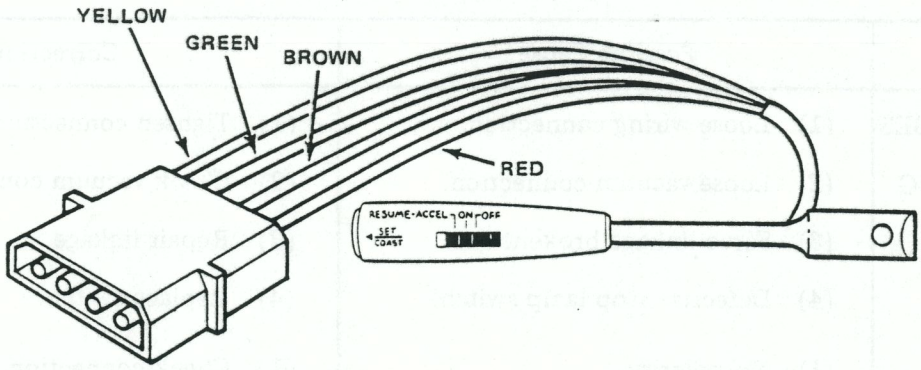
(2) Connect Cruise Command System Tester to harness connector.

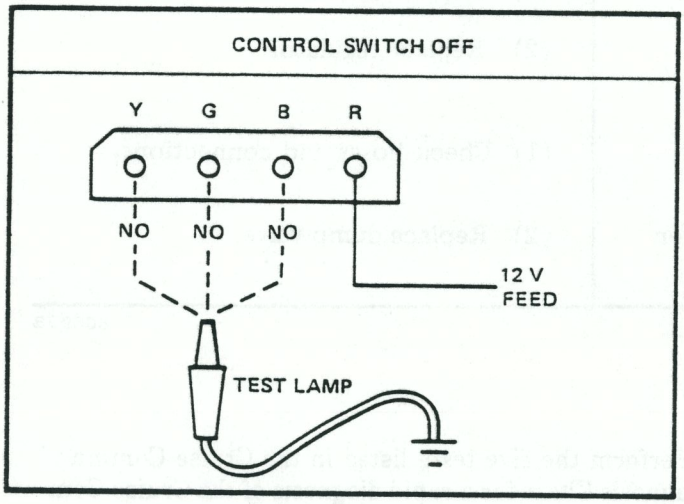
Perform the five tests listed in the Cruise Command Diagnosis Chart for a rapid diagnosis of the Cruise Command System.

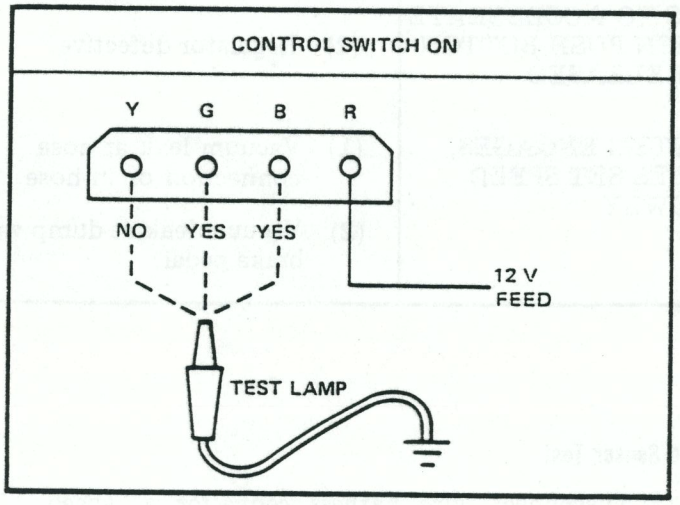
Tester AM-PC-1-R

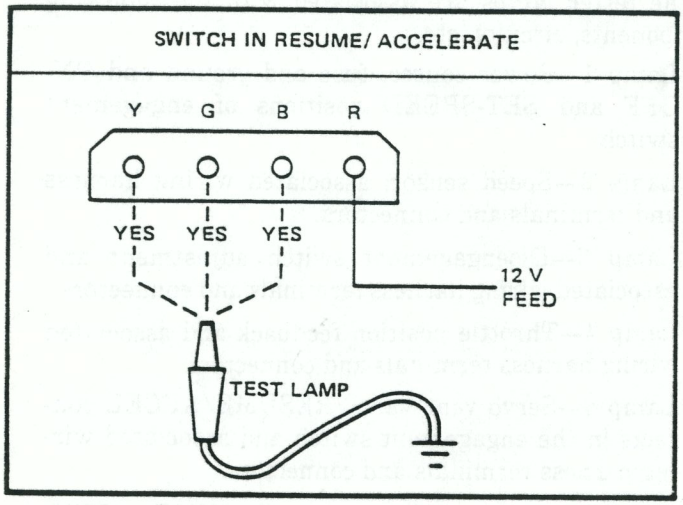
The tester lamps are associated with the following components, circuits, etc.

- Lamp 1—Power source, fuse and ground and ON-OFF and SET-SPEED positions of engagement switch.
- Lamp 2—Speed sensor, associated wiring harness and terminals and connectors.
- Lamp 3—Disengagement switch adjustment and associated wiring harness terminals and connectors.
- Lamp 4—Throttle position feedback and associated wiring harness terminals and connectors.
- Lamp 5—Servo vent valve, RESUME/ACCEL contacts in the engagement switch and associated wiring harness terminals and connectors.
- Lamp 6—Servo charge valve, RESUME/ACCEL contacts of the engagement switch and associated wiring harness terminals and connectors.









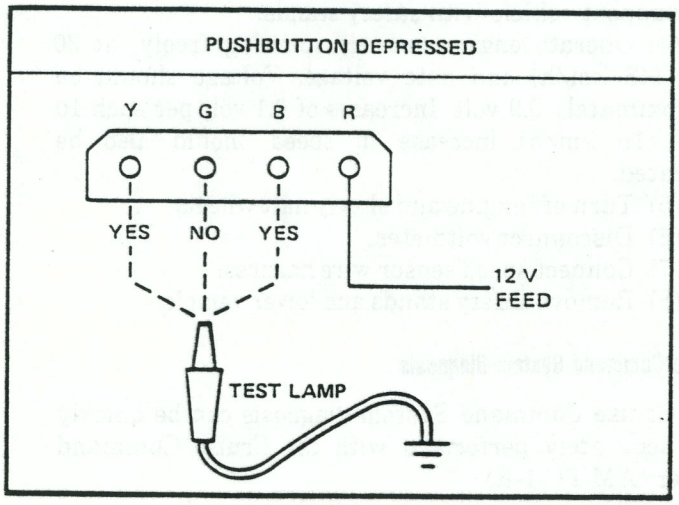


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Fig. 1H-3 Control Switch Continuity Test

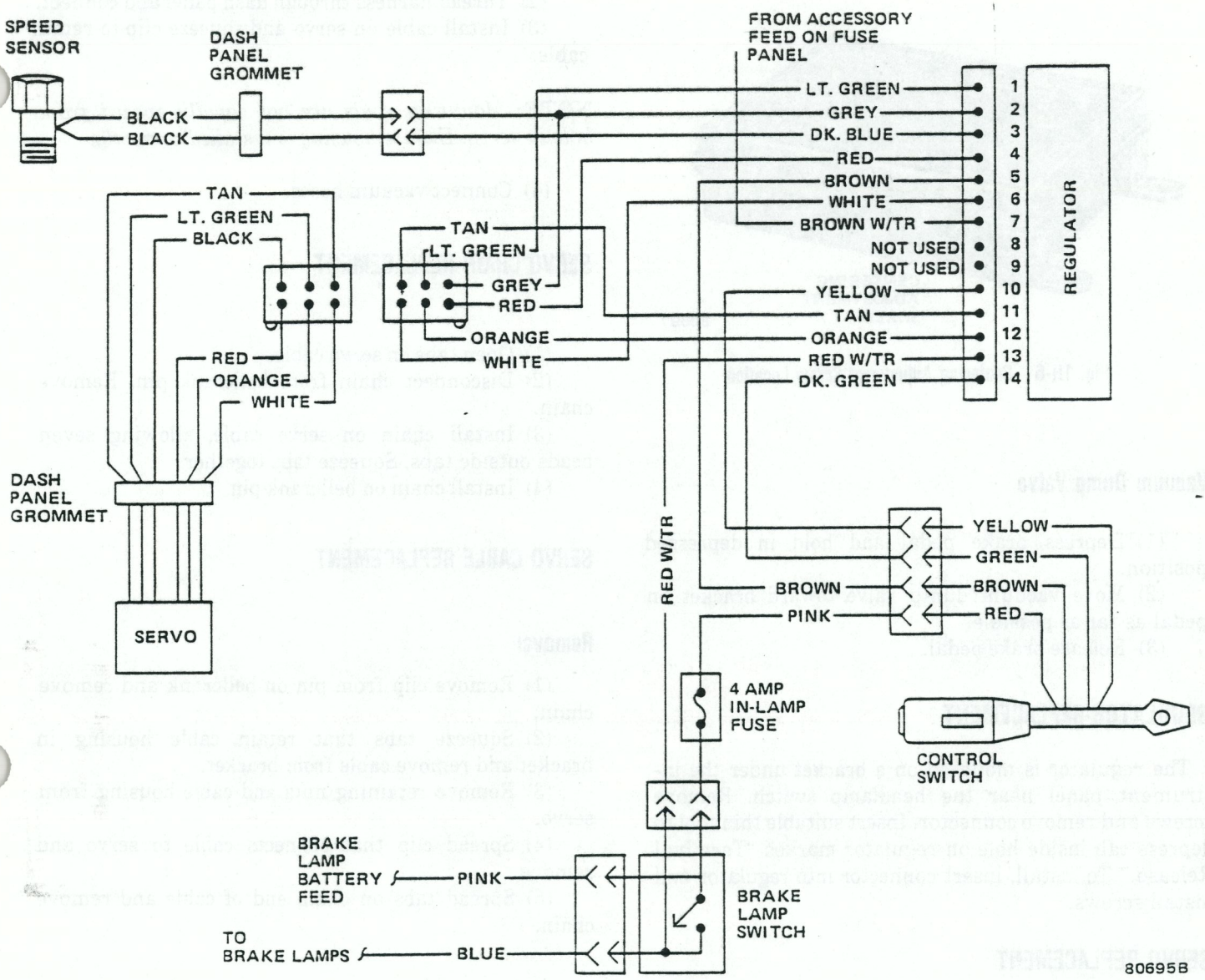

Fig. 1H-4 Cruise Command Wiring Diagram

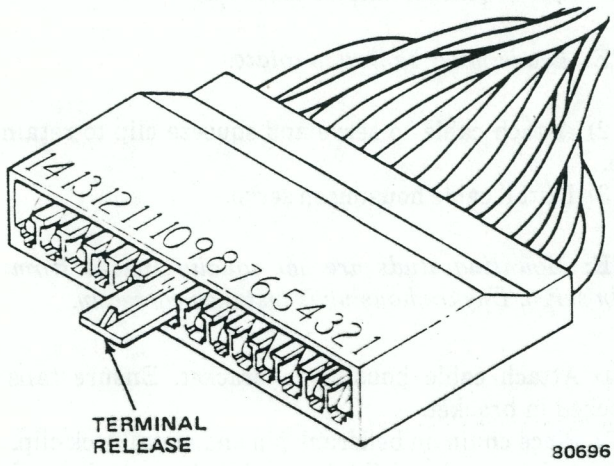

Fig. 1H-5 Harness Connector at Regulator

ADJUSTMENTS

Centering Adjustment

Adjustment is made by turning the centering adjustment screw on the regulator (fig. 1H-6).

If the speed control engages at two or more mph (3.2 km/h) higher than the selected vehicle speed, turn centering adjusting screw counterclockwise a small amount. If engagement speed is two or more mph (3.2 km/h) below selected speed, turn centering adjusting screw clockwise a small amount (fig. 1H-6).

NOTE: *Check for proper centering adjustment on a level road after each adjustment.*

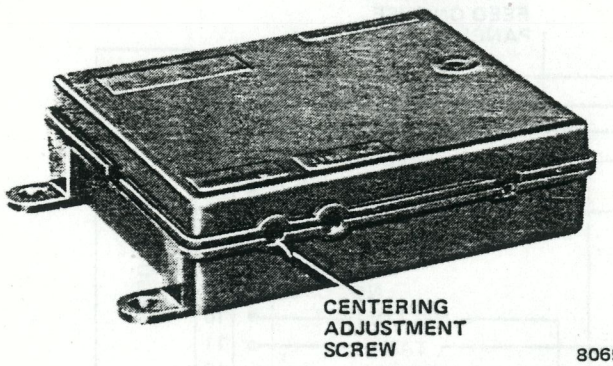

Fig. 1H-6 Centering Adjustment Screw Location

Vacuum Dump Valve

(1) Depress brake pedal and hold in depressed position.
(2) Move vacuum dump valve toward bracket on pedal as far as possible.
(3) Release brake pedal.

REGULATOR REPLACEMENT

The regulator is mounted on a bracket under the instrument panel near the headlamp switch. Remove screws and remove connector. Insert suitable thin tool to depress tab inside hole on regulator marked "Terminal Release." To install, insert connector into regulator and install screws.

SERVO REPLACEMENT

Removal

(1) Remove retaining nuts and cable housing from servo.
(2) Spread clip connecting cable to servo and remove.
(3) Disconnect vacuum hoses from servo.
(4) Remove retaining nut and servo from bracket. Note position of ground cable.
(5) Disconnect harness under instrument panel. Carefully thread harness through dash panel and remove servo.

Installation

(1) Attach servo and nut to bracket. Tighten with 60 inch-pounds (7 N•m) torque. Ensure ground cable is positioned on stud.
(2) Thread harness through dash panel and connect.
(3) Install cable on servo and squeeze clip to retain cable.

NOTE: *Mounting studs are not equally spaced from hole in servo. Ensure housing is installed correctly.*

(4) Connect vacuum hoses.

SERVO CHAIN REPLACEMENT

(1) Open tabs on servo cable.
(2) Disconnect chain from bellcrank pin. Remove chain.
(3) Install chain on servo cable, allowing seven beads outside tabs. Squeeze tabs together.
(4) Install chain on bellcrank pin.

SERVO CABLE REPLACEMENT

Removal

(1) Remove clip from pin on bellcrank and remove chain.
(2) Squeeze tabs that retain cable housing in bracket and remove cable from bracket.
(3) Remove retaining nuts and cable housing from servo.
(4) Spread clip that connects cable to servo and remove.
(5) Spread tabs on chain end of cable and remove chain.

Installation

(1) Connect chain to cable and squeeze tabs. Allow seven beads to remain outside cable tab.

NOTE: *Beads must be free to rotate.*

(2) Attach cable to servo and squeeze clip to retain cable.
(3) Install cable housing on servo.

NOTE: *Mounting studs are not equally spaced from hole in servo. Ensure housing is installed correctly.*

(4) Attach cable housing to bracket. Ensure tabs are locked in bracket.
(5) Place chain on bellcrank pin and install lock clip. Seven beads must be visible between bellcrank clip and cable clip.

CONTROL SWITCH ASSEMBLY REPLACEMENT

The Cruise Command control switch assembly is integral with the turn signal switch lever. The switch is not repairable. The switch and harness assembly can be replaced only as a complete unit.

Removal

(1) Remove following items.
- (a) Horn button insert
- (b) Steering wheel
- (c) Anti-theft cover
- (d) Locking plate and horn contact

(2) Remove turn signal switch lever and control switch assembly (allow handle to hang loose outside steering column).

(3) Remove four-way flasher knob.

(4) Remove holddown screws and turn signal switch.

(5) Remove trim piece from under steering column.

(6) Disconnect four-wire connector.

(7) *Tilt Column*—**Remove harness from plastic connector. Tape two of four wires back along harness (to allow smaller diameter) and tape string to harness.**

(8) *Standard Column*—**Tie or tape string to plastic connector.**

(9) Remove lever and harness assembly from column.

Installation

(1) Test replacement Cruise Command control switch by connecting to wire harness before installing in steering column. Refer to Control Switch Continuity Test.

NOTE: *When installing, the harness must be routed through the turn signal lever opening because the handle will not fit through the opening.*

(2) Tape two of four leads back along harness. Tape harness to string that was attached to original harness before removal.

(3) Pull replacement harness down through steering column. On tilt column, harness must pass through hole on left side of steering shaft.

NOTE: *It may be necessary to loosen steering column mounting screws for easier routing of harness.*

(4) Install turn signal switch and four-way flasher knob.

(5) Install turn signal switch lever and control switch assembly.

(6) Install horn contact, locking plate and lock ring anti-theft cover.

(7) Install steering wheel and horn button insert.

(8) Install trim on steering column.

Cruise Command Diagnosis Chart

TEST AND CONDITIONS	TEST LAMP RESULTS	CHECK—REPAIR
(1) Test for Correct Power Source Connection Ignition Switch—Off Engagement Switch—Off	All Lamps Off	None
	One or More Lamps On	Remove brown wire (5) from direct source of voltage or repair defective engagement switch.
(2) Test for System Electrical Continuity Ignition Switch—On Engagement Switch—On	Lamps 1, 2, 3, & 4 On, Lamps 5 & 6 Off	None
	Lamp 1 Off	Check for blown fuse in pink wire circuit. Check red, brown & grey wires at engagement switch connector for continuity to switch. Check dark green wire at regulator connector for continuity to regulator.
	Lamp 2 Off	Check speed sensor continuity. Check grey & dark blue wire at speed sensor for continuity. Check terminals 2, 3, 5 & 7 at regulator connector for proper connection to wires.

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TEST AND CONDITIONS	TEST LAMP RESULTS	CHECK—REPAIR
(2) Test for System Electrical Continuity Ignition Switch—On Engagement Switch—On	Lamp 3 Off	Check brake light switch adjustment. Check brown, light blue & green wire connections for continuity.
	Lamp 4 Off	Check terminals 2 & 11 on regulator connector. Check continuity of throttle position feedback potentiometer on servo.
(3) Test for Servo Valve Continuity Ignition Switch—On Engagement Switch—On Set Speed Switch—Depressed	Lamp 2, 3, 4, 5 & 6 On Lamp 1 Off Lamp 4 will dim when servo moves throttle to wide open position with engine operating.	None
WARNING: If engine is operating, servo will move throttle to wide open position.	Lamp 2 Off	Refer to Test 2, Lamp 2 Off.
	Lamp 3 Off	Refer to Test 2, Lamp 3 Off.
	Lamp 4 Off	Refer to Test 2, Lamp 4 Off.
	Lamp 5 Off	Check for defective connections at terminals 6 & 12 on regulator connector. Replace defective servo.
	Lamp 6 Off	Check for defective connection at terminals 4 & 12 on regulator connector. Replace defective servo.
	All lamps Off after depressing set speed switch or moving engagement switch to resume/ acceleration position.	Check for blown fuse. Check for shorts in red, pink & brown wire circuits. Replace defective servo.
(4) Test for System Disengagement with Brake Pedal Depressed Ignition Switch—On Engagement Switch—On Brake Pedal Depressed	Lamps 1, 2 & 4 On Lamps 3, 5 & 6 Off Lamp 3 On when brake pedal is released.	None
	Lamp 1 Off	Refer to Test 2, Lamp 1 Off.
	Lamp 2 Off	Refer to Test 2, Lamp 2 Off.
	Lamp 4 Off	Refer to Test 2, Lamp 4 Off.
	Lamp 3 Off when brake pedal is released.	Refer to Test 2, Lamp 3 Off.

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TEST AND CONDITIONS	TEST LAMP RESULTS	CHECK—REPAIR
(5) Test Resume/Acceleration Position of Engagement Switch Ignition Switch—On Engagement Switch—On Move engagement switch to resume/accelerate position. WARNING: If engine is operating, servo will move throttle to wide open position.	All Lamps On Lamp 4 will dim when servo moves throttle to wide open poision.	None
	Lamp 1 Off	Refer to Test 2, Lamp 1 Off.
	Lamp 2 Off	Refer to Test 2, Lamp 2 Off.
	Lamp 3 Off	Refer to Test 2, Lamp 3 Off.
	Lamp 4 Off	Refer to Test 2, Lamp 4 Off.
	Lamp 5 Off	Refer to Test 3, Lamp 5 Off.
	Lamp 6 Off	Refer to Test 3, Lamp 6 Off.
	All Lamps Off	Refer to Test 3, All Lamps Off.

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EIGHT-CYLINDER ENGINE SYSTEM

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GENERAL

The Jeep Cruise Command automatic speed control system for eight-cylinder engines receives vehicle speed by way of the speedometer cable and uses engine intake manifold vacuum to regulate the throttle to automatically maintain any preset cruising speed between 30 mph (48 km/h) and the legal maximum speed limit.

A slight increase or decrease of speed (as much as 3.5 mph or 5.6 km/h) is normal when a vehicle is driven up or down grades not exceeding 7 percent (most interstate highways). A change of speed greater than 3.5 mph (5.6 km/h) may be experienced when driving on unusually steep (or mountain) terrain or at high altitudes.

The Cruise Command control assembly is an integral part of the turn signal switch lever and consists of two separate switches, the OFF-ON-RES (resume) slide switch and the pushbutton set switch.

To engage the speed control system, move the OFF-ON-RES slide switch to the ON position and accelerate the vehicle to the desired speed. Press the set switch pushbutton on the end of the turn signal switch lever and release. The speed control system will now automatically maintain the selected speed. The system will be disengaged when the brake pedal is lightly depressed.

After accelerating to 30 mph (48 km/h), the speed control system can be reengaged at the previously selected speed by moving the OFF-ON-RES slide switch to the RES (resume) position and releasing the switch. When the resume function is used, the rate of acceleration is controlled by engine intake manifold vacuum. The rate of acceleration cannot be adjusted. On large displacement eight-cylinder engines, the acceleration rate will be firm.

WARNING: *Cruise Command should not be used when driving on slippery roads or in congested traffic areas.*

NOTE: *When the ignition switch is turned OFF or slide switch is moved to the OFF position, the preset speed*

selection and the resume speed function are canceled. The speed selection must be reset when the system is re-actuated.

The Cruise Command can be set for a higher speed than initially selected by accelerating to the desired speed and then depressing and releasing the set push-button. Depressing and holding the set pushbutton while cruising at a preset speed will also cause a slow increase in speed. A lower controlled speed can be achieved by lightly depressing the brake pedal momentarily, allowing the vehicle to slow to the desired speed and then depressing and releasing the set pushbutton.

COMPONENTS

The Jeep Cruise Command automatic speed control system for eight-cylinder engines consists of five major components: the regulator, relay, bellows, control switch assembly and release circuit.

Regulator

The regulator receives vehicle speed from the speedometer cable, which is connected between the regulator and the transmission. The flyweight-type governor reacts to the centrifugal force imparted by the rotating cable and engages the low speed switch at a rotation speed equivalent to approximately 30 mph (48 km/h). When the low speed switch is closed, the driver may set the selected vehicle speed.

The regulator is serviced as an assembly.

Relay

The speed control system relay is energized only when the ignition switch is turned to the ON position. This prevents a battery drain when the ignition switch is in the OFF position.

Bellows

The bellows, a vacuum servo, reacts to the modulated vacuum and controls the vehicle speed by actuating the throttle through a beaded chain.

Control Switch Assembly

The control switch assembly is an integral part of the turn signal switch lever. When actuated, it energizes either the solenoid valve, the coupling coil or both.

Release Circuit

When the brake pedal is depressed slightly, ground is removed to deenergize the solenoid valve and disengage the speed control system.

OPERATION

Regulator

The regulator consists of three functional sub-assemblies: the governor, solenoid valve, and coupling coil and centering spring.

Governor

The governor consists of two flyweights on a shaft, an actuator and a spring (fig. 1H-7). The shaft passes through the actuator but is not attached to it (i.e., the actuator is free to slide on the shaft). The spring applies tension that holds the actuator against the flyweights. When the shaft is rotated by the speedometer cable, the flyweights are thrown outward by centrifugal force. This forces the actuator to slide away from the flyweights against the tension of the spring. At a vehicle speed of approximately 30 mph (48 km/h), the actuator has moved far enough to close the low speed switch. This occurs when the spring-loaded slider on the actuator contacts the drive pin (fig. 1H-9) on the coupling coil.

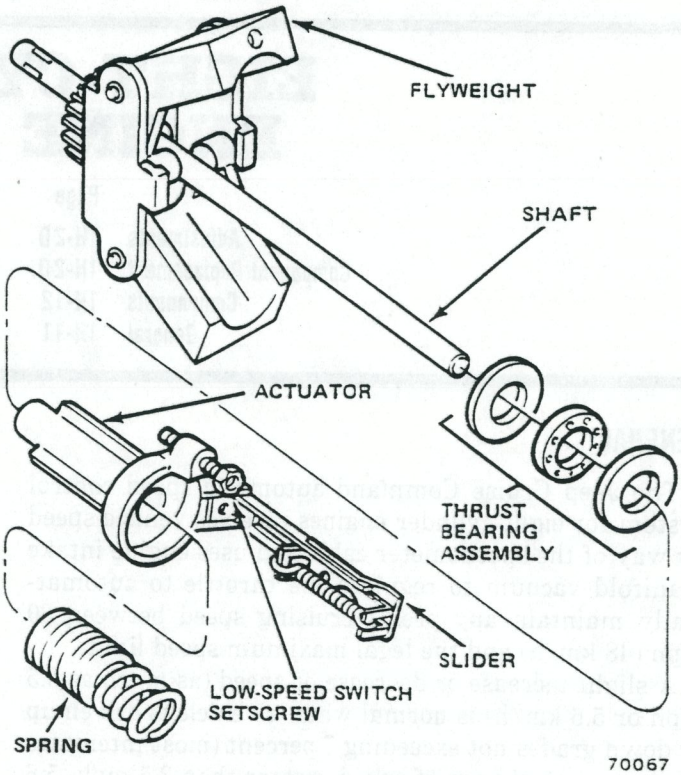

Fig. 1H-7 Regulator Governor

Solenoid Valve

The valve controls air pressure leaving the regulator by sealing the manifold vacuum port until the solenoid coil is energized (fig. 1H-8). When current is supplied to

the coil, the valve stem is pulled upward and opens the manifold vacuum port. When the coil is deenergized, the valve is closed by action of the spring.

A glass-encapsuled reed switch is mounted on the outside of the solenoid coil. The electromagnetic field surrounding the energized coil closes the reed switch and allows current to flow to the solenoid coil. As long as current is supplied via the closed reed switch, the coil remains energized and holds the valve open.

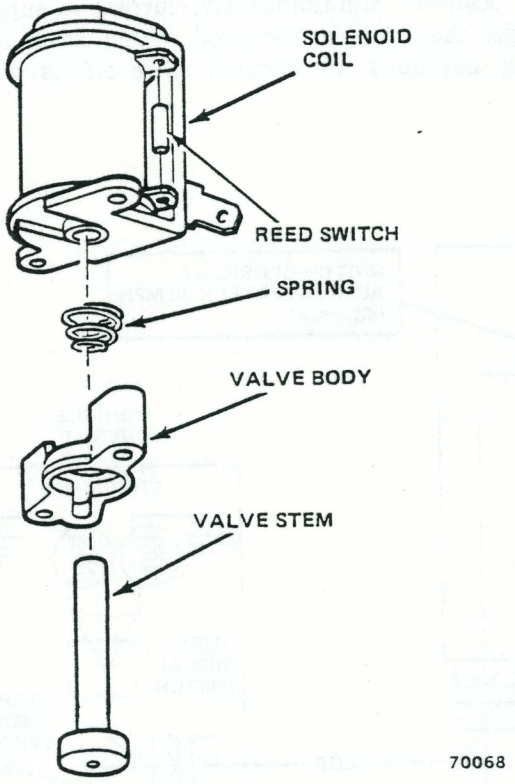

Fig. 1H-8 Regulator Solenoid Valve

Coupling Coil and Centering Spring

The coupling coil is the mechanism that provides the speed control system with the memory for the resume speed function (fig. 1H-9). When not under the influence of the electromagnetic field surrounding the coupling coil, the rotating vacuum regulator plate is held in a centered position by the centering spring (fig. 1H-10).

The coupling coil is rotated on its axis by motion of the governor actuator. When the coupling coil is not energized, it can be rotated without affecting the position of the rotating vacuum regulator plate. When energized, the electromagnetic field surrounding the coupling coil captures the vacuum regulator plate and forces it to rotate in union with the coupling coil. Slight rotational movement of the vacuum regulator plate either uncovers or blocks the vacuum vent port.

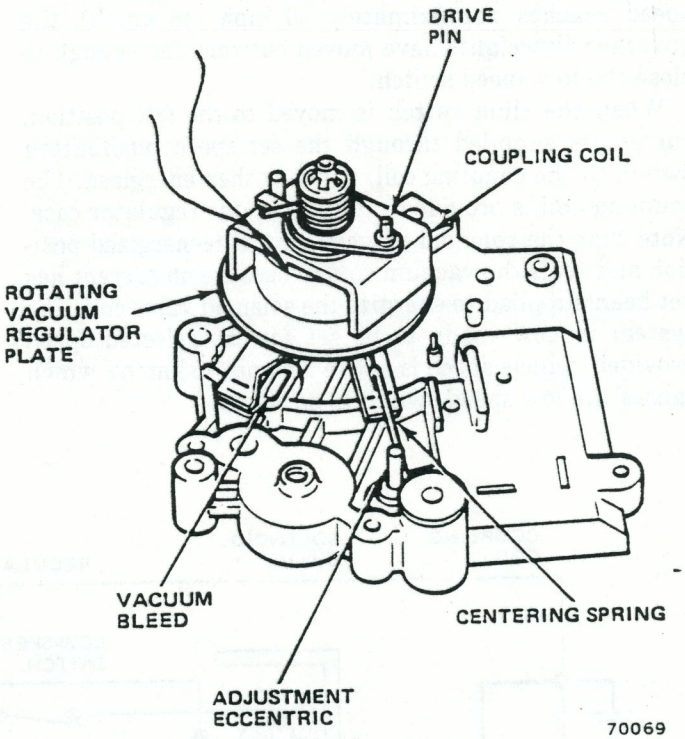

Fig. 1H-9 Regulator Coupling Coil and Centering Spring

The centering spring controls the position of the rotating vacuum regulator plate over the vacuum vent port when the set speed pushbutton switch is depressed (fig. 1H-10). Its adjustment is accomplished by an eccentric. Adjustments of more than 1/8 turn of the eccentric should not be attempted.

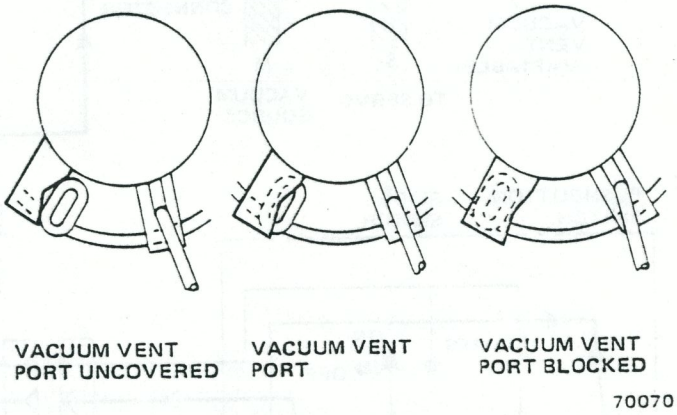

Fig. 1H-10 Vacuum Regulator Plate Positions

Control Switch Assembly

Slide Switch ON

With the ignition switch ON and the engine operating, the speed control system relay is energized and current

is supplied to the slide switch (fig. 1H-11). When vehicle speed reaches approximately 30 mph (48 km/h), the governor flyweights have moved outward far enough to close the low speed switch.

When the slide switch is moved to the ON position, current is supplied through the set speed pushbutton switch to the coupling coil, which is then energized. The coupling coil is provided a ground by the regulator case. Note that the solenoid valve is in the deenergized position and seals the vacuum source because no current has yet been supplied to energize the solenoid valve coil. The system is now ready to be set for the selected speed provided vehicle speed is above 30 mph (48 km/h), which causes the low speed switch to be closed.

Set Speed Pushbutton Switch Depressed

When the desired vehicle speed is reached, the set speed pushbutton switch is depressed momentarily (fig. 1H-12). Current to the coupling coil is interrupted and the coil is deenergized. This uncouples the vacuum regulator plate from the coupling coil. Spring tension from the governor actuator causes the freed coupling coil to rotate until it is in the position that corresponds to the selected vehicle speed. The vacuum regulator plate is moved by the centering spring to its neutral (calibrated vent) position. Simultaneously, current is supplied to energize the solenoid valve coil, which closes the reed switch and pulls the vacuum valve off its seat. The

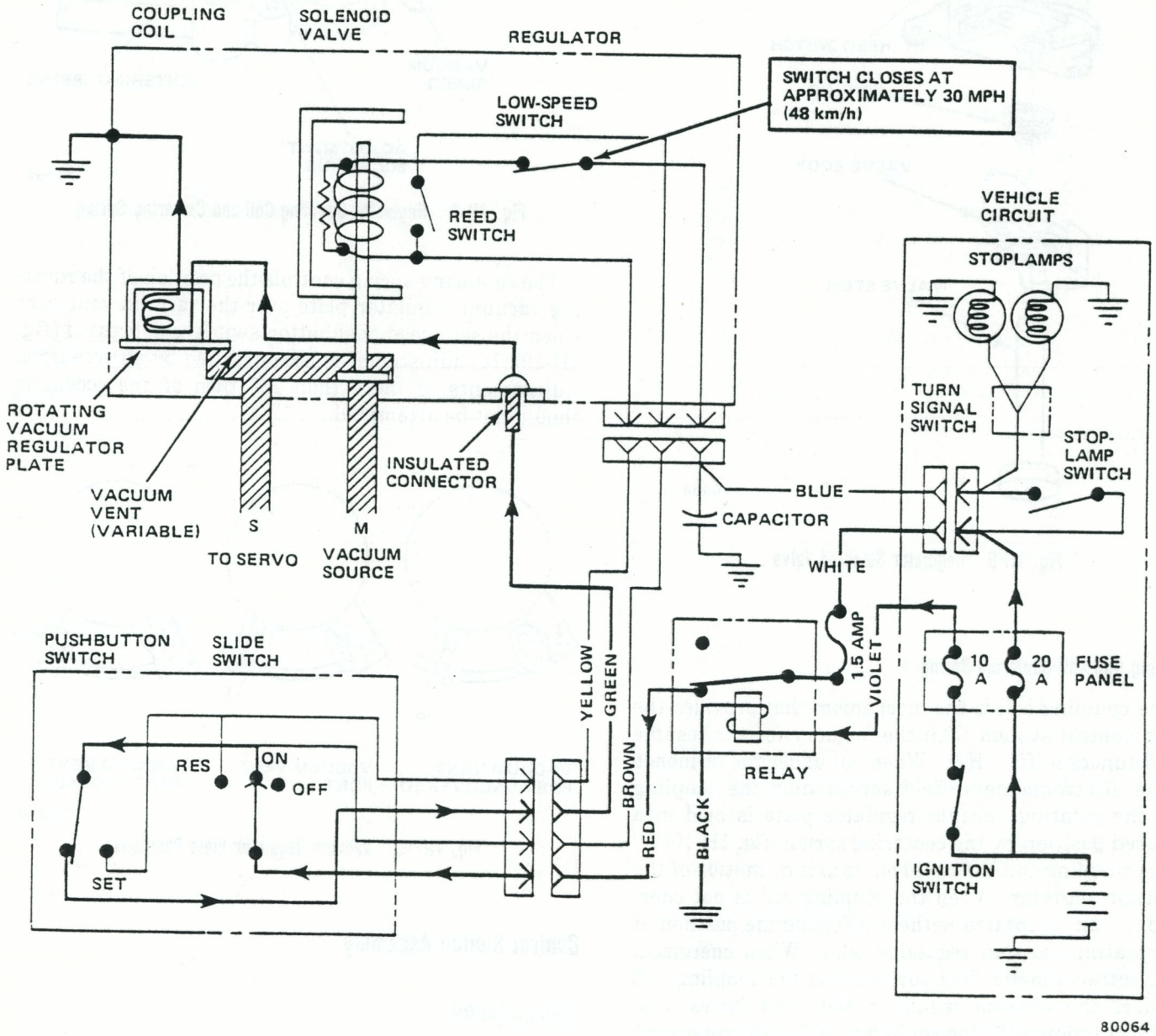

Fig. 1H-11 Current Flow—Slide Switch On

vacuum source begins to evacuate air from the mixing chamber of the regulator valve and the bellows.

The regulator solenoid valve coil is grounded through the stoplamp bulbs.

Set Speed Pushbutton Switch Released—Maintaining Speed

This mode of operation begins when the regulator solenoid valve is maintained in the energized position by the holding current flowing through the reed switch (fig. 1H-13). At that time, current flows from ground at the stoplamp bulbs, through the low-speed switch, through the solenoid coil, through the reed switch to the voltage source. This current holds the solenoid in the energized position. When the pushbutton is released, the hold-in current maintains the solenoid valve in the open position. Current is simultaneously supplied to the coupling coil, which electromagnetically captures the vacuum regulator plate. The coupling coil and vacuum regulator plate are electromagnetically locked together and may be regarded as a single unit. The coupling coil is grounded through the regulator case.

Varying vehicle speed causes the governor flyweights to turn the coupling coil. Lower speeds cause the weights to collapse, blocking the vacuum vent port. This directs all the vacuum to the bellows and causes the throttle to open further. Higher speeds cause the weights to move outward and uncover the vacuum vent port. Decreased vacuum at the bellows causes the throttle to close.

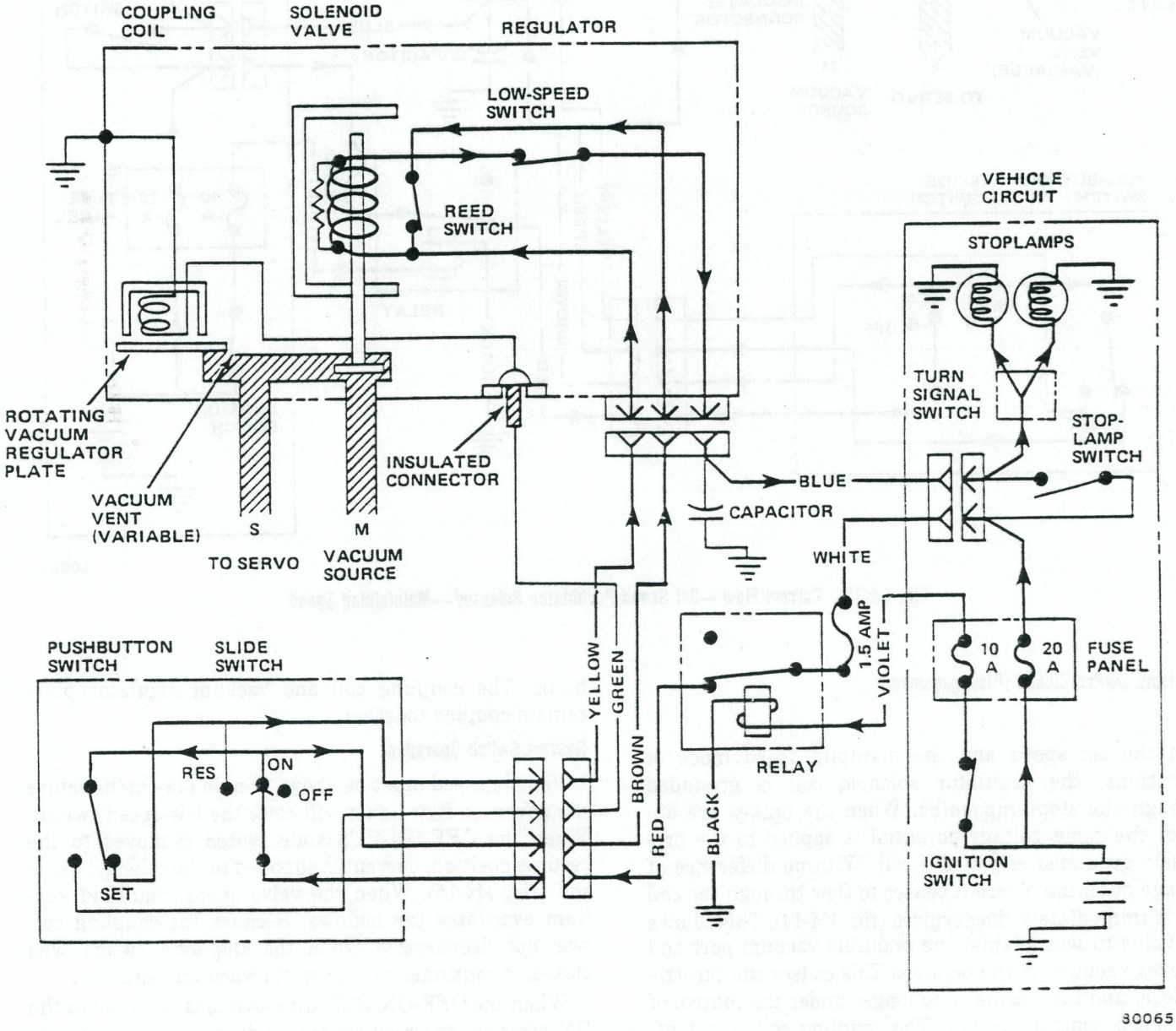

Fig. 1H-12 Current Flow—Set Speed Pushbutton Switch Depressed

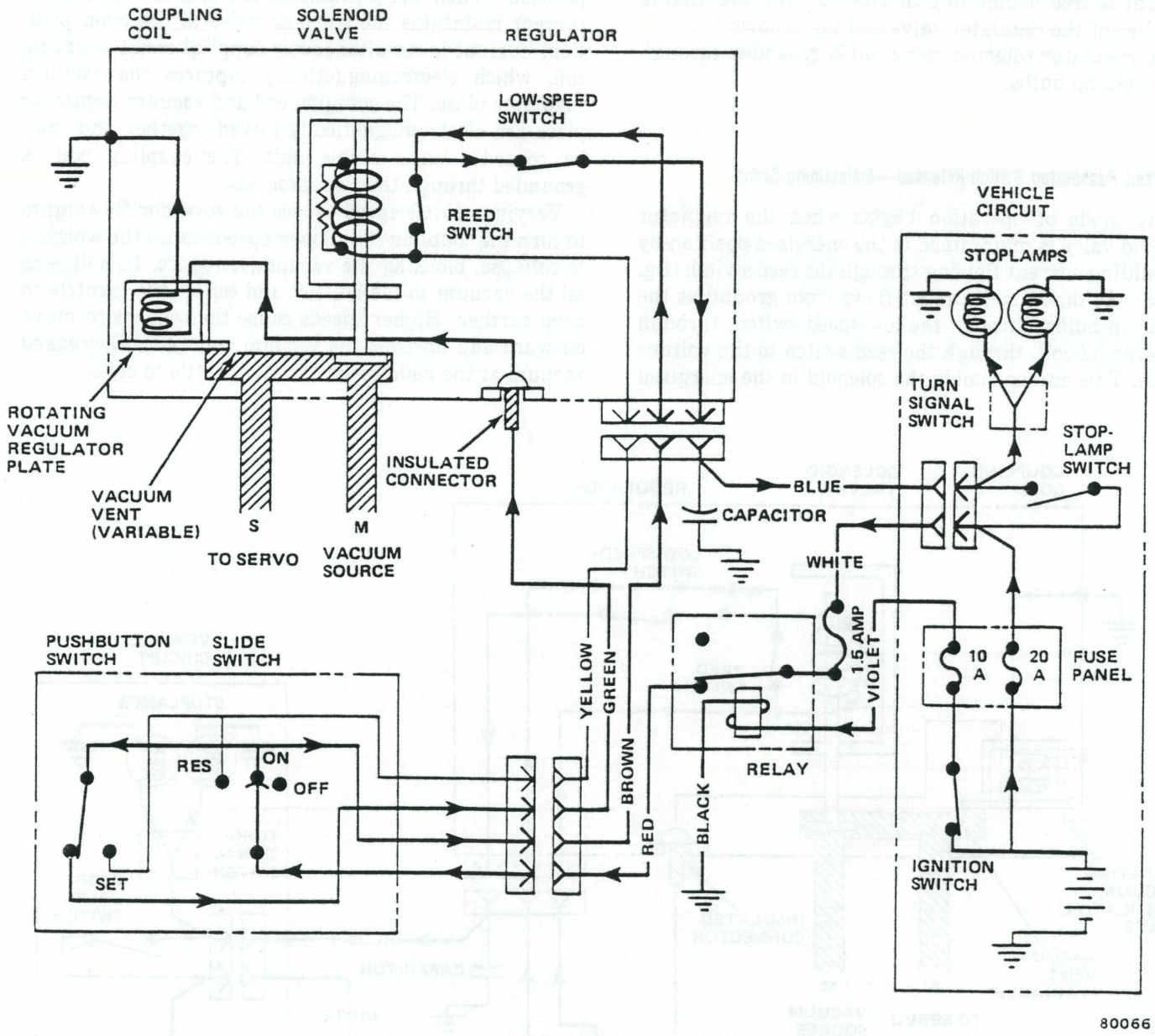

Fig. 1H-13 Current Flow—Set Speed Pushbutton Released—Maintaining Speed

Stoplamp Switch Closed (Disengagement)

In the set speed and the maintain speed mode of operations, the regulator solenoid coil is grounded through the stoplamp bulbs. When the brakes are applied, the same voltage potential is applied to the previously grounded end of the coil. With no difference of voltage potential, current ceases to flow through the coil and it immediately deenergizes (fig. 1H-14). This allows the valve to seat against the manifold vacuum port and relieves vacuum at the bellows. This causes the throttle to close, and the engine is no longer under the control of the speed control system. The coupling coil is not affected because it is not grounded through the stoplamp bulbs. The coupling coil and vacuum regulator plate remain coupled together.

Resume Switch Operation

Vehicle speed must be above 30 mph (48 km/h) before the governor flyweights will close the low-speed switch. When the OFF-ON-RES slide switch is moved to the resume position, current is supplied to the solenoid valve coil (fig. 1H-15). When the valve opens, manifold vacuum evacuates the bellows. Because the coupling coil was not deenergized when the stoplamp switch was closed, it continues to control the vacuum vent.

When the OFF-ON-RES slide switch is returned to the ON position, the reed switch holding current keeps the solenoid valve open and manifold vacuum causes the

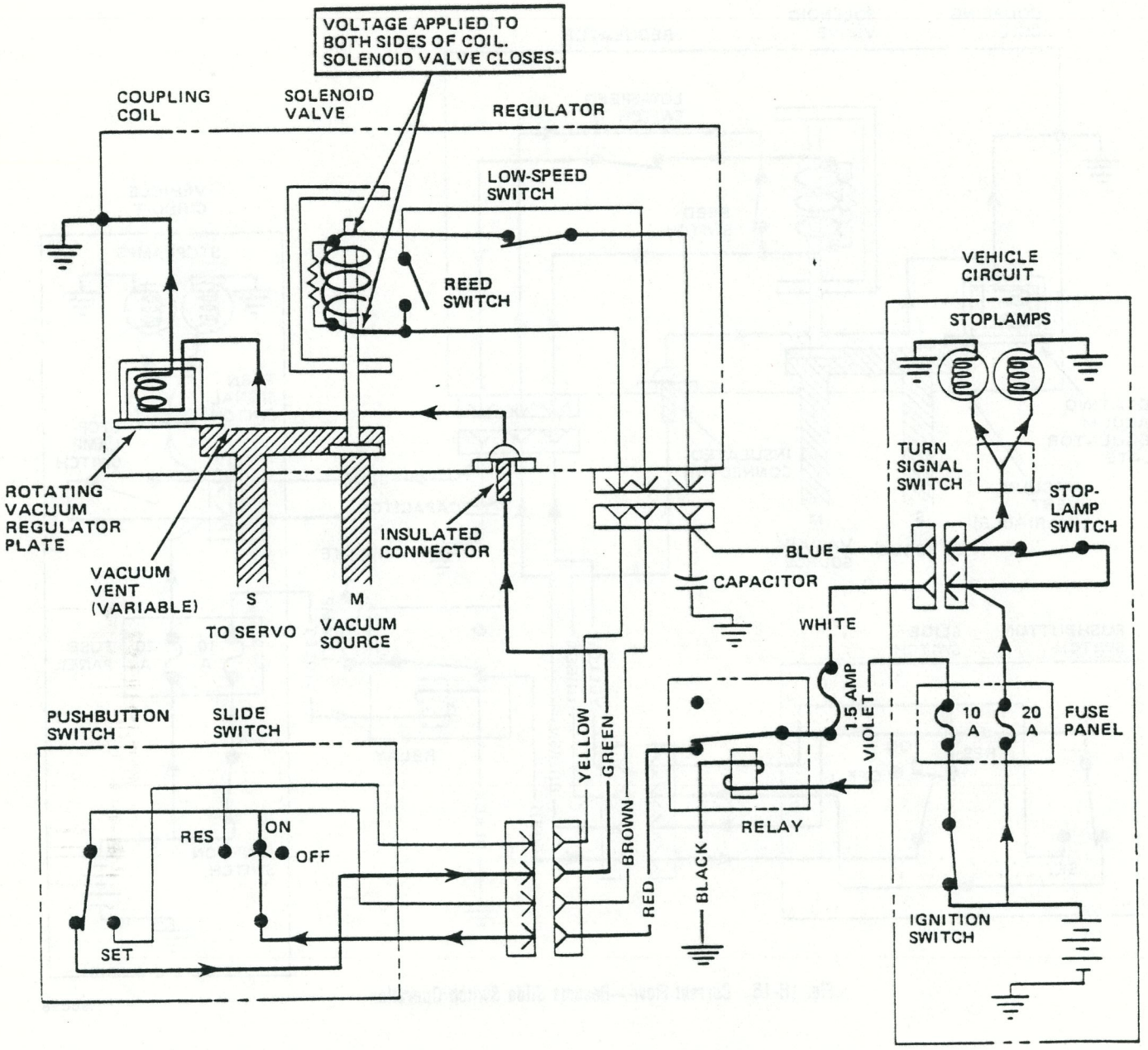

Fig. 1H-14 Current Flow—Stoplamp Switch Closed

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servo to move the throttle to accelerate the engine to attain the previously selected vehicle speed.

NOTE: *A mechanical interlock in the control switch assembly prevents operating the resume function and push button set-speed function at the same time.*

TROUBLESHOOTING

When troubleshooting the Cruise Command automatic speed control system, refer to Testing and the Service Diagnosis charts.

Refer to Chapter 3C for speedometer cable and gear replacement procedures.

TESTING

The following tests should be performed as part of a service diagnosis to determine the cause of the malfunction and the correction required.

Control Switch Assembly Continuity Test

Test the control switch assembly continuity with an ohmmeter or test lamp. Connect the testing device to the wire terminals as indicated in the Control Switch Assembly Continuity Test Chart.

CAUTION: *If an ohmmeter is used for the testing, the ignition switch must be off. Otherwise, the ohmmeter will be internally damaged.*

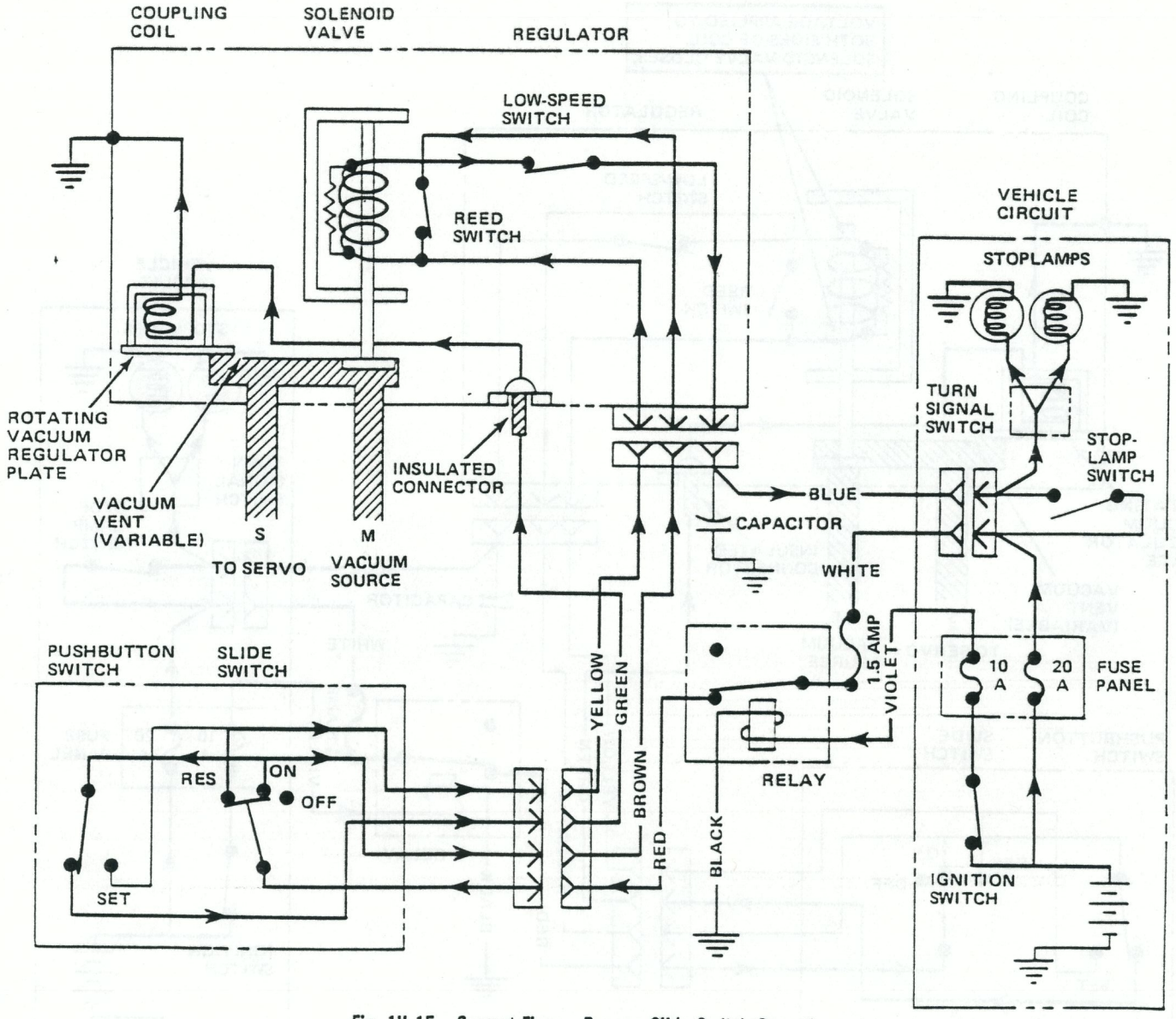

Fig. 1H-15 Current Flow—Resume Slide Switch Operation

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Control Switch Assembly Continuity Test Chart

Switch Wire	Slide Switch Continuity			Pushbutton Depressed Slide Switch On
	Off	On	Resume	
Red to Brown	Open	Closed	Closed	Closed
Red to Green	Open	Closed	Closed	Open
Red to Yellow	Open	Open	Closed	Closed

NOTE: *Pushbutton cannot be depressed with slide switch in resume position*

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Circuit Tests

Refer to figure 1H-16 for wiring diagram.

NOTE: *It is not always necessary to remove the regulator to perform circuit tests.*

(1) Disconnect push-on connectors (single terminal and triple terminal) from regulator.

(2) Turn ignition switch to ACCESSORY position.

(3) Move OFF-ON-RES slide switch to ON position.

(4) Using test lamp, connect one test lamp probe to ground and contact brown wire and then green wire at connector terminals with other probe. Test lamp should light. If test lamp does not light when in contact with either wire, inspect fuse, relay, control switch assembly and connection at power source.

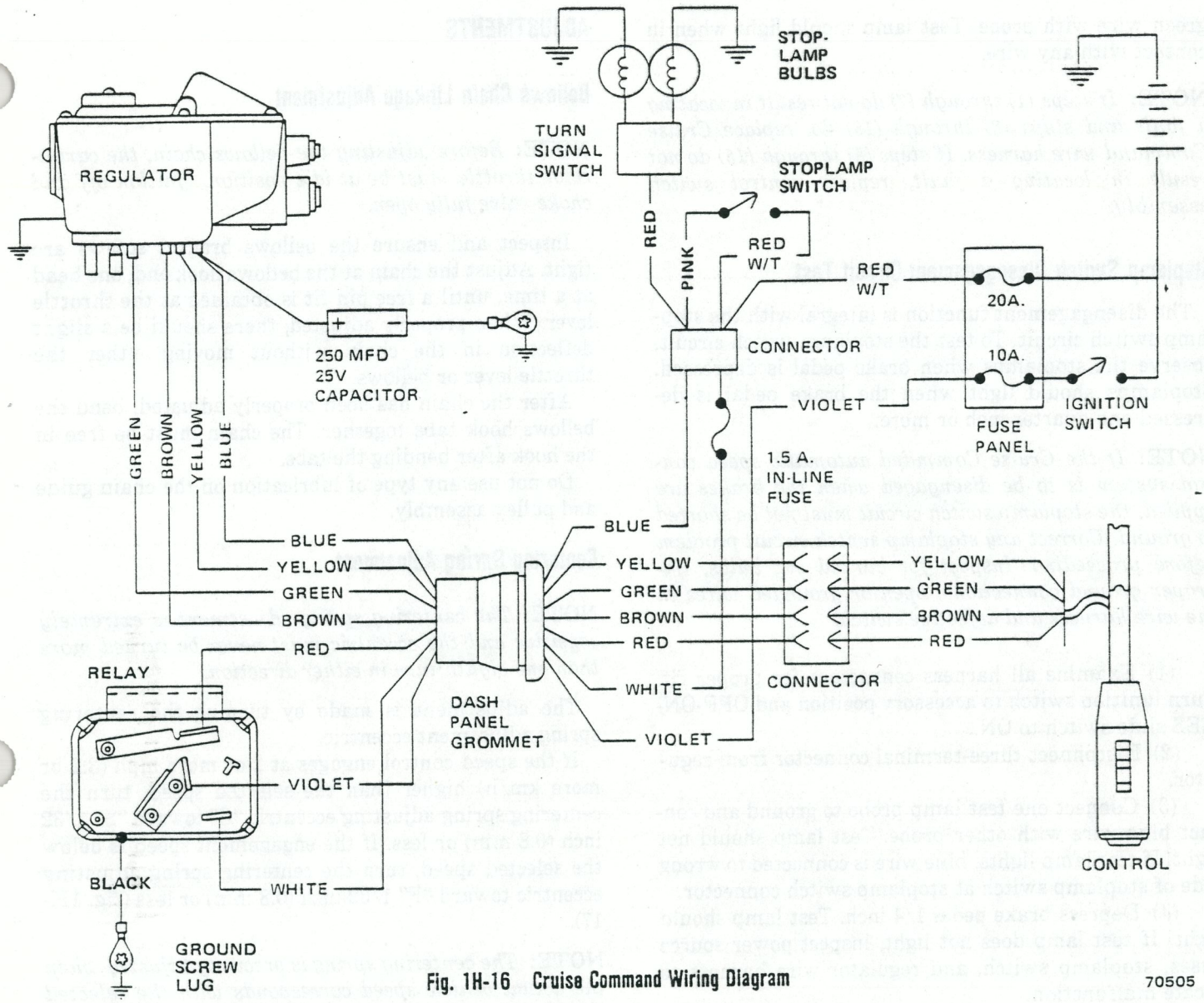

Fig. 1H-16 Cruise Command Wiring Diagram

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(5) Depress SET SPEED pushbutton and hold. Connect one test lamp probe to ground and contact each wire with other probe at connector terminals. Test lamp should light when in contact with brown and yellow wires and should not light when in contact with green or blue wire.

(6) Release SET SPEED pushbutton.

(7) Move OFF-ON-RES slide switch to RES position and hold. Connect one test lamp probe to ground and contact each wire terminal in connector with other probe. Test lamp should light when in contact with any wire except blue wire (blue wire connects to stoplamp bulbs side of stoplamp switch).

To conduct an independent test of the control switch assembly before removal from the vehicle, isolate the other components from the switch by disconnecting the multiple wire connector in passenger compartment. When performing the circuit tests, omit steps (8) through (15) if steps (1) through (7) resulted in locating a fault.

(8) Attach jumper wire from 12-volt power source to red wire terminal in control switch harness connector.

(9) Move OFF-ON-RES slide switch to OFF position.

(10) Using test lamp, connect one test lamp probe to ground and contact, in turn, brown wire, green wire, and yellow wire with other probe. Test lamp should not light when in contact with any of these wires.

(11) Move OFF-ON-RES slide switch to ON position.

(12) Contact brown wire and then green wire with probe. Test lamp should light when in contact with any of these wires. Contact yellow wire with probe. Lamp should not light.

(13) Depress SET SPEED switch pushbutton and hold. Repeat step (12). Test lamp should light when in contact with brown wire and yellow wire. Test lamp should not light when in contact with green wire.

(14) Release SET SPEED switch pushbutton.

(15) Move OFF-ON-RES slide switch to RES position and hold. Contact, in turn, brown wire, yellow wire, and

green wire with probe. Test lamp should light when in contact with any wire.

NOTE: *If steps (1) through (7) do not result in locating a fault and steps (8) through (15) do, replace Cruise Command wire harness. If steps (8) through (15) do not result in locating a fault, replace control switch assembly.*

Stoplamp Switch Disengagement Circuit Test

The disengagement function is integral with the stoplamp switch circuit. To test the stoplamp switch circuit, observe the stoplamps when brake pedal is depressed. Stoplamps should light when the brake pedal is depressed one-quarter inch or more.

NOTE: *If the Cruise Command automatic speed control system is to be disengaged when the brakes are applied, the stoplamp switch circuit must not be shorted to ground. Correct any stoplamp switch circuit problem before proceeding. Inspect for burned out bulbs, improper ground connections, open or grounded wires in the wire harness and defective switch.*

(1) Examine all harness connectors for proper fit. Turn ignition switch to accessory position and OFF-ON-RES slide switch to ON.

(2) Disconnect three-terminal connector from regulator.

(3) Connect one test lamp probe to ground and contact blue wire with other probe. Test lamp should not light. If test lamp lights, blue wire is connected to wrong side of stoplamp switch at stoplamp switch connector.

(4) Depress brake pedal 1/4 inch. Test lamp should light. If test lamp does not light, inspect power source fuses, stoplamp switch, and regulator wire harness to locate malfunction.

Automatic Speed Control System Relay Test

The automatic speed control system relay is located close to the fuse panel under the instrument panel.

NOTE: *Examine all wire connections for security prior to testing.*

(1) Turn ignition switch to accessory position and slide switch to ON position.

(2) Using test lamp, connect one probe to ground and contact each wire terminal at relay with other probe. Test lamp should light when in contact with every wire except ground (black) wire. If test lamp does not light when in contact with red wire but lights when in contact with white and violet wires, replace relay. If test lamp does not light when in contact with white and violet wires, test power source for battery voltage and inspect for open fuse and defective wire harness.

ADJUSTMENTS

Bellows Chain Linkage Adjustment

NOTE: *Before adjusting the bellows chain, the carburetor throttle must be at idle position, ignition off and choke valve fully open.*

Inspect and ensure the bellows bracket screws are tight. Adjust the chain at the bellows hook end, one bead at a time, until a free pin fit is obtained at the throttle lever. When properly adjusted, there should be a slight deflection in the chain without moving either the throttle lever or bellows.

After the chain has been properly adjusted, bend the bellows hook tabs together. The chain must be free in the hook after bending the tabs.

Do not use any type of lubrication on the chain guide and pulley assembly.

Centering Spring Adjustment

NOTE: *The centering spring adjustment is extremely sensitive and the eccentric must never be turned more than one-eighth turn in either direction.*

The adjustment is made by turning the centering spring adjustment eccentric.

If the speed control engages at 2 or more mph (3.2 or more km/h) higher than the selected speed, turn the centering spring adjusting eccentric "C" toward "S" 1/32 inch (0.8 mm) or less. If the engagement speed is below the selected speed, turn the centering spring adjusting eccentric toward "F" 1/32 inch (0.8 mm) or less (fig. 1H-17).

NOTE: *The centering spring is precisely adjusted when the actual vehicle speed corresponds with the selected speed or increases very slightly above it when the automatic speed control is engaged. The centering spring adjustment has no effect on maintaining the selected speed unless the centering spring eccentric is completely out of adjustment.*

COMPONENT REPLACEMENT

Regulator Replacement

(1) Disconnect driven hex cable from regulator.

(2) Disconnect knurled drive cable from regulator.

(3) Disconnect vacuum hoses, wiring harness connectors and ground connector.

(4) Remove regulator and relay.

(5) Install regulator, relay and ground connector.

(6) Connect vacuum hoses and wiring harness connectors.

(7) Connect knurled drive cable.

(8) Connect driven hex cable.

Service Diagnosis

Condition	Possible Cause	Correction
BLOWING STOPLAMP FUSES	(1) 250 mfd capacitor shorted.	(1) Replace capacitor.
BLOWING FUSES	(1) Short or ground in Cruise Command wiring circuit.	(1) Perform electrical checks.
CRUISE COMMAND DOES NOT ENGAGE	(1) Cruise Command harness fuse burned out.	(1) Check for cause. Replace fuse (1.5 amp only).
	(2) Faulty brake lamp switch.	(2) Replace brake lamp switch.
	(3) No current to brown wire.	(3) Check for loose connection or repair wiring harness.
	(4) Vacuum leak.	(4) Repair leak.
	(5) Bad ground at regulator.	(5) Check regulator for ground (use ohmmeter—check from regulator to mounting bracket).
	(6) Bad relay ground.	(6) Check ground wire for loose connection (use ohmmeter — check from relay case to known good ground).
	(7) Faulty connections.	(7) Check connections, repair as necessary.
	(8) Brake lamp fuse burned out.	(8) Check for cause and repair, replace fuse.
	(9) Brake lamp bulb(s) burned out.	(9) Replace bulb(s).
	(10) Control switch inoperative.	(10) See Circuitry Tests—steps (8) through (15).
	(11) Faulty regulator.	(11) Replace regulator.
	(12) Solenoid valve deformed.	(12) Replace regulator.
	(13) Relay inoperative.	(13) Replace relay, check ground, look for open in white wire.
CRUISE COMMAND DISENGAGES WHEN TURN SIGNAL SWITCH IS OPERATED	(1) 250 mfd capacitor open.	(1) Replace capacitor or repair ground.
	(2) Stop/turn lamp burned out on side opposite direction of turn.	(2) Replace bulb.

Service Diagnosis (Continued)

Condition	Possible Cause	Correction
CRUISE COMMAND DOES NOT DISENGAGE WHEN BRAKE IS APPLIED	(1) Defective brake lamp switch (open).	(1) Replace brake lamp switch.
	(2) Collapsed hose from servo to regulator.	(2) Replace hose.
	(3) 250 mfd. capacitor shorted.	(3) Replace capacitor.
RE-ENGAGES WHEN BRAKE IS RELEASED	(1) Faulty control switch.	(1) Replace control switch.
	(2) Check wiring for proper location.	(2) Correct wiring location at regulator or 4-wire connector.
	(3) Solenoid valve deformed.	(3) Replace regulator.
CARBURETOR DOES NOT RETURN TO NORMAL IDLE OR PULSATING ACCELERATOR PEDAL	(1) Improper throttle chain linkage adjustment.	(1) Adjust throttle chain linkage.
	(2) Speedometer cable or drive cable.	(2) Lubricate cable, including tips.
SPEEDOMETER INOPERATIVE AND CRUISE COMMAND OPERATES	(1) Speedometer cable not driving speedometer.	(1) Check for broken cable or loose connections.
	(2) Faulty regulator.	(2) Replace regulator as necessary.
NEITHER SPEEDOMETER NOR CRUISE COMMAND OPERATES	(1) Transmission cable not driving regulator.	(1) Check for broken cable or loose connections.
CRUISE COMMAND ENGAGES ABOVE OR BELOW DESIRED SPEED	(1) Regulator out of adjustment.	(1) Refer to centering spring adjustment.
SYSTEM DISENGAGES ON LEVEL ROAD WITHOUT APPLYING BRAKE	(1) Loose wiring connections or poor ground.	(1) Tighten connection and check ground.
	(2) Loose hoses.	(2) Check hose connections.

Service Diagnosis (Continued)

Condition	Possible Cause	Correction
SYSTEM DISENGAGES ON LEVEL ROAD WITHOUT APPLYING BRAKE	(3) Servo linkage chain broken or throttle clevis slipped.	(3) Repair chain or install clevis.
	(4) Oversensitive stoplamp switch.	(4) Replace switch or check for binding in brake linkage.
ERRATIC OPERATION OF CRUISE COMMAND	(1) Check vacuum servo or vacuum hose.	(1) Replace servo or vacuum hose.
	(2) Check regulator.	(2) Replace regulator as necessary.
CRUISE COMMAND CONTINUES TO ACCELERATE AFTER ENGAGEMENT	(1) Open circuit in green wire attached to number 4 terminal at regulator.	(1) Repair open circuit in green wire. Check for improper connection at brake switch (crossed wires).
CAR LOSES EXCESSIVE SPEED ON HILLS	(1) Excessive slack in servo chain.	(1) Refer to Adjustments.
	(2) Lack of engine manifold vacuum.	(2) Move vacuum source to center of intake manifold.

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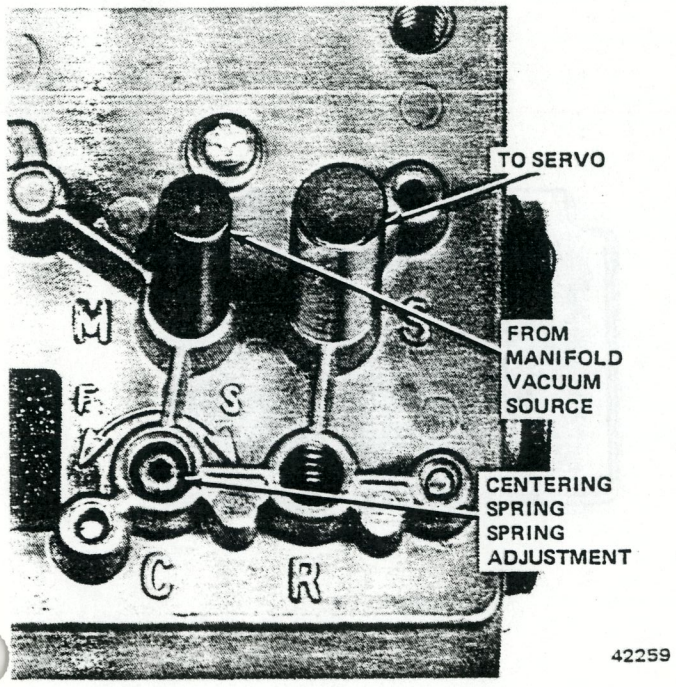


Fig. 1H-17 Centering Spring Adjustment

Relay Replacement

(1) Disconnect wires from relay.
(2) Remove relay.
(3) Install relay.
(4) Connect wires to relay.

Bellows Replacement

(1) Disconnect vacuum hose from bellows.
(2) Count number of beads outside bellows hook tabs. Disconnect chain from bellows.
(3) Remove bellows.
(4) Install replacement bellows.
(5) Connect chain, with same number of beads outside hook tabs as counted in step (2). Bend hook tabs.
(6) Connect vacuum hose.

Bellows Chain Replacement

(1) Count number of chain beads outside bellows hook tabs.
(2) Open hook tabs on bellows.
(3) Disconnect chain from throttle lever. Remove chain and compare length to replacement chain.

(4) Connect chain to bellows, allowing number of beads outside tabs as counted in step (1). Crimp tabs.

(5) Connect chain to throttle lever.

Control Switch Assembly Replacement

The control switch assembly is an integral part of the turn signal switch lever. The switch assembly is not repairable. The switch assembly and harness are serviced only as a unit.

Removal

(1) Remove following items.
- (a) Horn button insert
- (b) Steering wheel
- (c) Anti-theft cover
- (d) Locking plate and horn contact

(2) Remove turn signal switch lever (allow handle to hang loose outside steering column).

(3) Remove four-way flasher knob.

(4) Remove holddown screws and turn signal switch.

(5) Remove trim piece from under steering column.

(6) Disconnect four-wire connector.

(7) *Tilt Column*—Remove harness from plastic connector. Tape two of four wires back along harness (to allow a smaller diameter) and tape string to harness.

(8) *Standard Column*—Tie or tape string to plastic connector.

(9) Remove turn signal switch lever and control switch assembly and wire harness from column.

Installation

(1) Test replacement control switch assembly by connecting to wire harness before installing in steering column. Refer to Control Switch Assembly Continuity Test.

NOTE: *When installing the wire harness, it must be routed through the turn signal lever opening from the outside because the handle will not fit through the opening.*

(2) Tape two of four wires back along harness. Tape harness to string that was attached to original harness before removal.

(3) Pull replacement harness down through steering column. On tilt column, harness must pass through hole on left side of steering shaft.

NOTE: *It may be necessary to loosen steering column mounting screws for easier routing of harness.*

(4) Install turn signal switch and four-way flasher knob.

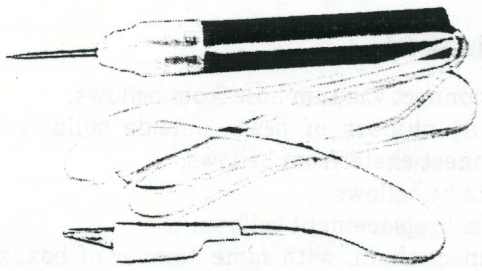
(5) Install turn signal switch lever and control switch assembly.

(6) Install horn contact, locking plate and lock ring anti-theft cover.

(7) Install steering wheel and horn button insert.

(8) Install trim on steering column.

Tools



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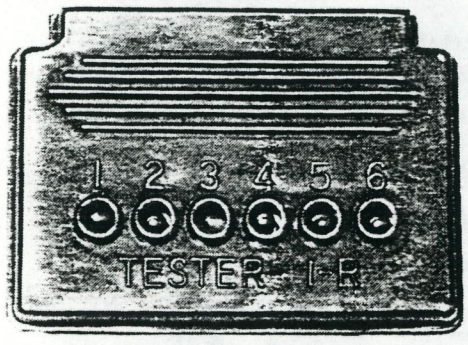
CONTINUITY
TEST LAMP



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FUEL SYSTEMS 1J

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AIR CLEANERS

An air cleaner is necessary to protect the fuel system, as well as the moving parts of the engine, from the abrasive and clogging effects of dust, dirt and sediment normally present in the intake air supply.

The lower portion of the air cleaner is designed to reduce the noise emitted by air rushing through the carburetor to the intake system. The air cleaner also serves as a flame arrester in the event of a backfire up through the carburetor.

A replaceable filter element (paper-type) is used as standard equipment (figs. 1J-1 and 1J-2).

Replace the air cleaner filter element at the intervals listed in the Maintenance Schedule. More frequent replacement is advisable when the vehicle is operated in dusty areas or on unpaved roads.

The air cleaner intake duct contains the air valve for the Thermostatically Controlled Air Cleaner (TAC) System and trap door (if equipped). The operation and diagnosis of both systems are described within Thermostatically Controlled Air Cleaner (TAC) System section of this chapter. The thermal sensor is located on the inside base of the air cleaner housing.

Service

To clean the paper filter element, shake out accumulated dirt—**DO NOT WASH.** Use compressed air to carefully blow through the element from the inside toward the outside, opposite the direction of normal airflow.

Replace the air cleaner filter element more frequently than specified in the Maintenance Schedule if there is any apparent damage or evidence of being clogged.

FUEL FILTERS

All Jeep six- and eight-cylinder engine fuel systems are protected from the entry of dirt and other foreign matter through the carburetor fuel inlet by a replaceable 15-micron, pleated paper filter located in the carburetor fuel inlet pipe and secured by two short rubber hoses and clamps. Replace the filter at the intervals outlined in the Maintenance Schedule.

All vehicles with six- and eight-cylinder engines have a fuel return system that requires an extra nipple on the fuel filter to route fuel back to the fuel tank. The filter must be installed with the return nipple upward. Refer to Fuel Return System.

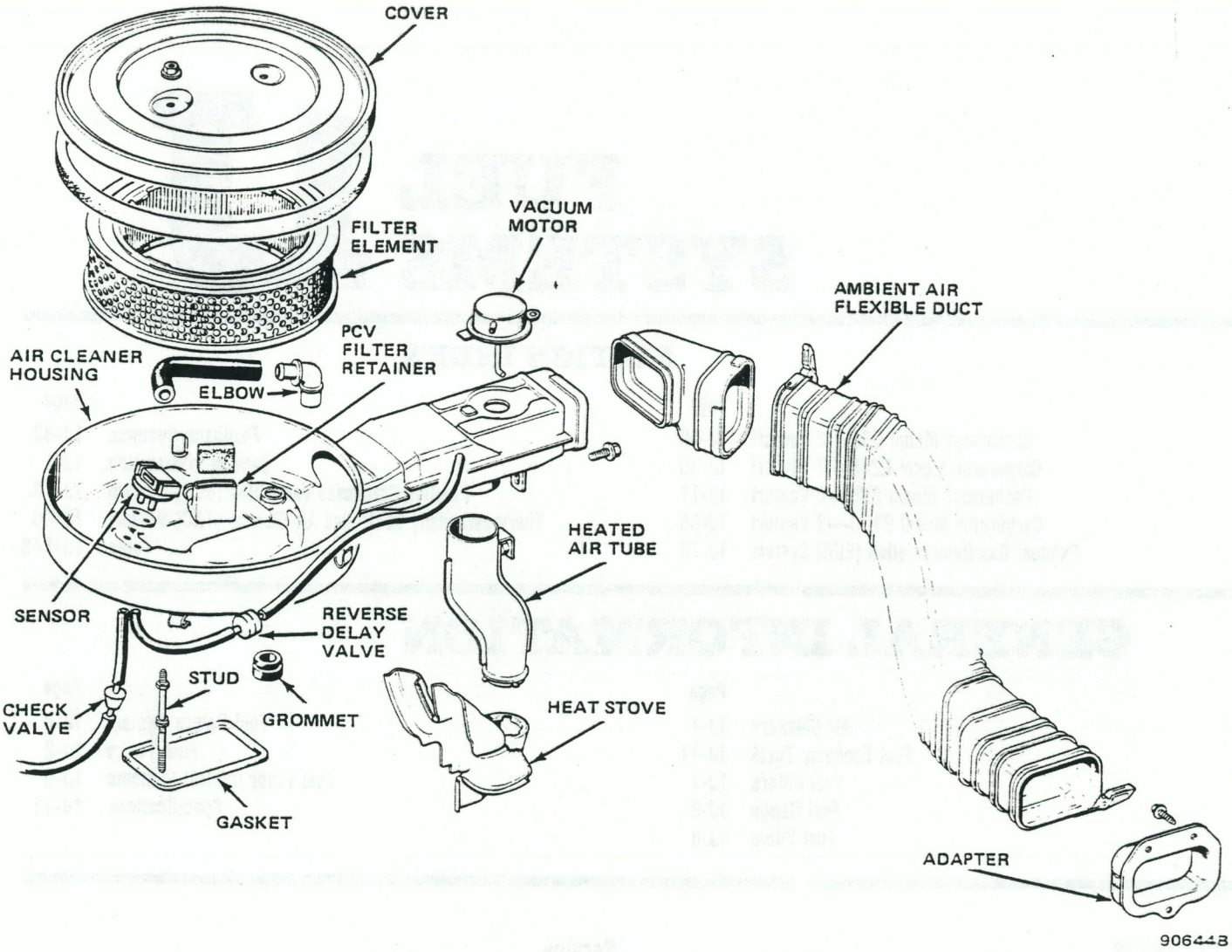

Fig. 1J-1 Carburetor Air Cleaner—Four-Cylinder Engines

The fuel filter for four-cylinder engines is located inside the carburetor. If allowed to become plugged, the result will be restricted fuel flow and loss of engine power. To replace the fuel filter:

NOTE: *Four-cylinder engines have no fuel return to the fuel tank. The sending unit fuel return nipple is capped.*

WARNING: *Battery negative cable must be removed to prevent a potential fire hazard when fuel pipe is disconnected.*

(1) Disconnect battery negative cable.
(2) Disconnect fuel pipe at fuel inlet filter fitting.
(3) Remove fuel inlet filter fitting from carburetor.
(4) Remove filter element and spring (fig. 1J-3).
(5) Install replacement filter element and spring with hole in filter element toward fitting.
(6) With new gasket on fitting, install fuel inlet fitting and tighten with 25 foot-pounds (34 N•m) torque.
(7) Install fuel pipe and tighten with 18 foot-pounds (24 N•m) torque while holding fuel inlet fitting with wrench.
(8) Connect battery negative cable.

WARNING: *Use extreme caution when engine is operating. The fan, pulleys and belts can cause serious personal injury. Do not wear loose clothing. Do not stand in direct line with fan blades.*

(9) Start engine and inspect for leaks.

All vehicles use a woven Saran sleeve-type filter that is attached to the end of the fuel outlet tube inside the fuel tank. This filter is rated at 65 microns and repels water. Under normal conditions, it requires no maintenance or service.

FUEL TANKS

The fuel tank on all models is protected by a shield. Cherokee, Wagoneer and CJ models have two tank vents while Truck models have one vent. The various fuel tank and venting arrangements are illustrated in figures 1J-4, 1J-5 and 1J-6.

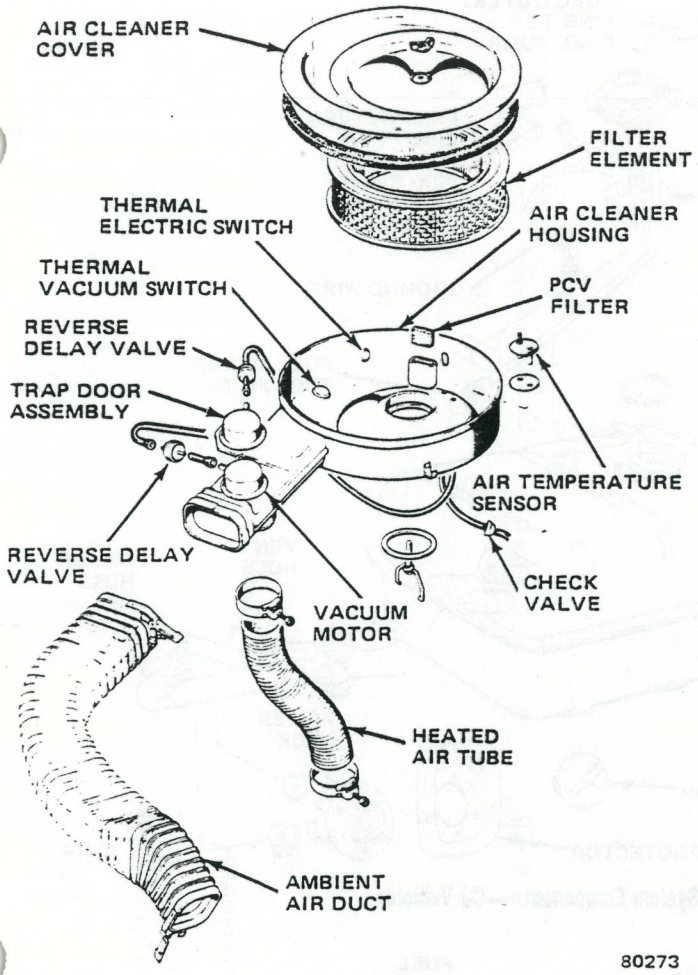

Fig. 1J-2 Typical Carburetor Air Cleaner—Six- and Eight-Cylinder Engines

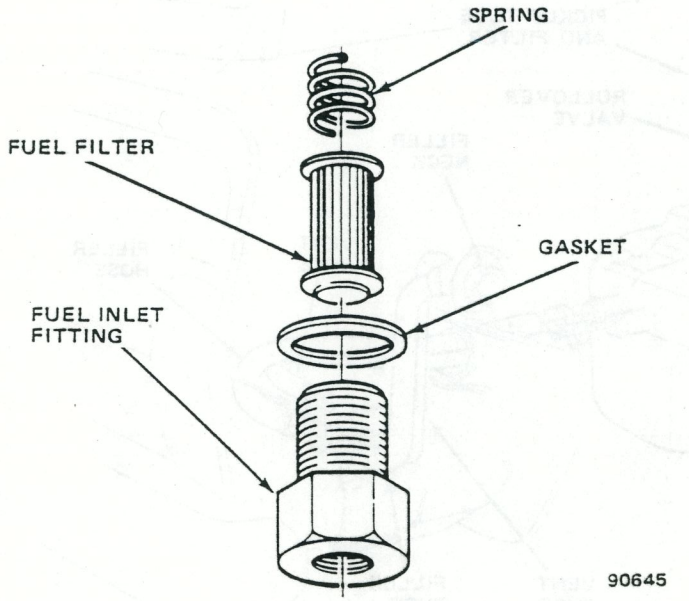

Fig. 1J-3 Four-Cylinder Engine Fuel Filter

The fuel tanks are external expansion types that are vented by vapor hoses routed to the vapor canister. Refer to Fuel Vapor Control System.

Fuel Tank Replacement

Removal—CJ Vehicles

(1) Position jack under shield and remove screws.
(2) Disconnect fuel outlet and return hoses, fuel filler hose and filler vent hose.
(3) Partially lower shield and tank and disconnect tank vapor vent hoses.
(4) Disconnect fuel gauge sending unit wires, lower tank and remove.

Installation—CJ Vehicles

(1) Position shield and tank on jack and partially raise.
(2) Install fuel outlet hose, return hose, fuel gauge sending unit wires and tank vapor vent hoses.
(3) Raise shield and tank to installation position, install screws and tighten.
(4) Install fuel filler hose and filler vent hose.

Removal—Cherokee-Wagoneer Vehicles

(1) Remove parking brake cable guide clips.
(2) Disconnect one brake cable at connector.
(3) Disconnect fuel filler hose.
(4) Disconnect front drive shaft and position aside to allow clearance for tank removal.
(5) Place jack under shield and tank and remove attaching hardware.
(6) Lower shield and tank. Disconnect fuel gauge sending unit wires, fuel outlet hose and return hose.

Installation—Cherokee-Wagoneer Vehicles

(1) Place shield and tank on jack. Connect fuel gauge sending unit wires, fuel outlet hose and return hose.
(2) Raise shield and tank to installation position and secure with attaching hardware.
(3) Connect fuel filler hose.
(4) Connect parking brake cable.
(5) Connect front drive shaft.

Removal—Truck Vehicles

(1) Disconnect fuel filler hose, filler vent hose and tank vapor vent hose.
(2) Place jack under shield and tank.
(3) Loosen straps and lower shield and tank.
(4) Disconnect fuel gauge sending unit wires, fuel outlet hose and fuel return hose.
(5) Remove shield and tank.

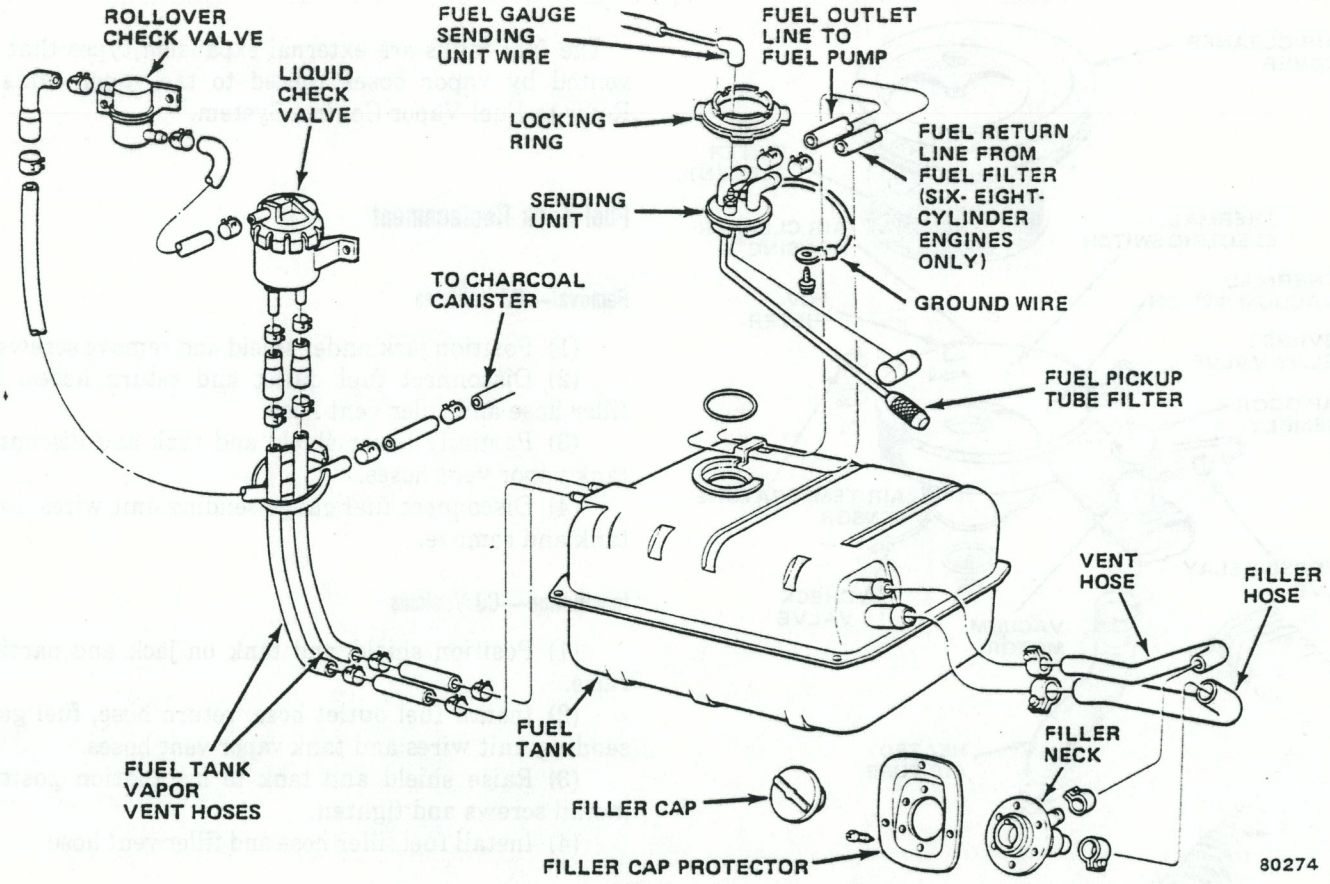

Fig. 1J-4 Fuel Tank and Associated Fuel System Components—CJ Vehicles

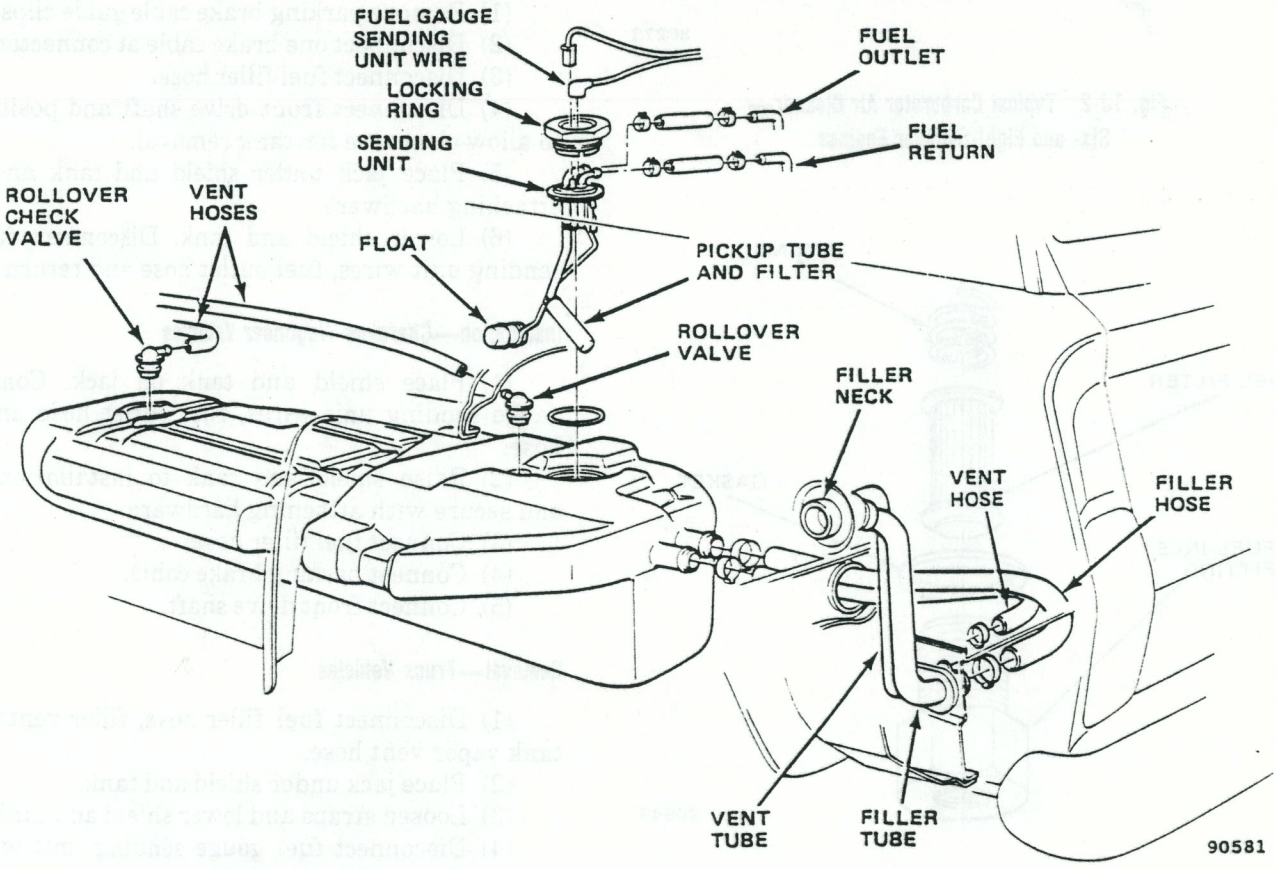

Fig. 1J-5 Fuel Tank and Associated Fuel System Components—Cherokee-Wagonner Vehicles

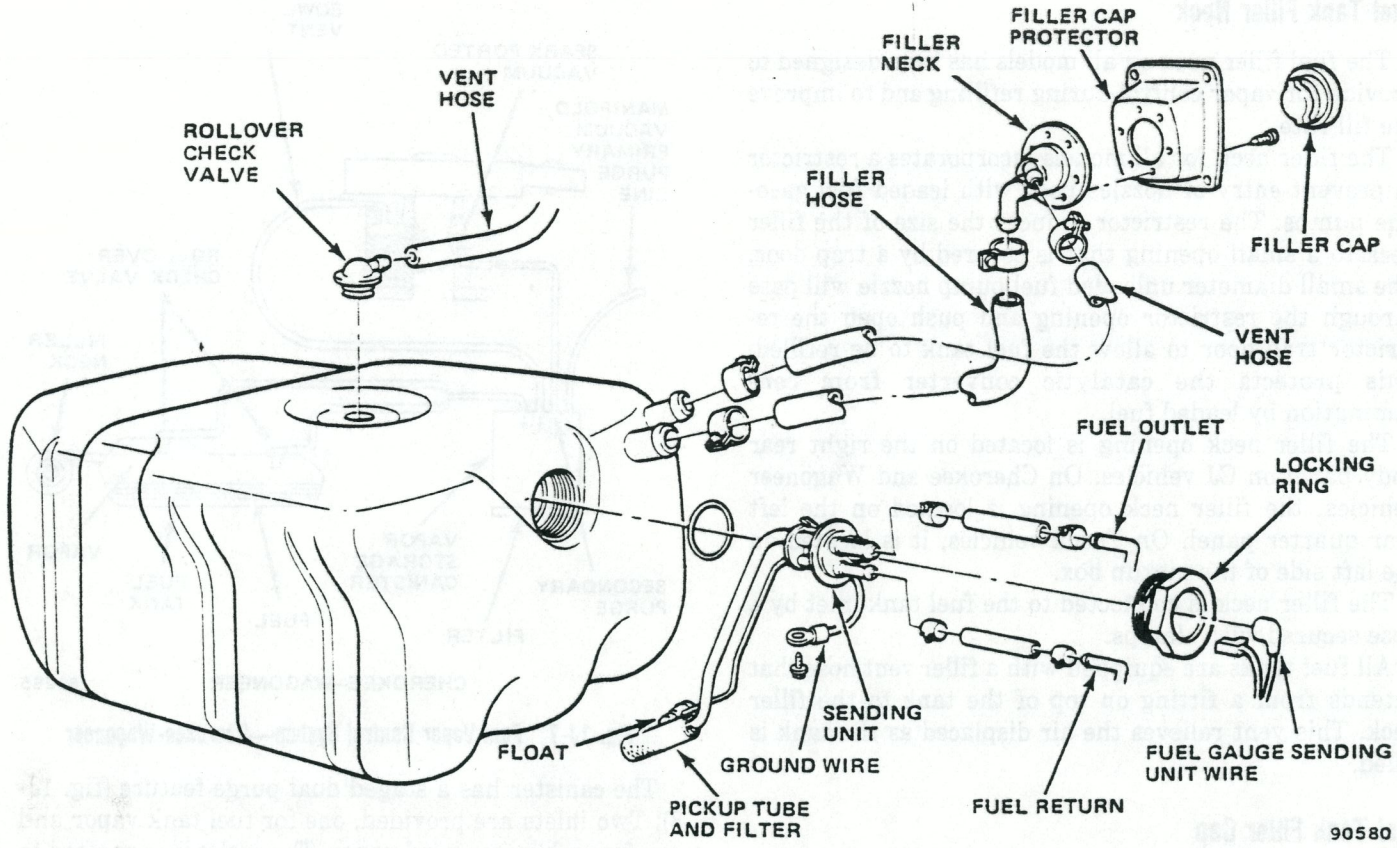

Fig. 1J-6 Fuel Tank and Associated Fuel System Components—Truck Vehicles

Installation—Truck Vehicles

(1) Install replacement clamps on filler and vent hoses and fuel outlet and return hoses.

(2) Position shield and tank on jack.

(3) Connect fuel outlet and return hoses and sending unit wires.

(4) Raise shield and tank and install straps.

(5) Connect filler and vent hoses to tank.

Fuel Gauge Sending Unit

The sending unit assembly utilizes a float that pivots on a variable resistance element.

The fuel pickup, fuel system nipples and the sending unit assembly are an integral unit that is mounted on a flanged opening on the fuel tank. For Cherokee, Wagoneer and Truck vehicles, it is secured with a threaded retainer that must be tightened with a torque of 14 to 18 foot-pounds (19 to 24 N•m). For CJ vehicles, the unit is secured with a locking ring.

Removal—All Vehicles

(1) Remove fuel tank according to removal procedures previously outlined.

(2) With Tool J-23726, turn threaded retainer (except CJ tanks) counterclockwise and remove. For CJ tanks, turn locking ring counterclockwise and disengage from retaining flange.

(3) Remove sending unit assembly (figs. 1J-4, 5 and 6).

Installation—All Vehicles

(1) Position sending unit assembly in opening on top of tank (figs. 1J-4, 5 and 6).

NOTE: *Ensure O-ring is properly positioned in groove. Replace improperly fitting ring.*

(2) Position threaded retainer (except CJ tanks), turn clockwise and, with Tool J-23726, tighten with a torque of 14 to 18 foot-pounds (19 to 24 N•m). For CJ tanks, position locking ring on retaining flange, align with cutout in flange and turn clockwise to stop position.

NOTE: *Do not attempt to turn locking ring beyond stop position.*

(3) Install fuel tank according to installation procedures previously outlined.

NOTE: *Ensure the sending unit ground wire has a good electrical connection.*

Fuel Tank Filler Neck

The fuel filler neck on all models has been designed to provide for vapor control during refilling and to improve the fill rate.

The filler neck for all models incorporates a restrictor to prevent entry of nozzles used with leaded fuel gasoline pumps. The restrictor reduces the size of the filler neck to a small opening that is covered by a trap door. The small diameter unleaded fuel pump nozzle will pass through the restrictor opening and push open the restrictor trap door to allow the fuel tank to be refilled. This protects the catalytic converter from contamination by leaded fuel.

The filler neck opening is located on the right rear body panel on CJ vehicles. On Cherokee and Wagoneer vehicles, the filler neck opening is located on the left rear quarter panel. On Truck vehicles, it is located on the left side of the pickup box.

The filler neck is connected to the fuel tank inlet by a hose secured with clamps.

All fuel tanks are equipped with a filler vent hose that extends from a fitting on top of the tank to the filler neck. This vent relieves the air displaced as the tank is filled.

Fuel Tank Filler Cap

The filler cap incorporates a two-way relief valve that is closed to the atmosphere during normal operating conditions. The relief valve is calibrated to open only when a pressure of 0.75 to 1.5 psi (5 to 10 kPa) or a vacuum of 1.1 to 1.8 in. Hg (4 to 6 kPa) occurs within the tank. When the pressure or vacuum is relieved, the valve returns to the normally closed position.

FUEL VAPOR CONTROL SYSTEMS

The fuel vapor control system prevents raw fuel vapor from escaping into the atmosphere. Fuel vapor from the fuel tank and carburetor bowl are collected in a canister and are metered into the intake manifold for combustion. On all vehicles, rollover check valves in the vent system prevent fuel from flowing out of the vent hoses if the vehicle is accidentally rolled over. The various typical components, depicted in figure 1J-7, are described below.

NOTE: *The systems used with CJ and Truck vehicles are similar to that illustrated in figure 1J-7.*

Components

Vapor Canister

This component is used on all vehicles. The canister is filled with granules of activated charcoal. Vapor entering the canister is absorbed by the granules.

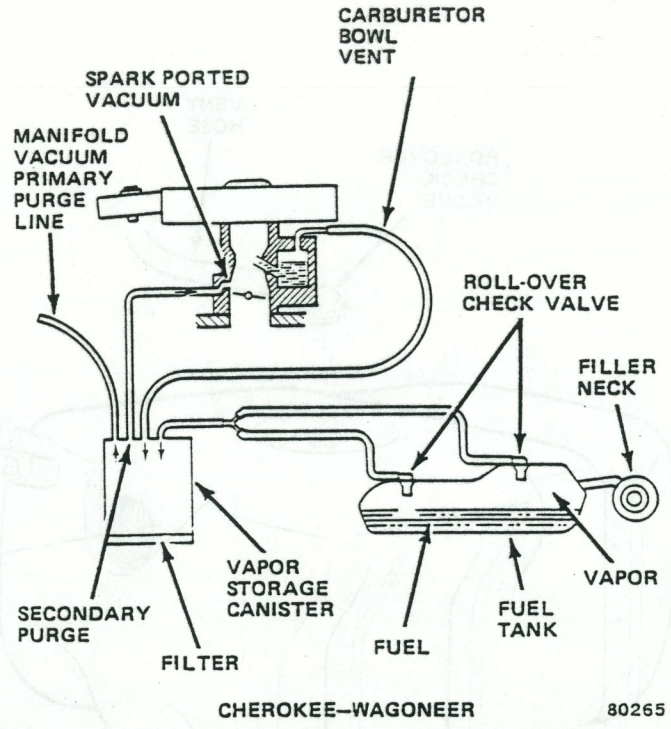

Fig. 1J-7 Fuel Vapor Control System—Cherokee-Wagoneer

The canister has a staged dual purge feature (fig. 1J-8). Two inlets are provided, one for fuel tank vapor and one for carburetor bowl vapor. The outlet is connected to an intake manifold vacuum source. The fourth nipple is connected to the carburetor spark port (ported vacuum).

When the engine is operating, fresh air enters through the inlet filter in the bottom of the canister and purges the stored vapor. When the ported vacuum reaches 12 in. Hg (41 kPa), the secondary purge circuit is opened, and the canister is purged at a much higher rate.

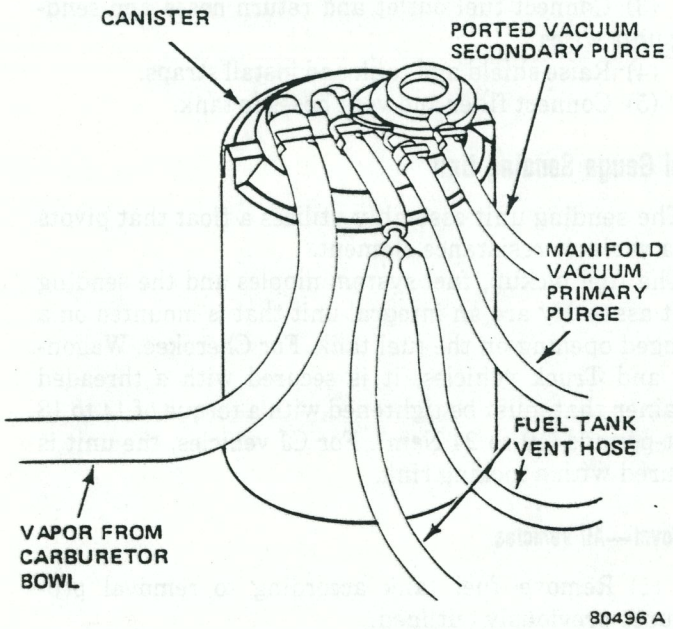

Fig. 1J-8 Fuel Vapor Control Canister and Hoses—Typical

Rollover Check Valve

This component is used on all Jeep vehicles. The rollover check valve prevents fuel flow from the fuel tank through the vent hoses in the event of vehicle rollover. The check valve consists of a plunger and a stainless steel ball (figs. 1J-9 and 1J-10). When inverted, the stainless steel ball pushes the plunger against its seat. A properly functioning rollover valve will hold 3 psi (21 kPa) of air pressure on the inlet side when inverted.

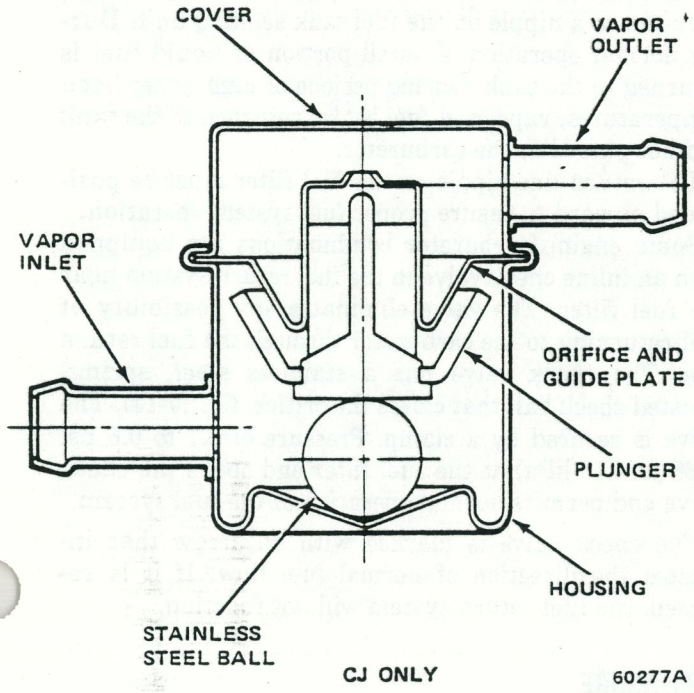

Fig. 1J-9 Rollover Check Valve—CJ Vehicles

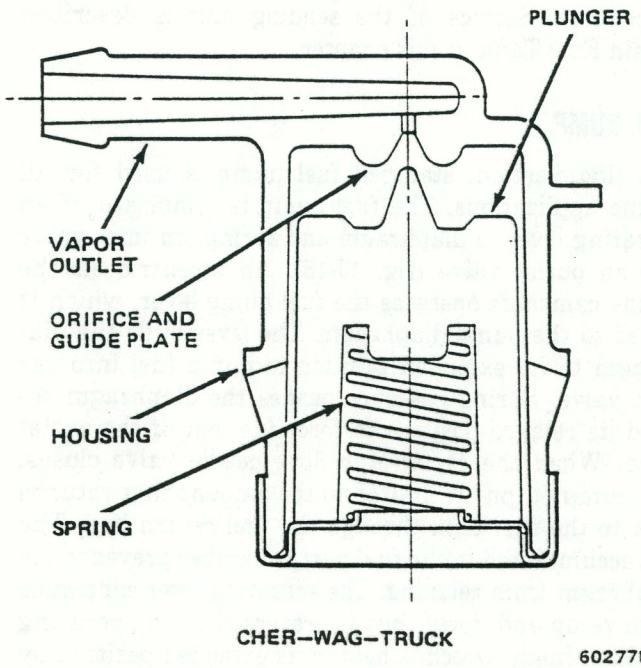

Fig. 1J-10 Rollover Check Valve—Cherokee-Wagoneer-Truck Vehicles

Carburetor External Bowl Vent

This component is used on all carburetors. The carburetor external bowl vent provides an outlet for fuel vapor when the engine is not operating (fig. 1J-11). If the vent were not provided, raw fuel vapor would enter the atmosphere. Some would also enter the intake manifold and cause difficult hot restarts. When the engine is operating, the fuel bowl must be vented to the inside of the air cleaner for proper fuel flow. This is accomplished by automatically closing the external bowl vent by a mechanical link from the throttle. Refer to Float Circuit in the applicable carburetor section for specific operating principles.

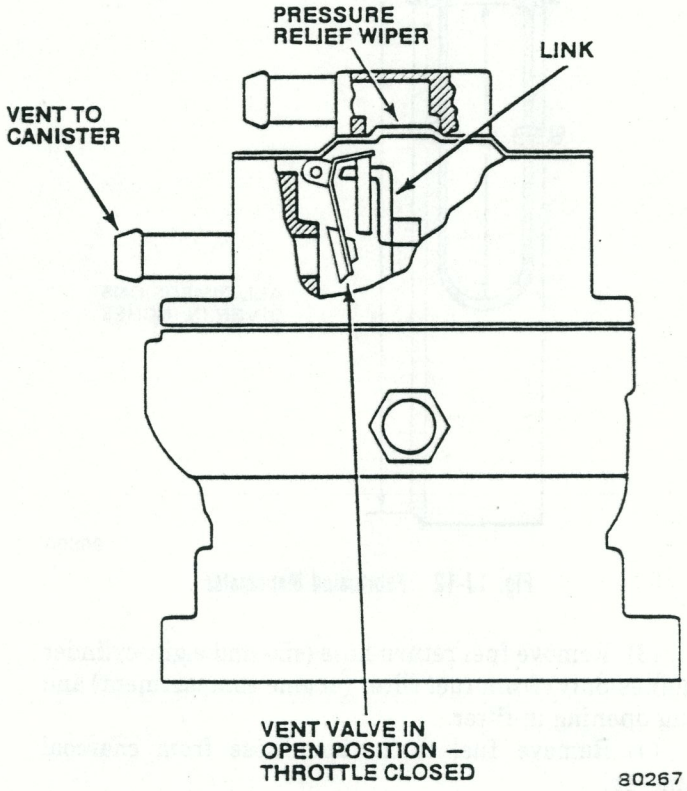

Fig. 1J-11 External Bowl Vent—Typical

Fuel Vapor Control Integrity Test

NOTE: *This procedure is for six- and eight-cylinder engines only.*

(1) If a manometer is not available, one may be fabricated (fig. 1J-12).

(a) Attach a 6-foot length of 3/8-inch clear plastic tubing (Tygon or equivalent) to a 4-foot x 6-inch x 1-inch board.

(b) Fill tube with water to a height of 15 inches.

(2) Visually inspect fuel vapor control system for loose or damaged hoses, clamps, etc. Repair as necessary.

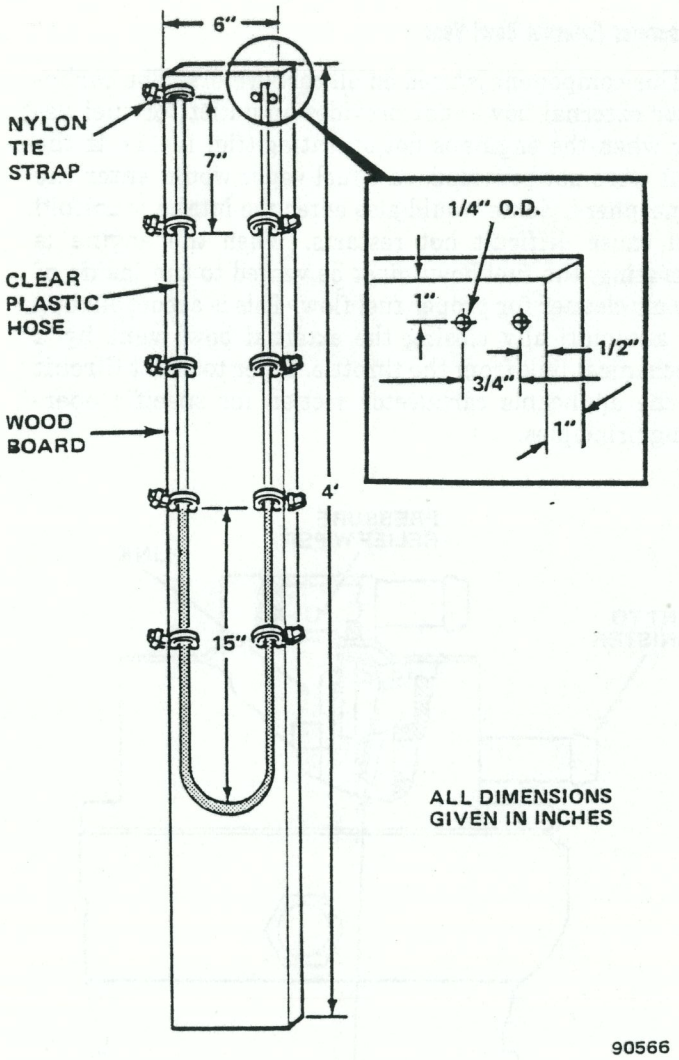

Fig. 1J-12 Fabricated Manometer

(3) Remove fuel return hose (six- and eight-cylinder engines only) from fuel filter (engine compartment) and plug opening in filter.

(4) Remove fuel tank vapor hose from charcoal canister.

(5) Connect plastic tube or rubber hose between manometer and fuel tank vapor hose.

NOTE: *Fuel tank must be no more than 3/4 full.*

CAUTION: *Do not pressurize the fuel vapor control system more than 1.5 psi or 10.3 kPa (41.5 inches of water).*

(6) With bicycle tire air pump (suggested maximum pump size is 15 inches in length, 1 inch plunger diameter), pressurize system at fuel return hose until column of water in manometer rises 15 inches (1.1 in. Hg or 3.7 kPa) from no-pressure position.

(7) With soap and water solution, inspect all fuel vapor control system connections for leaks (bubbles). Repair as necessary.

(8) Connect fuel tank vapor hose to canister and fuel return hose to fuel filter.

FUEL RETURN SYSTEM

All Jeep vehicles with six- and eight-cylinder engines employ a fuel return system to reduce the possibility of high temperature fuel vapor problems. The fuel return system is comprised of a fuel filter with a return nipple and a return line to the fuel tank (fig. 1J-13).

The fuel return line is routed to the fuel tank, where it connects to a nipple on the fuel tank sending unit. During normal operation, a small portion of liquid fuel is returned to the tank. During periods of high under hood temperatures, vaporized fuel is also returned to the tank and not passed to the carburetor.

The return line nipple on the fuel filter must be positioned upward to ensure proper fuel system operation.

Some engine/carburetor combinations are equipped with an inline check valve in the fuel return system near the fuel filter. The valve eliminates any possibility of fuel returning to the carburetor through the fuel return line. The check valve has a stainless steel, spring-assisted check ball that closes the orifice (fig. 1J-14). The valve is secured by a clamp. Pressure of 0.1 to 0.6 psi (0.68 to 4.13 kPa) at the fuel filter end opens the check valve and permits normal operation of the fuel system.

The check valve is marked with an arrow that indicates the direction of normal fuel flow. If it is reversed, the fuel return system will not function.

FUEL GAUGE

Refer to Chapter 1L—Power Plant Instrumentation for operation, malfunction diagnosis and replacement procedures. Service of the sending unit is described within Fuel Tank in this chapter.

FUEL PUMP

A single-action, stamped fuel pump is used for all engine applications. The fuel pump is comprised of an actuating lever, a diaphragm and spring, an inlet valve and an outlet valve (fig. 1J-15). An eccentric on the engine camshaft operates the fuel pump lever, which is linked to the pump diaphragm. The lever pulls the diaphragm to its extended position to pump fuel into the inlet valve. Spring pressure pushes the diaphragm toward its relaxed position to force fuel out of the outlet valve. When the carburetor float needle valve closes, fuel pump output is limited to the amount that returns back to the fuel tank through the fuel return line. The fuel accumulated in the fuel pump chamber prevents the diaphragm from relaxing. The actuating lever continues to move up and down, but is prevented from operating the diaphragm, which is held in its extended position by fuel pressure. Fuel flow from the pump remains halted

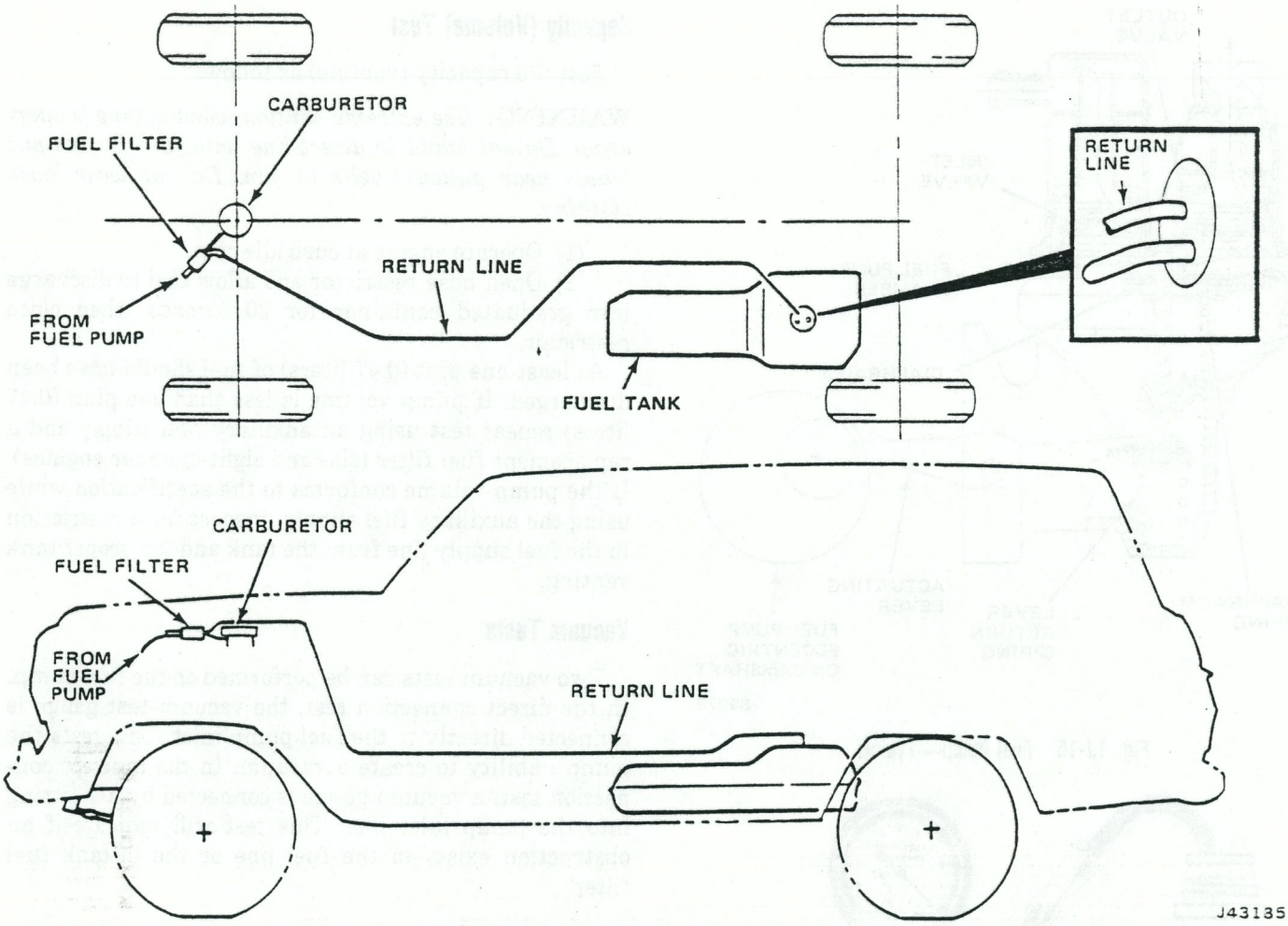

Fig. 1J-13 Fuel Return System—Typical

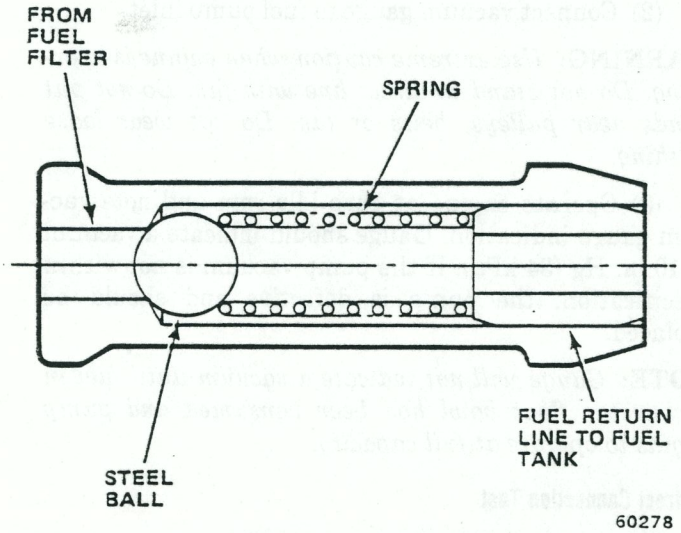

Fig. 1J-14 In-Line Check Valve

until excess pressure is released through the fuel return line or the carburetor needle opens. This process continues as long as the engine is operating.

Fuel pumps cannot be overhauled. Replace a fuel pump if it fails any of the following tests.

NOTE: *Before performing tests, ensure the in-line fuel filter (six- and eight-cylinder engines) is not clogged.*

Pressure Test

(1) Remove air cleaner assembly.

(2) Disconnect fuel inlet fitting or fuel filter at carburetor.

(3) Disconnect fuel return hose at fuel filter and plug nipple on filter.

NOTE: *Remove any spilled fuel from engine.*

(4) Connect pressure gauge, restrictor and flexible hose between fuel filter and carburetor (fig. 1J-16).

(5) Position flexible hose and restrictor so fuel can be discharged into suitable graduated container.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(6) Operate engine at curb idle rpm and discharge fuel into container by momentarily opening hose restrictor.

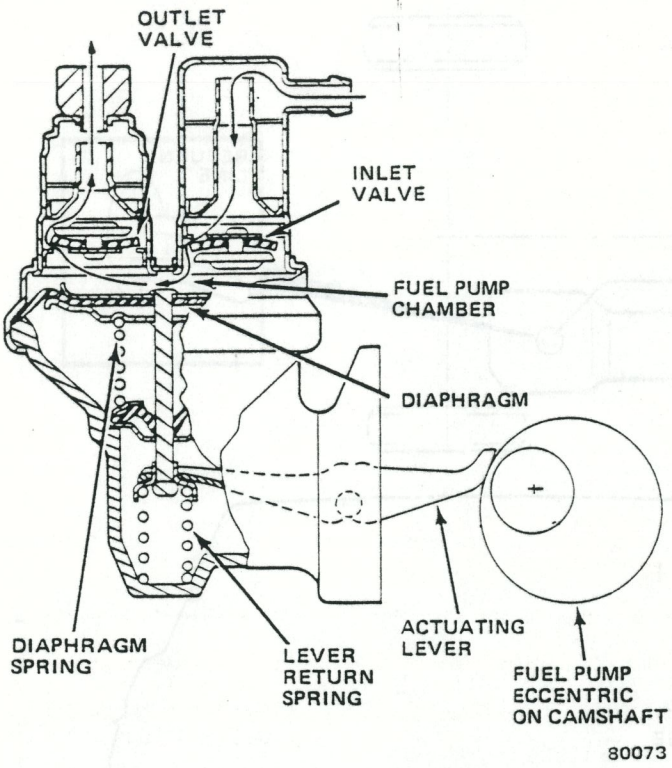

Fig. 1J-15 Fuel Pump—Typical

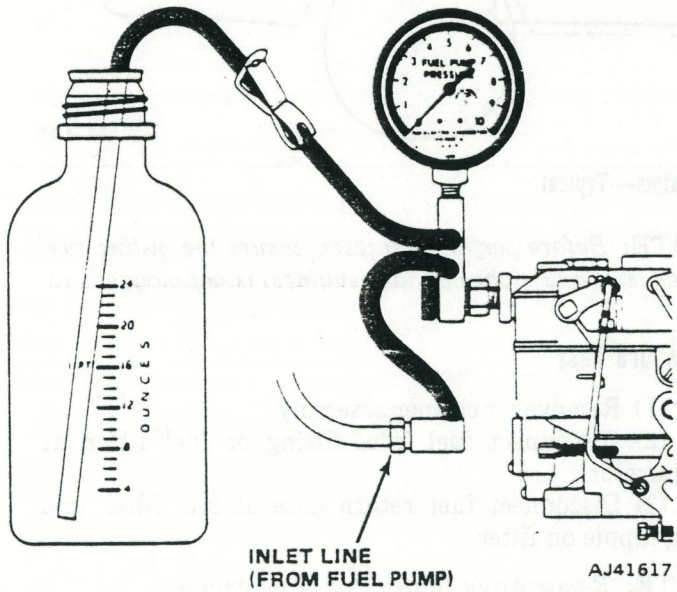

Fig. 1J-16 Fuel Pump Pressure and Volume Test

(7) Close hose restrictor, allow pressure to stabilize, and not pressure. Gauge should indicate 6.5 to 8 psi (45 to 55 kPa) for four-cylinder engines, 4 to 5 psi (28 to 34 kPa) for six-cylinder engines, and 5 to 6.5 psi (34 to 45 kPa) for eight-cylinder engines.

If the pump pressure is not within specification and the fuel lines and filter are in satisfactory condition, the pump is defective and should be replaced. If the pump pressure is within specification, perform the capacity and vacuum tests.

Capacity (Volume) Test

Test the capacity (volume) as follows:

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(1) Operate engine at curb idle rpm.

(2) Open hose restrictor and allow fuel to discharge into graduated container for 30 seconds, then close restrictor.

At least one pint (0.47 liters) of fuel should have been discharged. If pump volume is less than one pint, (0.47 liters) repeat test using an auxiliary fuel supply and a replacement fuel filter (six- and eight-cylinder engines). If the pump volume conforms to the specification while using the auxiliary fuel supply, inspect for a restriction in the fuel supply line from the tank and for proper tank venting.

Vacuum Tests

Two vacuum tests can be performed on the fuel pump. In the direct connection test, the vacuum test gauge is connected directly to the fuel pump inlet. This tests the pump's ability to create a vacuum. In the indirect connection test, a vacuum gauge is connected by a T-fitting into the pump inlet line. This test will indicate if an obstruction exists in the fuel line or the in-tank fuel filter.

Direct Connection Test

(1) Disconnect fuel inlet pipe at fuel pump.

(2) Connect vacuum gauge to fuel pump inlet.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(3) Operate engine at curb idle rpm and note vacuum gauge indication. Gauge should indicate a vacuum of 10 in. Hg (34 kPa). If the pump vacuum is not within specification, the pump is defective and should be replaced.

NOTE: *Gauge will not indicate a vacuum until fuel in carburetor float bowl has been consumed and pump begins to operate at full capacity.*

Indirect Connection Test

(1) Disconnect fuel inlet pipe at fuel pump.

(2) Install T-fitting between disconnected fitting and fuel pump inlet. Connect vacuum gauge to T-fitting.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(3) Operate engine at 1500 rpm for 30 seconds. Vacuum should not exceed 3 in. Hg (10 kPa).

(4) If vacuum exceeds 3 inches of mercury, check fuel line for restriction. A partially clogged in-tank fuel filter can also cause excess vacuum.

NOTE: *Gauge will not indicate a vacuum until fuel in carburetor float bowl has been consumed and pump begins to operate at full capacity.*

Fuel Pump Specification Chart

Engine	Volume (30 seconds)	Pressure PSI (kPa)	Vacuum in. Hg(kPa)	
			Direct	Indirect
Four-Cylinder	1 pint (0.47 liters)	6.5 to 8 (44 to 55)	10 (33.77kPa)	3 (10.13kPa)
Six-Cylinder	1 pint (0.47 liters)	4 to 5 (28.58 to 34.47)	10 (33.77kPa)	3 (10.13kPa)
Eight-Cylinder	1 pint (0.47 liters)	5 to 6.5 (34 to 45)	10 (33.77kPa)	3 (10.13kPa)

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Fuel Pump Replacement

Removal

(1) Disconnect fuel pipe fittings from fuel pump.
(2) Remove retaining screws.
(3) Remove pump and gasket.

Installation

(1) Install pump and replacement gasket.

NOTE: *Ensure actuating lever is positioned properly on camshaft eccentric.*

(2) Install retaining screws.
(3) Connect fuel pipe fittings to fuel pump.

FUEL ECONOMY TESTS

When testing fuel economy for six- and eight-cylinder engines, connect the testing device between the **fuel filter** and the **carburetor**. Do not block off the fuel return line because this may cause an erronious miles-per-gallon indication.

SPECIFICATIONS

Fuel Tank Capacity

Vehicle	Gallons
CJ	14.8 (56.0 liters)
Cherokee Wagoneer	21.5 (81.4 liters)
Truck	18.2 (68.9 liters)

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CARBURETOR MODEL 2SE – 2 VENTURI

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GENERAL

The model 2SE carburetor is a two venturi, two stage, down draft type carburetor (figs. 1J-17 and 1J-18). To reduce weight, aluminum castings are used for the air horn, float bowl and throttle body. A heat insulator gasket is located between the throttle body and float bowl to reduce heat transfer to the float bowl.

The primary stage has a triple venturi with a small 35 mm bore that provides efficient fuel metering control during idle and partial throttle operation.

The secondary stage has a larger 46 mm bore that provides the additional air supply necessary for higher engine power requirements. An air valve with a single tapered metering rod is used in the secondary stage.

An integral one-inch pleated-paper fuel filter with check valve is located between the front of the float bowl and the fuel inlet fitting. The check valve prevents fuel flow to the carburetor in the event of vehicle rollover.

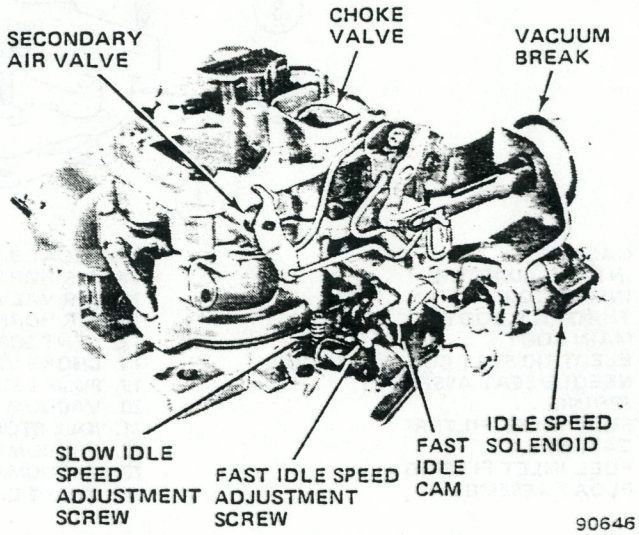
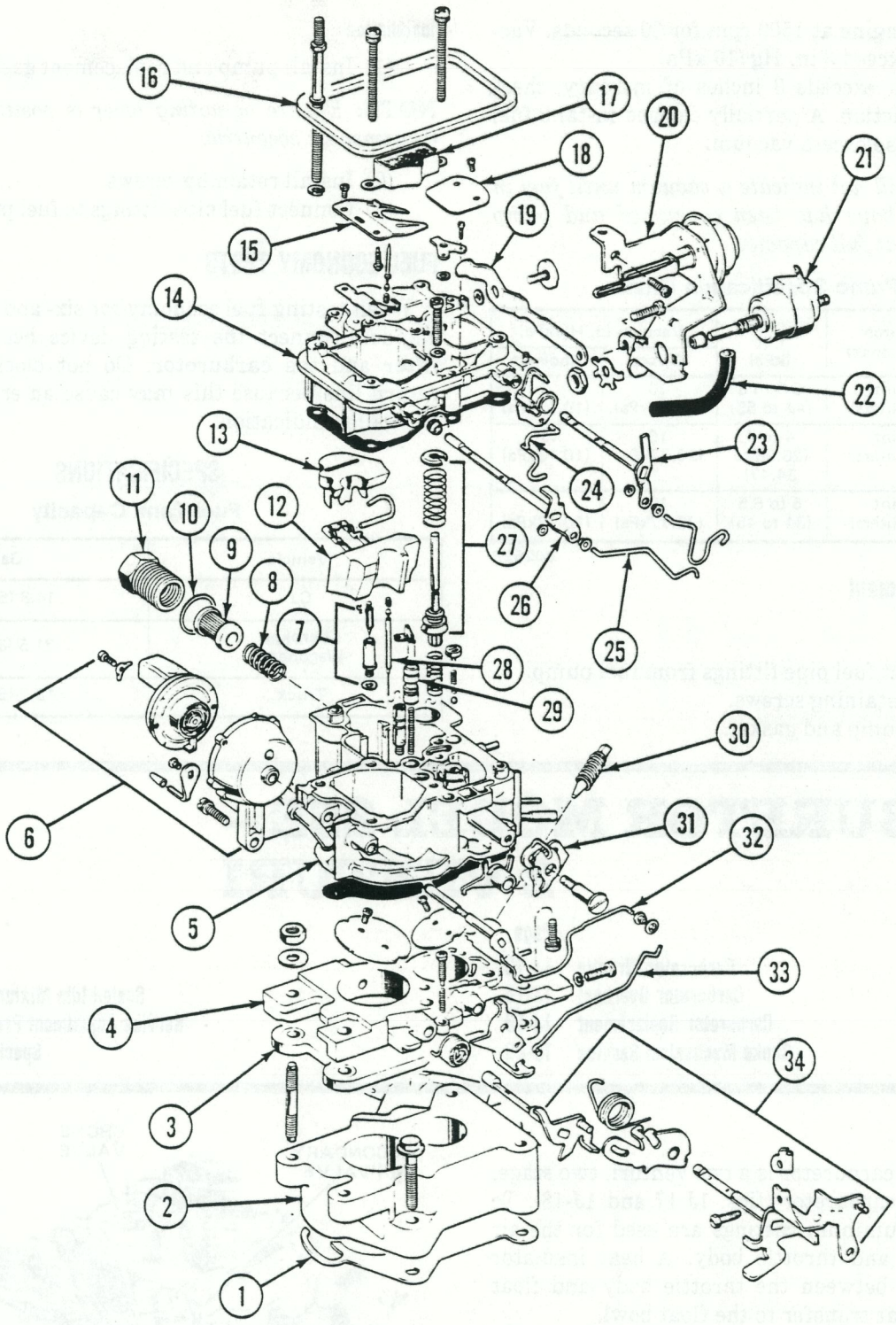


Fig. 1J-17 Model 2SE Carburetor—View A



1. GASKET
2. INTAKE ADAPTER
3. INSULATOR
4. THROTTLE BODY
5. MAIN BODY
6. ELECTRIC STAT COVER AND COIL
7. NEEDLE SEAT ASSEMBLY
8. SPRING
9. FUEL INLET FILTER
10. GASKET
11. FUEL INLET FITTING
12. FLOAT ASSEMBLY
13. FLOAT BAFFLE
14. AIR HORN
15. AIR VALVE
16. AIR HORN GASKET
17. VENT SCREEN
18. CHOKE VALVE
19. PUMP LEVER
20. VACUUM BREAK AND BRACKET
21. IDLE STOP SOLENOID
22. VACUUM HOSE
23. VACUUM BREAK LEVER
24. CHOKE LINK
25. AIR VALVE ROD
26. AIR VALVE LEVER
27. ACCELERATOR PUMP
28. METERING ROD
29. POWER PISTON
30. IDLE NEEDLE AND SPRING
31. FAST IDLE CAM
32. INTERMEDIATE CHOKE ROD
33. PUMP ROD
34. THROTTLE LEVER ASSEMBLY

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Fig. 1J-18 Model 2SE Carburetor—View B

Identification

The carburetor model identification is stamped vertically on the float bowl in a flat area adjacent to the vacuum tube (fig. 1J-19). When replacing the float bowl, follow the manufacturer's instructions contained in the service package and ensure that the identification number is transferred to the new float bowl.

Refer to the part number on the bowl when servicing the carburetor.

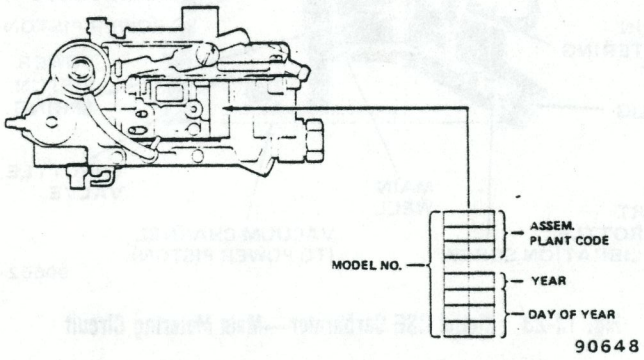

Fig. 1J-19 Model 2SE Carburetor Identification

CARBURETOR CIRCUITS

Model 2SE carburetor has six basic circuits. They are:

- Float
- Idle
- Main Metering
- Power Enrichment
- Pump
- Choke

Float Circuit

The float chamber is located adjacent to the primary and secondary bores (figs. 1J-20 and 1J-21). This feature assures adequate fuel supply to both carburetor venturi bores during all standard engine operations.

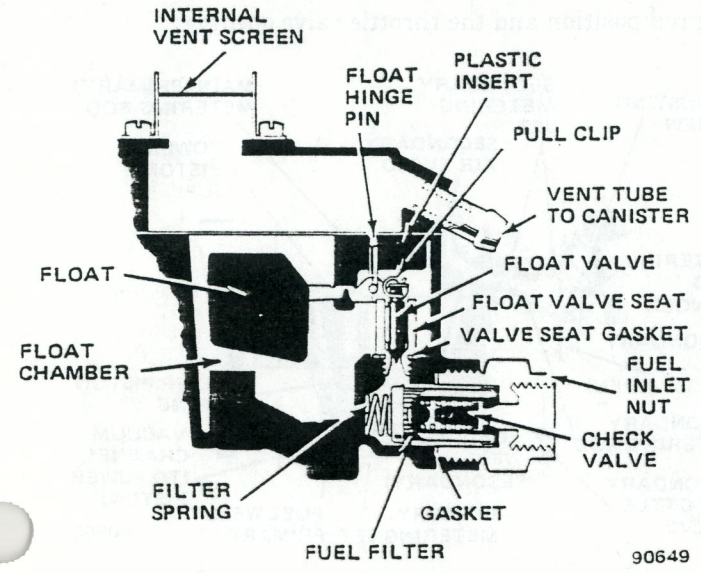

Fig. 1J-20 Model 2SE Carburetor—Float Circuit

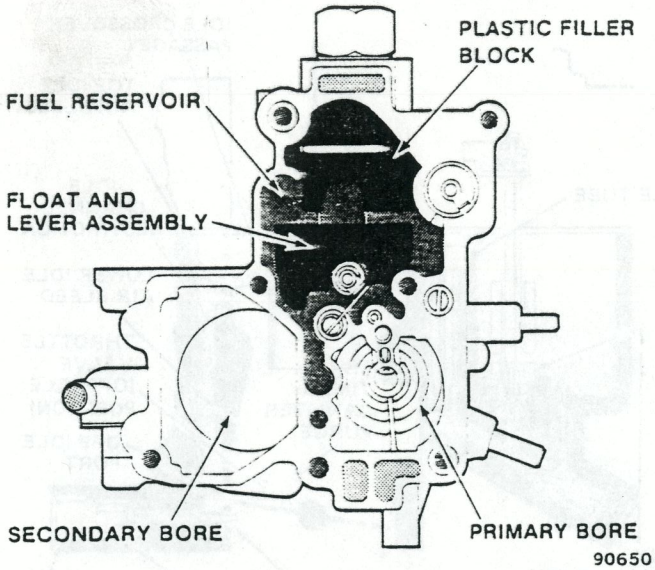

Fig. 1J-21 Model 2SE Carburetor—Fuel Reservoir

A single pontoon float, brass needle seat, and a rubber tipped float needle with pull clip are used to control the fuel level in the float chamber. The float chamber is internally vented through a vertical vent cavity in the air horn. Above this vent cavity is a removable vent stack assembly that has a small meshed screen at its top. This vent stack provides the correct height for the internal vent.

The float chamber is also externally vented through a tube (fig. 1J-18) in the air horn. A hose connects this tube directly to a vacuum operated vapor vent valve located at the vapor canister. When the engine is not operating, the canister vapor vent valve is open, allowing fuel vapor from the float chamber to flow into the canister where it is stored until purged. The venting of fuel vapor from the carburetor float bowl to the canister conforms to evaporative emission requirements and improves hot engine starting.

Idle Circuit

Fuel for engine idle and partial throttle operation is controlled by the idle circuit. Fuel flows through the main metering jet into the idle tube and continues to and through the idle cross-over passage where it is mixed with air entering from the lower idle air bleed (fig. 1J-22).

A partial throttle adjustment screw in the float bowl aids in refinement of the fuel mixture for good emission control. This screw is **preset** during factory assembly and a plug is installed to prevent indiscriminate tampering and to seal against any fuel leaks. The plug should not be removed nor the screw adjusted during normal service. If it becomes necessary to replace the float bowl, the new service float bowl will include an adjustable partial throttle (APT) screw that has been preset and plugged as required.

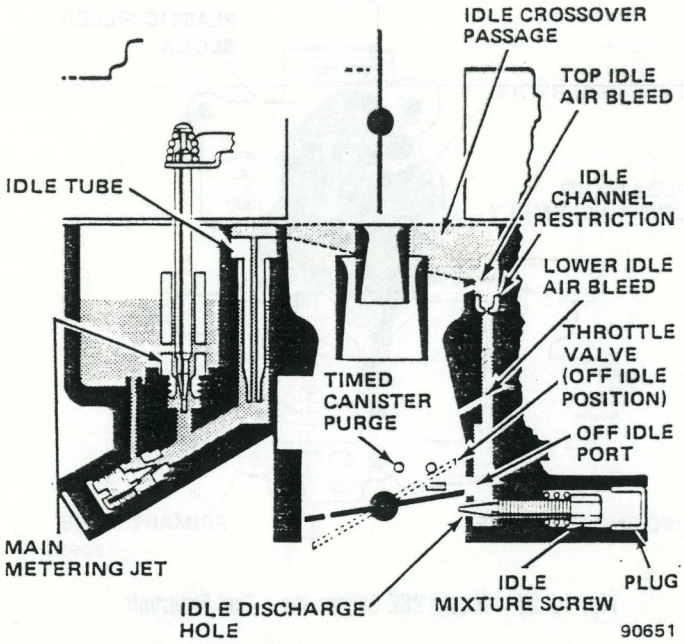

Fig. 1J-22 Model 2SE Carburetor—Idle Circuit

A hot idle compensator assembly (when used) is located in the air horn casting. The opening and closing of the hot idle compensator valve is controlled by a bimetallic strip that is calibrated for a specific temperature. When the valve opens, additional air is allowed to bypass the throttle valves and enter the intake manifold to prevent rough idle during periods of hot engine operation.

The idle mixture screw is recessed in the throttle body casting and sealed with a hardened steel plug to discourage indiscriminate tampering with the factory adjusted mixture setting, which could cause excessive undesirable exhaust emissions. The plug must not be removed, nor the idle mixture screw readjusted, unless required because of major carburetor overhaul or throttle body replacement. Adjustment requires special service procedures.

Main Metering Circuit

At partial throttle and cruising rpm, increased airflow creates a low pressure area in the venturi. Because air above the fuel level in the bowl is at normal pressure, fuel flows to the lower pressure area created by the venturi and amplified by the booster venturi.

The fuel flow moves through the main jets to the main well. Air enters through the main well air bleeds. The resulting mixture of fuel and air is lighter than raw fuel, responds more quickly to changes in venturi vacuum, and is more readily vaporized when discharged into the venturi (fig. 1J-23).

Power Enrichment Circuit

During heavy load or high speed operation the air/fuel ratio must be enriched to provide the necessary increase in engine power.

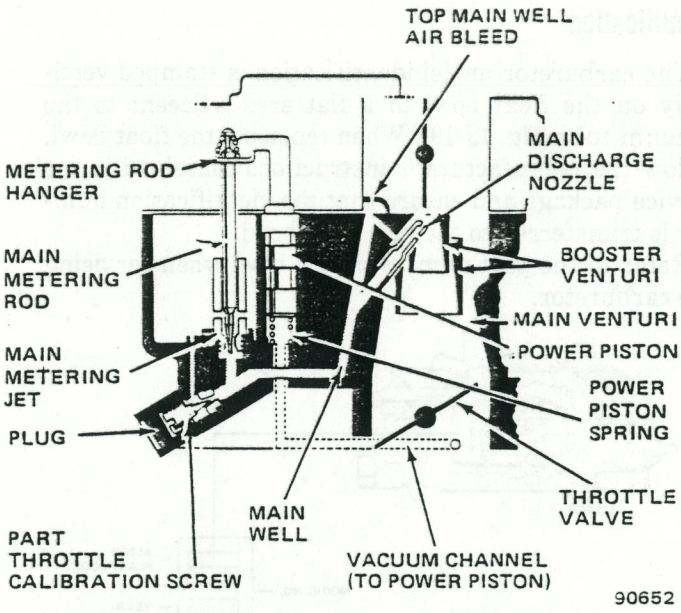

Fig. 1J-23 Model 2SE Carburetor—Main Metering Circuit

Power enrichment is accomplished by means of a calibrated metering rod yoked to a single manifold vacuum actuated piston (fig. 1J-24).

The metering rod piston rests on a calibrated spring that functions to maintain the piston at the top of its cylinder. This allows only the smallest diameter of the tapered metering rods to extend into the main metering jets and permits maximum fuel flow through the jets to the main well cavities.

At idle, partial throttle or cruise conditions, when manifold vacuum is high, the piston is forced down into the vacuum cylinder against the calibrated spring tension and the larger diameters of the metering rods extend into the main metering jets. This restricts the fuel flow to the main well cavities. An additional control is provided by the rod lifter on the accelerator pump rod. This establishes a direct relationship between the metering rod position and the throttle valve opening.

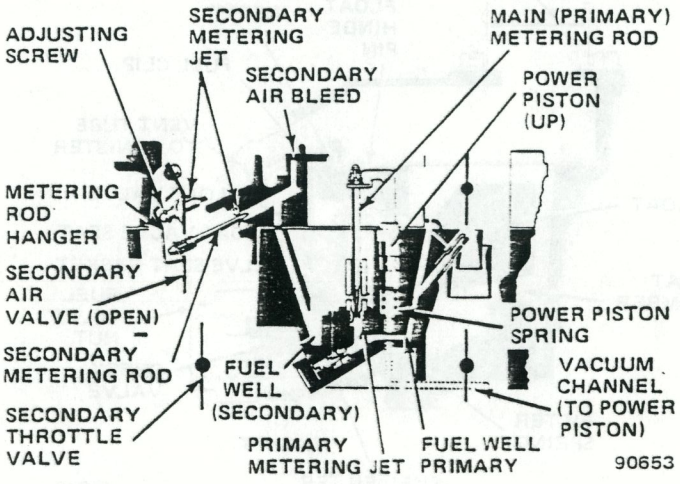

Fig. 1J-24 Model 2SE Carburetor—Power Enrichment Circuit

Pump Circuit

When the throttle is opened suddenly, airflow response through the carburetor is almost immediate. There is a brief time lag before fuel inertia is overcome. This lag causes the desired air/fuel ratio to be leaned-out.

A piston-type accelerating pump assembly mechanically supplies the fuel necessary to overcome this deficiency (fig. 1J-25). Fuel is forced into the pump cylinder from the fuel bowl past the pump piston on the upward movement of the accelerator pump shaft. As the throttle lever is moved, the pump link, operating through a system of levers and assisted by the pump drive spring, pushes the pump piston down. Fuel is forced through a passage, past the pump discharge check ball, and out the pump discharge jets in the venturi cluster.

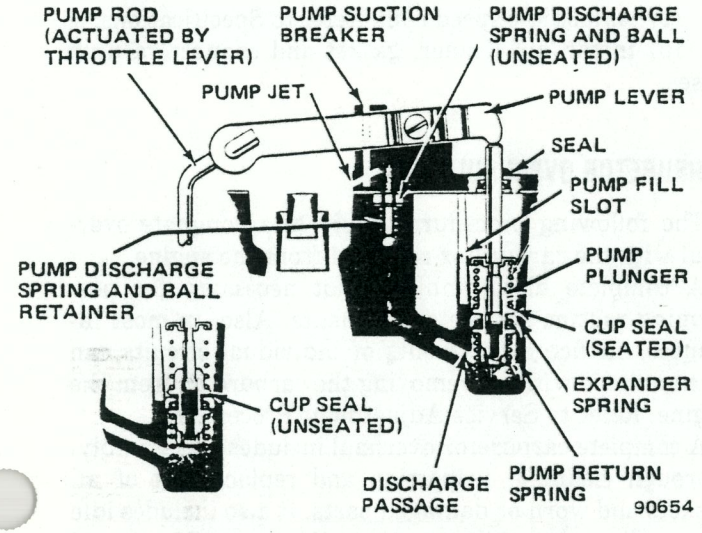

Fig. 1J-25 Model 2SE Carburetor—Pump Circuit

Choke Circuit

The choke valve, located in the air horn assembly, provides a high vacuum, both above and below the throttle valves, when it is closed. During engine starting, vacuum above the throttle valve causes fuel to flow from the main metering and idle circuits and provides the richer air/fuel mixture ratio needed for cold engine starting (fig. 1J-26).

The choke shaft is connected by linkage to a bimetallic coil located within the choke cover. This coil winds up (contracts) when cold and unwinds (expands) when heated. When cold, the tension of the coil holds the choke valve closed. When the engine starts, manifold vacuum is applied to the diaphragm assembly to open the choke valve slightly. This is referred to as the initial choke valve clearance.

The carburetor has an adjustment screw located in the primary throttle lever for fast idle speed adjustment. A separate adjustment screw, located in the throttle body, is used to adjust the curb, or base (depending upon application), idle speed (solenoid de-energized).

NOTE: *Special rivets and conventional retainers are used to maintain the factory adjustment of the bimetallic choke coil. They provide a tamper-resistant enclosure to discourage indiscriminate readjustment in the field.*

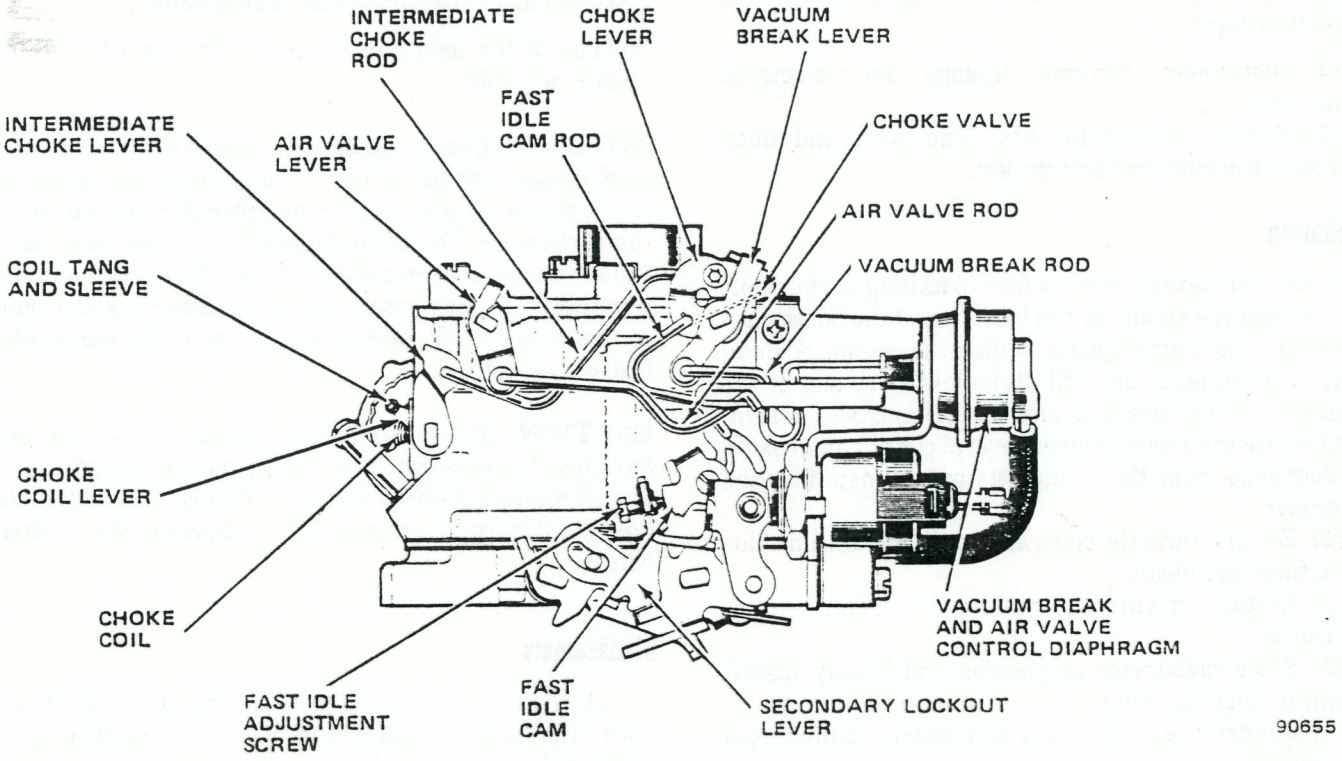

Fig. 1J-26 Model 2SE Carburetor—Choke Circuit

SEALED IDLE MIXTURE SCREW

The idle mixture screw is recessed in the throttle body and sealed with a hardened steel plug to prevent changing the factory assembly adjustment of the air/fuel mixture ratio. **Do not remove the plug and readjust the idle mixture screw unless involved in a major carburetor overhaul, throttle body replacement or the presence of high idle CO has been determined by a competent authority.**

CARBURETOR REPLACEMENT

Removal

Flooding, hesitation on acceleration and other performance complaints are, in many instances, caused by the presence of dirt, water or other foreign matter in the carburetor. To aid in diagnosis, the carburetor should be carefully removed from the engine without draining fuel from the bowl. The contents of the fuel bowl can then be examined for contamination as the carburetor is disassembled. Also, the filter should be examined to determine if it should be replaced.

WARNING: *Battery negative cable must be removed to prevent a potential fire hazard when the fuel pipe fitting is disconnected.*

(1) Remove battery negative cable.
(2) Remove vacuum hoses, air cleaner and gasket.
(3) Disconnect fuel pipe fitting and vacuum hoses from carburetor.

NOTE: *Identify and tag vacuum hoses before disconnecting them.*

(4) Disconnect throttle linkage and electrical connectors.
(5) Remove carburetor attaching bolts and nuts, and remove carburetor and gasket.

Installation

Fill the carburetor bowl before installing carburetor. This reduces the strain on the battery and the possibility of backfire when attempting to start the engine. A small quantity of no-lead fuel will also allow a pre-test of the operation of the float and inlet needle and seat assembly. Operate the throttle lever several times and observe the discharge from the pump jets before installing the carburetor.

(1) Ensure throttle body and intake manifold mating surfaces are clean.
(2) Install manifold gasket on replacement carburetor.
(3) Place carburetor in position and loosely install attaching bolts and nuts.
(4) Connect vacuum hoses and loosely connect fuel pipe fitting.
(5) Tighten attaching bolts and nuts with 12 foot-pounds (16 N•m) torque.
(6) Tighten fuel pipe fitting with 25 foot-pounds (34 N•m) torque.
(7) Connect throttle linkage and electrical connectors.
(8) Connect battery negative cable.

NOTE: *Plug disconnected vacuum hoses.*

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(9) Adjust idle speed rpm. Refer to Specifications.
(10) Install air cleaner, gasket and connect vacuum hoses.

CARBURETOR OVERHAUL

The following procedures apply to a complete overhaul with the carburetor removed from the engine.

A complete disassembly is not necessary for performing routine service adjustments. Also, in most instances, service adjustments of individual circuits can be completed without removing the carburetor from the engine. Refer to Service Adjustment Procedures.

A complete carburetor overhaul includes disassembly, thorough cleaning, inspection and replacement of all gaskets and worn or damaged parts. It also includes idle speed adjustment, idle mixture adjustment (if removal of adjustment screws was necessary) and fast idle adjustment after the carburetor is reinstalled.

NOTE: *When using an overhaul kit, use all parts included in the kit.*

NOTE: *Flooding, hesitation on acceleration, and other performance problems are in many instances caused by the presence of dirt, water, or other foreign matter in the carburetor. To aid in diagnosing the problem, carefully remove the carburetor from the engine without removing the fuel from the bowl. Examine the bowl contents and filter for contamination as the carburetor is disassembled.*

CAUTION: *Before performing any service on the carburetor, it is essential that the carburetor be placed on an appropriate holding fixture. Without the use of the holding fixture, it is possible to damage the throttle valves.*

Disassembly

(1) Remove pump lever retaining screw from air horn (fig. 1J-27). Rotate pump lever to remove from pump rod.

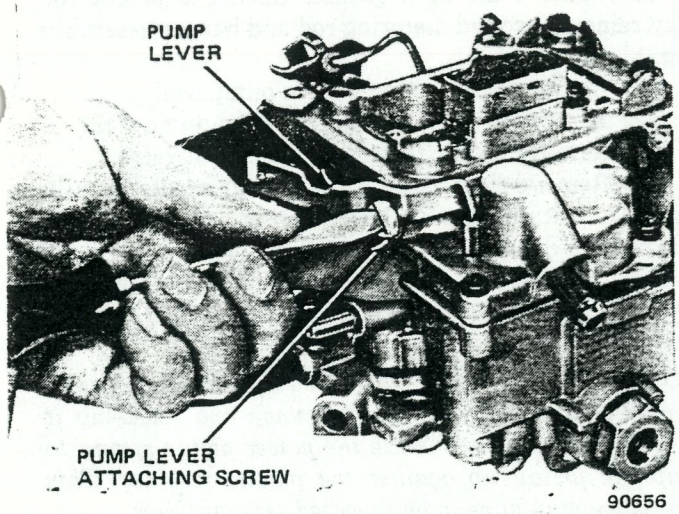

Fig. 1J-27 Model 2SE Carburetor—Pump Lever Removal

(2) Remove hose from vacuum break assembly.

(3) Remove idle speed solenoid-vacuum break bracket attaching screws from air horn and throttle body (fig. 1J-28). Rotate bracket to remove vacuum break rod and air valve rod from vacuum break diaphragm plunger and remove bracket assembly from float bowl. If not removed previously, solenoid may be removed from bracket.

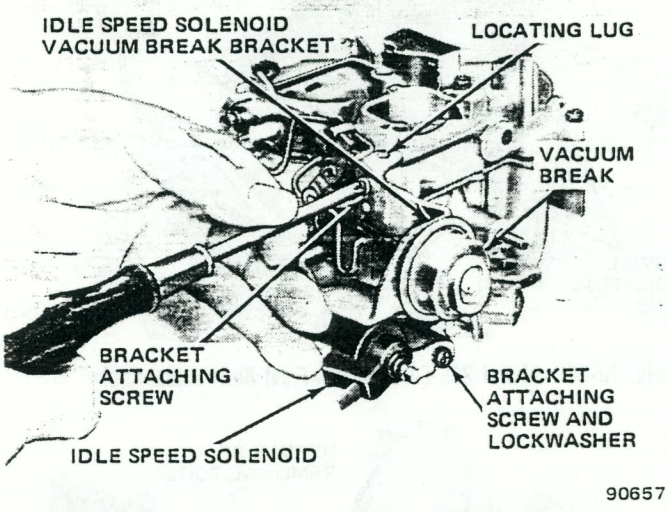

Fig. 1J-28 Model 2SE Carburetor—Vacuum Brake Removal

CAUTION: *Do not immerge vacuum break assembly and solenoid in carburetor cleaning solution.*

(4) Remove and discard retaining clip from intermediate choke rod at choke lever (fig. 1J-29). A new retaining clip is required for reassembly. Remove choke rod and plastic bushing from choke lever.

The plastic bushing will be loose and should be retained for reassembly.

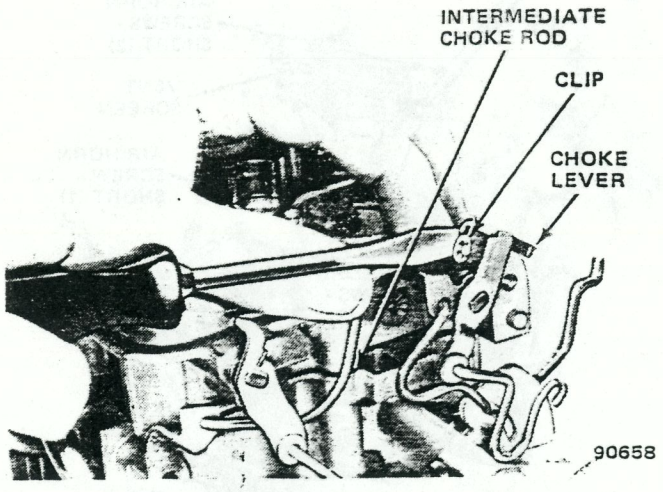

Fig. 1J-29 Model 2SE Carburetor—Choke Rod Removal

(5) If equipped, remove two small screws that retain hot idle compensator valve (fig. 1J-30). Remove valve and seal from air horn, discard seal. Hot idle compensator valve must be removed to gain access to short air horn-to-bowl attaching screw.

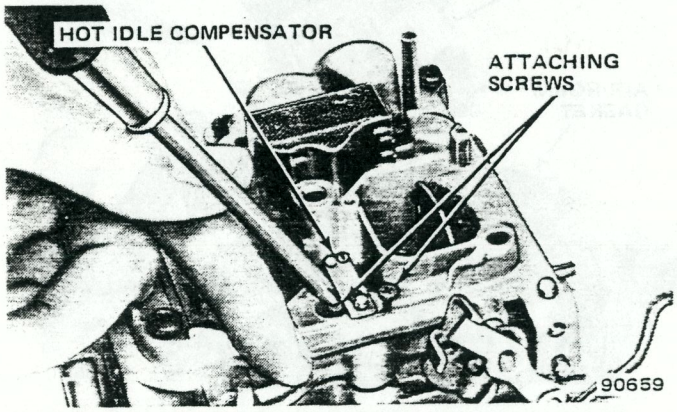

Fig. 1J-30 Model 2SE Carburetor—Idle Compensator Removal

(6) Remove six air horn-to-bowl attaching screws and lockwashers (fig. 1J-31). Remove vent and screen assembly.

(7) Rotate fast idle cam to full UP position and remove air horn assembly by tilting to disengage fast idle cam rod from slot in fast idle cam (fig. 1J-32).

NOTE: *DO NOT remove fast idle cam and screw from float bowl. These components are not serviced separately and must remain permanently in place as installed during manufacturing assembly. The new service replacement float bowl will include the secondary lock-out lever, fast idle cam and screw installed as required.*

(8) Further disassembly of the air horn is not required for cleaning purposes. If component replacement is required, remove staking on two choke valve attaching screws. Remove screws, choke valve and shaft from air horn.

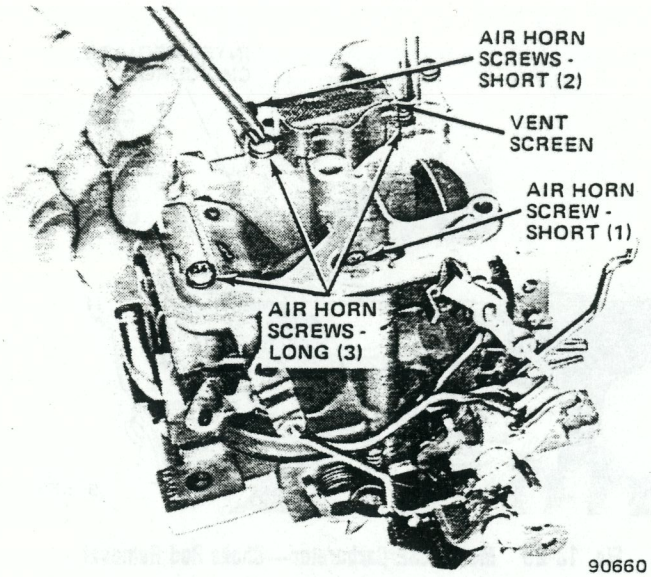

Fig. 1J-31 Model 2SE Carburetor—Air Horn Attaching Screws and Vent Screen

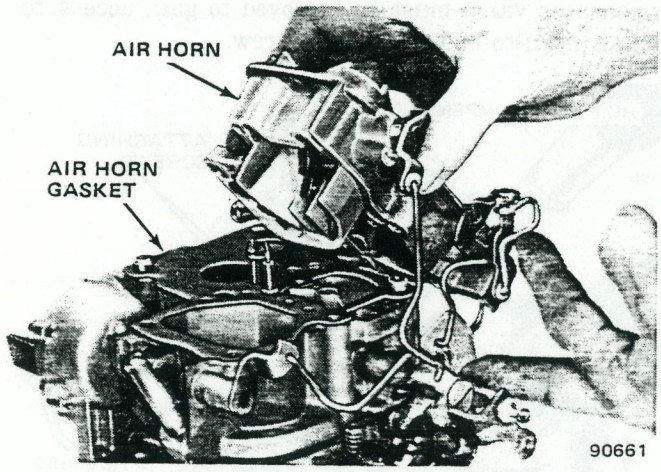

Fig. 1J-32 Model 2SE Carburetor—Air Horn Removal

NOTE: *The air valve screws are permanently staked in place and should not be removed. Do not attempt to remove the secondary metering rod from the air valve assembly. The secondary metering rod adjustment screw is preset during original assembly. Do not attempt to change this adjustment in the field. If air horn replacement is required during carburetor service, the new service air horn will include a preadjusted secondary metering rod-air valve assembly. It is not necessary to remove the vacuum break rod, fast idle cam rod or air valve rod from the levers in the air horn unless replacement of the rods is necessary. The plastic bushings used with the levers can be cleaned with carburetor cleaning solution.*

(9) If necessary to replace vacuum break rod, fast idle cam rod or air valve rod, remove retaining clips from end of rods. Remove plastic bushing on rods and retain for reassembly.

(10) Remove air horn gasket. Gasket is precut for easy removal around metering rod and hanger assembly (fig. 1J-33).

(11) Remove pump plunger from pump well.

(12) Remove pump return spring from pump well.

(13) Remove plastic filler block over float valve.

(14) Remove float assembly and float needle by pulling up on retaining pin. Remove inlet needle seat and gasket with Seat Remover J-22769 (fig. 1J-34).

(15) Remove power piston and metering rod assembly by depressing piston stem and allowing it to snap free (fig. 1J-35).

NOTE: *The power piston, when equipped, can be easily removed by pressing the piston down and releasing it with a snap. This will cause the power piston spring to snap the piston up against the plastic retainer. This procedure may have to be repeated several times.*

CAUTION: *Do no remove power piston by using pliers on metering rod holder. Remove the power piston spring from the piston bore. If necessary, metering rod can be removed from power piston hanger by compressing spring on top of metering rod and aligning groove on rod with slot in holder (fig. 1J-36). Use extreme care in handling the metering rod to prevent damage to metering rod tip.*

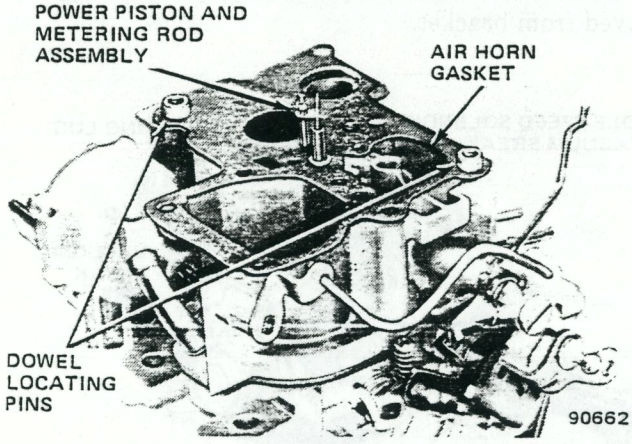

Fig. 1J-33 Model 2SE Carburetor—Float Bowl Disassembly

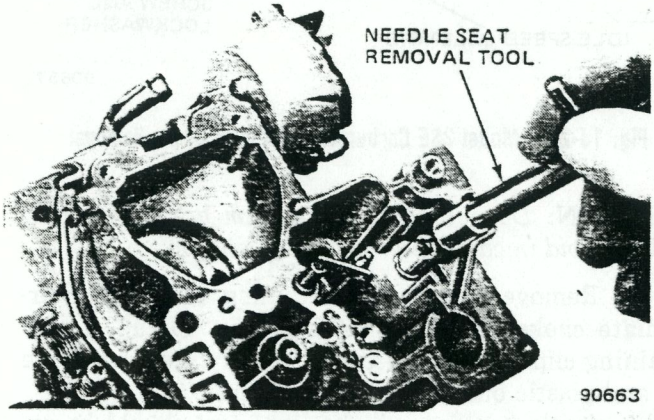

Fig. 1J-34 Model 2SE Carburetor—Inlet Needle Seat Removal

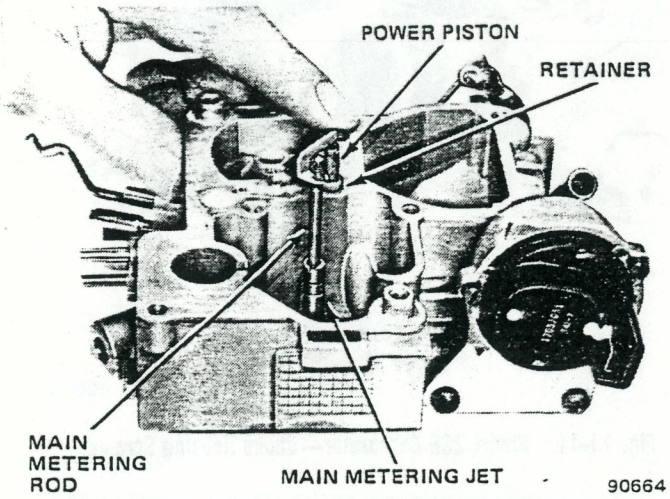

Fig. 1J-35 Model 2SE Carburetor—Power Piston Removal

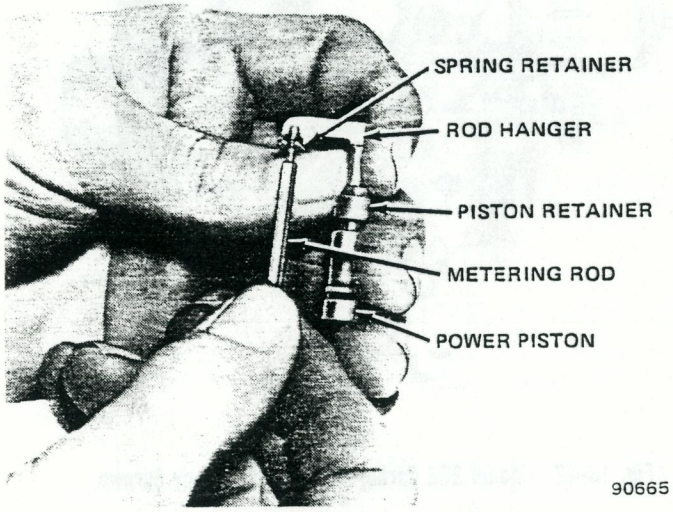

Fig. 1J-36 Model 2SE Carburetor—Removing Metering Rod from Piston Holder

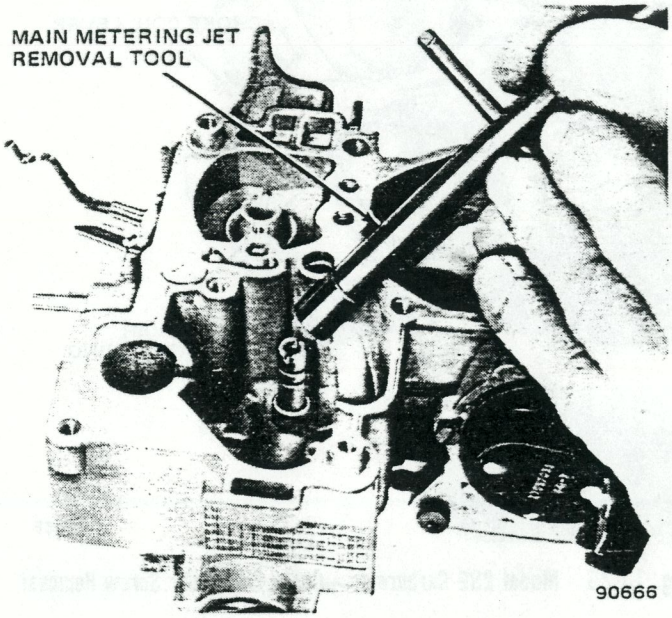

Fig. 1J-37 Model 2SE Carburetor—Main Metering Jet Removal

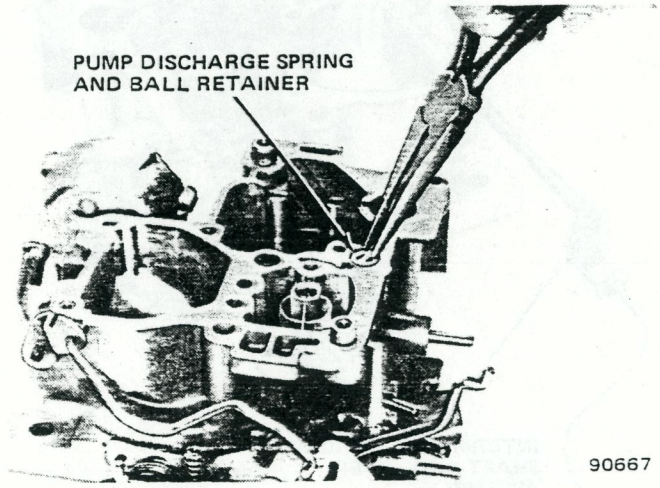

Fig. 1J-38 Model 2SE Carburetor—Pump Discharge Retainer Removal

(16) Remove main metering jet with Tool J-22769 or suitable screwdriver. Screwdriver must fully fit slot in top of jet to prevent damage to jet (fig. 1J-37).

CAUTION: *To prevent damage to pump discharge check ball spring, insert ends of needlenose pliers in plastic retainer only far enough to grasp the head of the retainer for removal. Turn bowl upside down and catch pump discharge spring and check ball in palm of hand.*

(17) Use needlenose pliers to remove plastic retainer holding pump discharge spring and check ball in place (fig. 1J-38). Discard plastic retainer (a new retainer is required for assembly).

(18) Remove three attaching rivets and retainers from choke cover and coil assembly. Pull straight outward and remove cover and coil assembly from choke housing.

NOTE: *The tamper-resistant choke cover design is used to discourage indiscriminate readjustment of the choke cover and coil assembly in the field. However, it is necessary to remove the cover and coil assembly during normal carburetor disassembly for cleaning and overhaul. With a small chisel and hammer carefully cut off each rivet head. Use a small drift and hammer to drive remainder of rivets out of choke housing and remove cover and coil assembly. Use care to prevent damage to choke cover and housing.*

(19) Remove screw from end of intermediate choke shaft inside choke housing (fig. 1J-39). Remove choke coil lever from shaft.

(20) Remove intermediate choke shaft and lever assembly from float bowl by sliding rearward out of throttle lever side (fig. 1J-40).

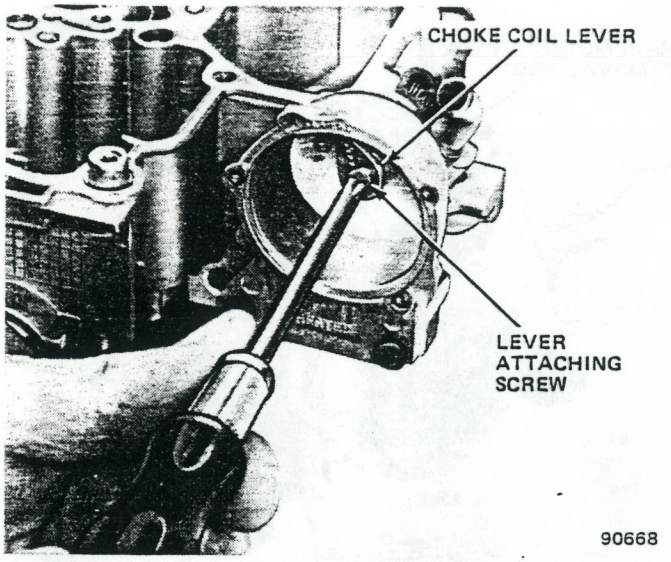

Fig. 1J-39 Model 2SE Carburetor—Choke Coil Lever Screw Removal

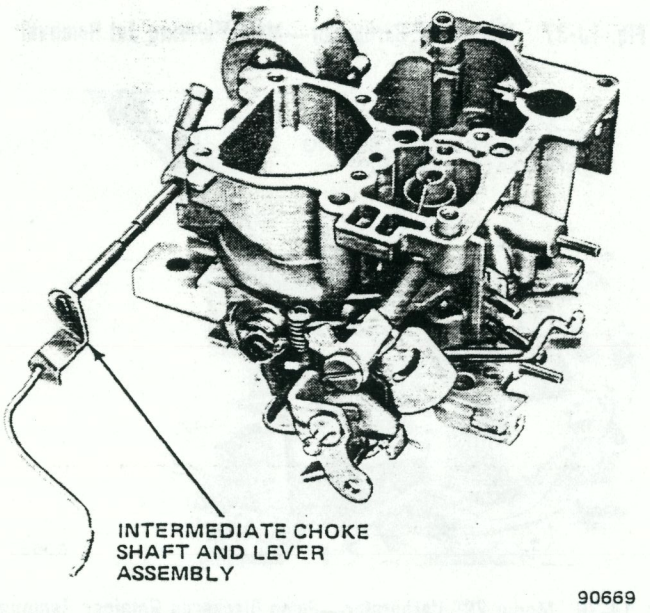

Fig. 1J-40 Model 2SE Carburetor—Intermediate Choke Shaft Removal

(21) Remove choke housing by removing two attaching screws in throttle body (fig. 1J-41).

(22) Remove fuel inlet fitting, gasket, check valve/filter assembly and spring.

(23) Disassemble remaining throttle body components.

(a) Remove four throttle body-to-bowl attaching screws and lockwashers and remove throttle body assembly (fig. 1J-42).

CAUTION: *Place throttle body assembly on carburetor holding fixture (Tool J-9789-118) to avoid damaging throttle valves.*

(b) Hold primary throttle lever wide-open and disengage pump rod from throttle lever by rotating rod until squirt on rod aligns with slot in lever.

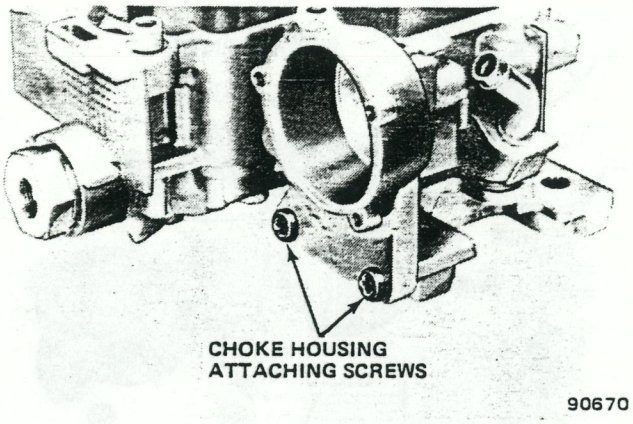

Fig. 1J-41 Model 2SE Carburetor—Choke Housing Screws

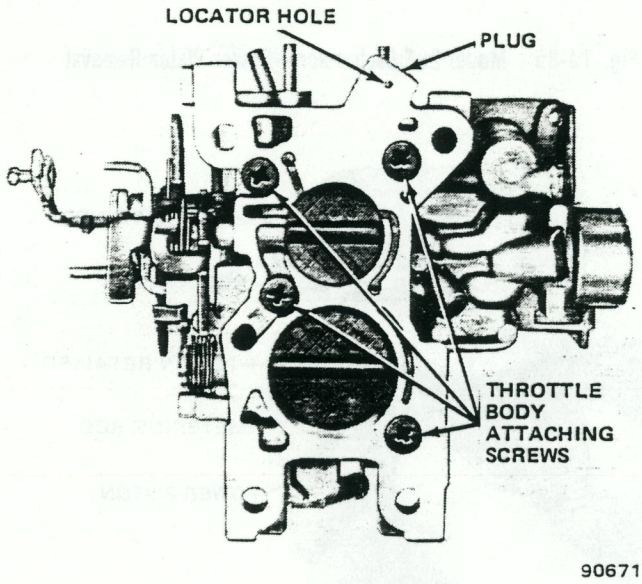

Fig. 1J-42 Model 2SE Carburetor—Throttle Body Screws

(c) If replacement is necessary, remove fast idle screw and clip in primary throttle lever.

(d) If required, remove slow idle speed screw and spring in throttle body. Further disassembly of the throttle body is not required for cleaning purposes (fig. 1J-43).

NOTE: *The primary and secondary throttle valve screws are permanently staked in place and must not be removed. The throttle body is serviced as a complete assembly.*

NOTE: *Do not remove the plug concealing the idle mixture screw unless it is necessary to replace the mixture screw or normal soaking and air pressure fails to clean the idle mixture passages.*

CAUTION: *The idle mixture should be adjusted only if required at time of major carburetor overhaul, for throttle body replacement or for the presence of high idle carbon monoxide (CO) when determined by authorized competent officials.*

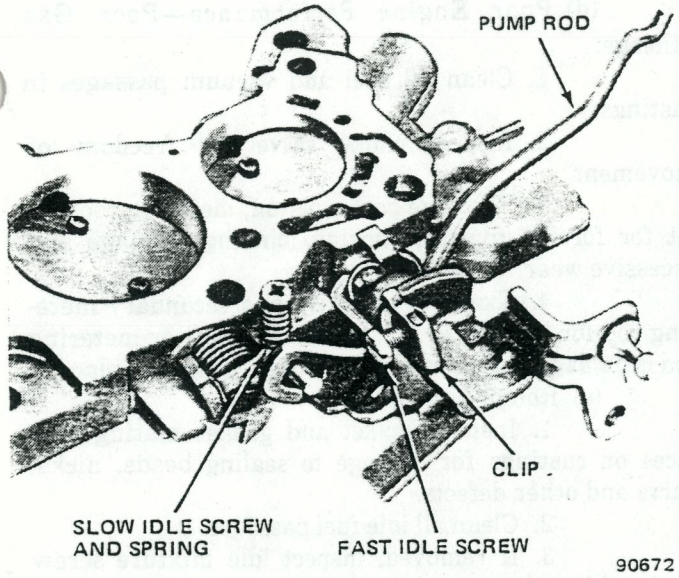

Fig. 1J-43 Model 2SE Carburetor—Throttle Body Assembly

(24) Remove idle mixture screw and plug as follows:

(a) Position punch in locator hole in throttle body beneath idle mixture screw plug (manifold side) (fig. 1J-44). Holding punch vertical, drive punch through locator until hardened steel plug shatters. Holding punch at 45 degree angle, breakout throttle body casting to gain access to mixture screw plug.

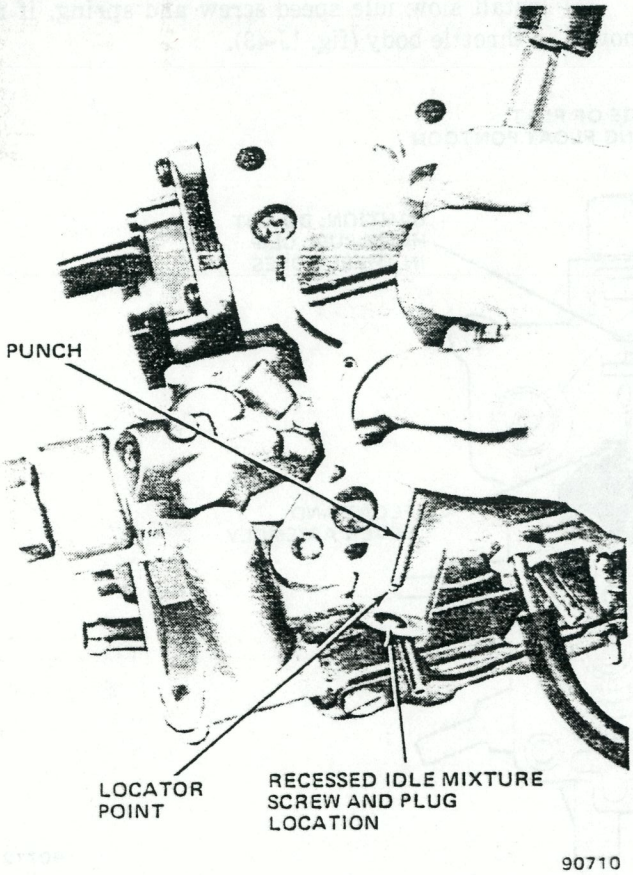

Fig. 1J-44 Model 2SE Carburetor—Idle Mixture Screw Plug Removal

NOTE: *Hardened plug will shatter rather than remaining intact. It is not necessary to remove the plug completely; instead, remove loose pieces to allow use of Idle Mixture Adjusting Tool J-29030.*

(b) Using Tool J-29030, remove idle mixture screw, washer (if used), and spring from throttle body (fig. 1J-45).

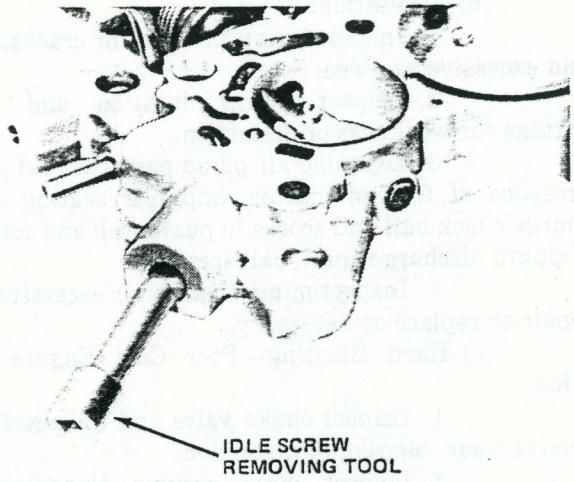

Fig. 1J-45 Model 2SE Carburetor—Idle Mixture Screw Removal

Cleaning and Inspection

The carburetor components should be cleaned in a cold immersion-type carburetor cleaning solution.

CAUTION: *The solenoid, choke cover and coil assembly, rubber parts, plastic parts, diaphragms, pump plunger, and plastic filler block should NOT be immersed in carburetor cleaning solution because they will swell, harden or distort. The plastic bushings located at the end of the vacuum break rod, fast idle cam rod and air valve rod can be cleaned with carburetor cleaning solution.*

(1) Thoroughly clean all metal parts and blow dry with compressed air. Ensure all fuel passages and metering components are free of burrs and foreign matter. Do not insert drill bits or wires into jets and passages.

(2) Inspect upper and lower surface of carburetor castings for damage.

(3) Inspect holes in levers for excessive wear or out of round conditions. If worn, levers should be replaced. Inspect plastic bushings for damage and excessive wear. Replace as required.

(4) Inspect, repair or replace components if following problems are encountered.

(a) Flooding:

1. Inspect float needle and seat for debris, deep wear grooves, scores and improper seating.

2. Inspect float needle pull clip for proper installation (fig. 1J-46). Use care to prevent bending needle pull clip.

3. Inspect float, float arms and hinge pin for distortion, binding and burrs. Check density of material in float; if heavier than normal, replace float.

4. Clean or replace fuel inlet filter/check valve.

(b) Hesitation:

1. Inspect pump plunger for cracks, scores and excessive cup wear.

2. Inspect pump duration and return springs for weakness or distortion.

3. Examine all pump passages and jets for presence of foreign matter, improper seating of discharge check ball and scores in pump well and condition of pump discharge check ball spring.

4. Inspect pump linkage for excessive wear; repair or replace as necessary.

(c) Hard Starting—Poor Cold Engine Operation:

1. Inspect choke valve and linkage for excessive wear, binding or distortion.

2. Inspect choke vacuum diaphragm for leaks.

3. Clean or replace carburetor fuel inlet filter/check valve.

4. Inspect inlet needle for improper seating, debris, etc. Also examine items listed within Flooding above.

(d) Poor Engine Performance—Poor Gas Mileage:

1. Clean all fuel and vacuum passages in castings.

2. Inspect choke valve for freedom of movement.

3. Examine power piston, metering rod and jet for foreign matter, sticking, binding, damage and excessive wear.

4. Examine air valve and secondary metering rod for binding conditions. If air valve or metering rod is damaged, the air horn assembly must be replaced.

(e) Rough Engine Idle:

1. Inspect gasket and gasket mating surfaces on castings for damage to sealing beads, nicks, burrs and other defects.

2. Clean all idle fuel passages.

3. If removed, inspect idle mixture screw tip for ridges, burrs and distortion.

4. Inspect throttle lever and valves for binding, nicks and other defects.

5. Examine all diaphragms for possible ruptures and leaks.

6. Clean plastic components with clean, soft, dry cloth.

Assembly

(1) Install slow idle speed screw and spring, if removed, in throttle body (fig. 1J-43).

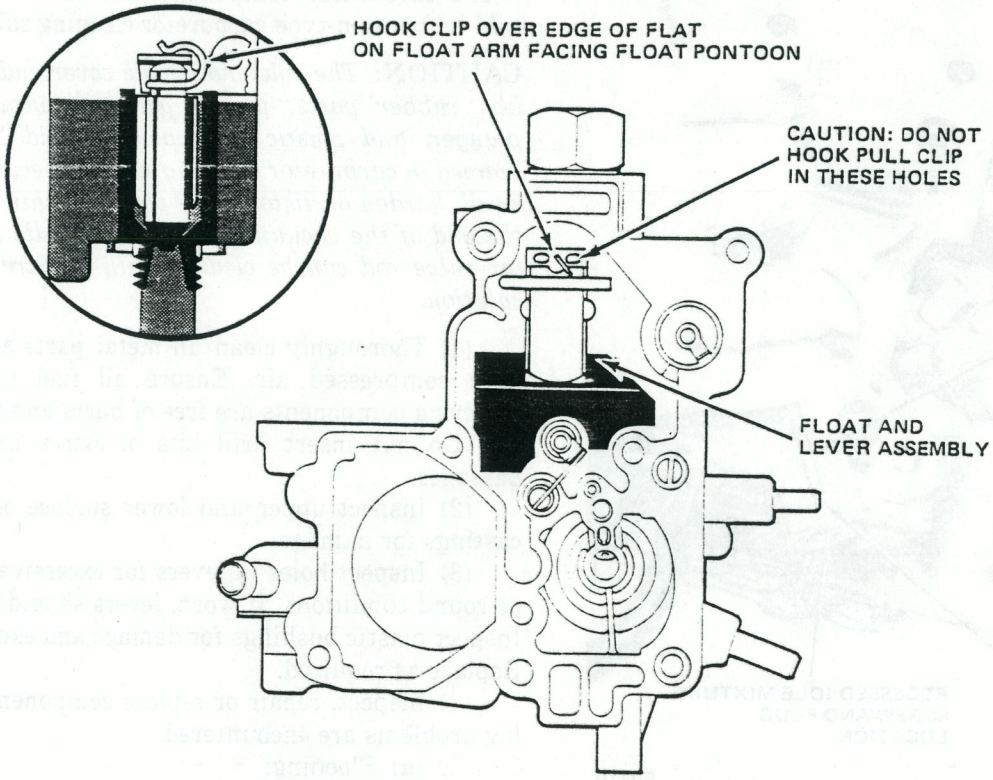

Fig. 1J-46 Model 2SE Carburetor—Float Needle Pull Clip Location

(2) If removed, install fast idle adjustment screw and clip in primary throttle lever (fig. 1J-43).

(3) Holding primary throttle lever wide open, install lower end of pump rod in throttle lever by aligning notch on rod with slot in lever. End of rod should point outward toward throttle lever.

(4) If removed, install idle mixture screw, washer (if used), and spring with Tool J-29030 (fig. 1J-45). Lightly seat screw and back out three turns for preliminary idle mixture adjustment. Final idle mixture adjustment must be with carburetor installed on engine using procedures described within Idle Mixture Adjustment.

NOTE: *If a new float bowl assembly is used, stamp or engrave the model number on the new float bowl (fig. 1J-19).*

(5) Install new throttle body-to-bowl insulator gasket over two locating dowels on bowl.

(6) Holding fast idle cam so that cam steps face fast idle adjustment screw on throttle lever when properly installed, install throttle body ensuring it is properly located over dowels on float bowl (fig. 1J-47). Install four throttle body-to-bowl screws and lockwashers and tighten securely (fig. 1J-42).

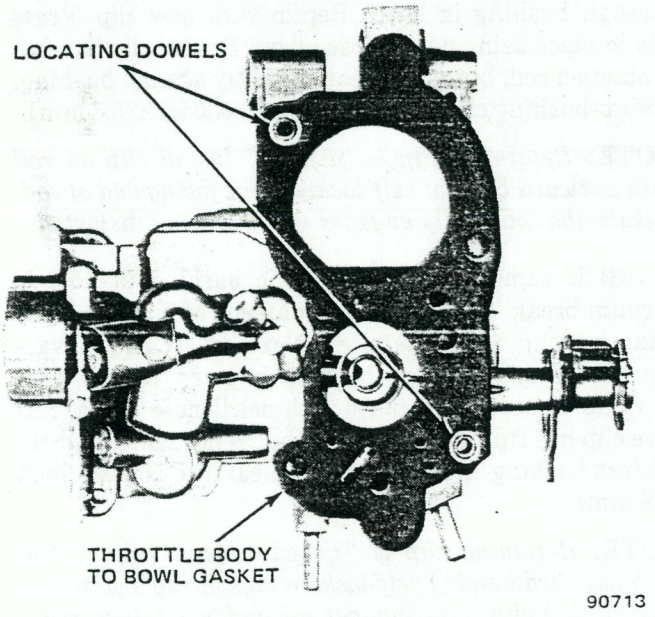

Fig. 1J-47 Model 2SE Carburetor—Throttle Body-to-Bowl Insulator Gasket

NOTE: *Inspect linkage to ensure lockout tang is located properly to permit engaging slot in secondary lockout lever and that linkage moves freely.*

(7) Place carburetor on proper holding fixture (J-9789-118).

CAUTION: *When properly installed, hole in filter faces toward inlet. Ribs on closed end of filter element prevent filter from being installed incorrectly unless forced. Tightening in excess of specified torque can damage nylon gasket and cause fuel leak.*

(8) Install fuel inlet filter spring, check valve and filter assembly, new gasket and inlet fitting. Tighten fitting with 25 foot-pounds (34 N•m) torque.

CAUTION: *When installing a service replacement filter, ensure the filter is the type that includes a check valve that conforms to U.S. Motor Vehicle Safety Standards.*

(9) Install choke housing on throttle body, ensuring raised boss and locating lug on rear of housing fit into recesses in float bowl casting (fig. 1J-41). Install two choke housing attaching screws and lockwashers in throttle body and tighten screws evenly and securely.

(10) Install intermediate choke shaft and lever assembly in float bowl by pushing through from throttle lever side (fig. 1J-40).

(11) With intermediate choke lever in UP (12 o'clock) position, install bimetallic coil lever inside choke housing onto flats on intermediate choke shaft. Coil is properly aligned when coil pick-up tang is at top (12 o'clock) position (fig. 1J-48). Install inside lever retaining screw into end of intermediate choke shaft and tighten securely.

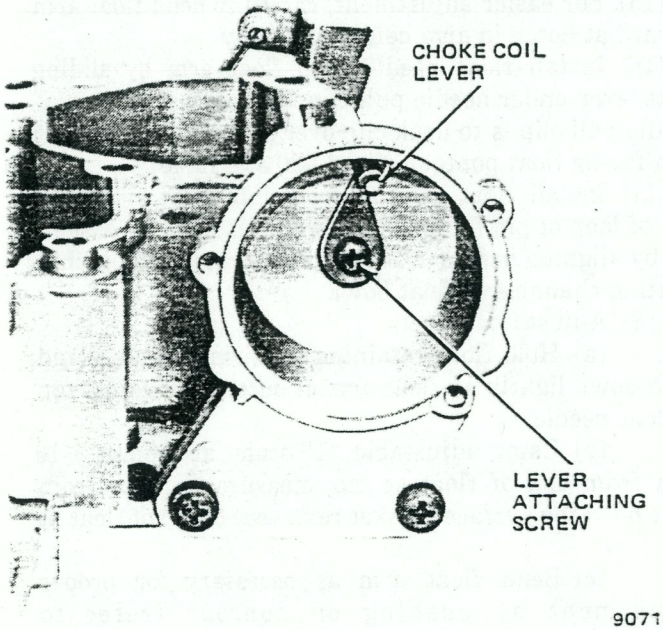

Fig. 1J-48 Model 2SE Carburetor—Installed Choke Coil Lever

NOTE: *Do not install choke cover and bimetallic coil assembly in housing until inside coil lever is adjusted (refer to Service Adjustment Procedures).*

(12) Install pump discharge steel check ball and spring in passage adjacent to float chamber (fig. 1J-49). Insert end of replacement plastic retainer into end of spring and install retainer in float bowl. Tap lightly in place until top of retainer is flush with bowl casting surface.

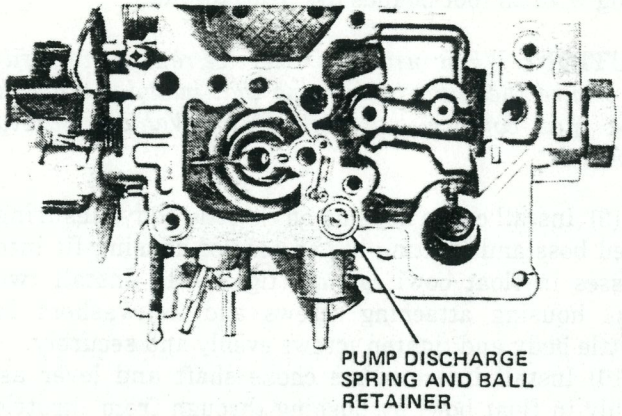

Fig. 1J-49 Model 2SE Carburetor—Pump Discharge Retainer Installed

(13) Using Tool J-22769 or screwdriver that fully fits slot in top, install main metering jet into bottom of float chamber. Tighten jet securely.

(14) Install inlet needle seat assembly with gasket using Tool J-22769 (fig. 1J-34).

(15) For easier adjustment, carefully bend float arm inward at notch in arm before assembly.

(16) Install float needle onto float arm by sliding float lever under needle pull clip. Correct installation of needle pull clip is to hook clip over edge of float on float arm facing float pontoon (fig. 1J-20 and 1J-46).

(17) Install float retaining pin into float arm with end of loop of pin facing pump well. Install float assembly by aligning needle in seat and float retaining pin into locating channels in float bowl.

(18) Adjust float level:

(a) Hold float retaining pin firmly in place and push down lightly on float arm at outer end against top of float needle.

(b) Using adjustable "T" scale, at a point 3/16 inch from end of float at toe, measure distance from float bowl top surface (gasket removed) to top of float at toe.

(c) Bend float arm as necessary for proper adjustment by pushing on pontoon (refer to Specifications).

(d) Visually inspect float alignment after adjustment.

(19) Install power piston spring into piston bore.

(20) If removed, attach metering rod to holder on power piston. Spring must be on top of arm when assembled correctly (fig. 1J-36).

(21) Install power piston and metering rod assembly into float bowl and main metering jet. Use care installing metering rod into jet to prevent damaging metering rod tip. Press down firmly on plastic power piston retainer to ensure retainer is seated in recess in bowl and top is flush with top of bowl casting. If necessary, tap retainer lightly in place using drift and small hammer.

(22) Install plastic filler block over float needle by pressing downward until properly seated (flush with bowl casting surface).

(23) Install air horn gasket on float bowl by carefully sliding slit portion of gasket over two dowel locating pins on float bowl.

(24) Install pump return spring in pump well.

(25) Install pump plunger assembly in pump well.

CAUTION: *Inspect choke valve for freedom of movement and proper alignment before staking screws in place.*

(26) If removed, install choke shaft, choke valve and two attaching screws. Tighten screws securely and stake lightly in place.

(27) If removed, install plastic bushing in lower hole in choke lever ensuring small end of bushing faces retaining clip when installed. With inner choke coil lever at 12 o'clock position, insert end of fast idle cam rod through bushing in lever. Retain with new clip. Press clip in place using needlenose pliers. Ensure clip has full contact on rod, but is not seated tightly against bushing. Rod-to-bushing clearance should be 0.030 inch (0.8 mm).

NOTE: *Retaining clip is "dished." Install clip on rod with outward bend of self-locking lugs facing end of rod. Ensure that clip fully engages rod and is not distorted.*

(28) If removed, install plastic bushing in hole in vacuum break lever ensuring small end of bushing faces retaining clip when installed. Next, insert end of vacuum break rod through bushing in lever. Retain with new clip. Press clip in place with needlenose pliers. Ensure clip has full contact on rod, but is not seated tightly against bushing. Rod-to-bushing clearance is 0.030 inch (0.8 mm).

NOTE: *Retaining clip is "dished." Install clip on rod with outward bend of self-locking lugs facing end of rod. Ensure that clip fully engages rod and is not distorted.*

(29) If removed, install plastic bushing in hole in air valve lever. Ensure small end of bushing faces retaining clip when installed. Next, insert end of air valve rod through bushing in lever. Retain with new clip. Press clip in place with needlenose pliers. Ensure clip has full contact on rod, but is not seated tightly against bushing. Rod-to-bushing clearance is 0.030 inch (0.8 mm).

NOTE: *Retaining clip is "dished." Install clip on rod with outward bend of self-locking lugs facing end of rod. Ensure that clip fully engages rod and is not distorted.*

(30) Rotate fast idle cam to full UP position and tilt air horn assembly to engage fast idle cam rod in slot in fast idle cam (fig. 1J-32). Next, holding down on pump plunger assembly, carefully lower air horn assembly onto float bowl while guiding pump plunger stem through hole in air horn casting.

NOTE: *Do not force air horn assembly onto bowl.*

(31) Install vent screen assembly on air horn assembly (fig. 1J-31) and install six air horn-to-bowl attaching screws and lockwashers.

NOTE: *Three medium long air horn screws are installed in the primary and secondary venturi area. The two longer screws hold the vent screen assembly in place. The two short screws are installed on the fuel inlet side. One short screw is installed in the area beneath the hot idle compensator valve. All air horn screws must be tightened evenly and securely. Refer to figure 1J-50 for proper tightening sequence.*

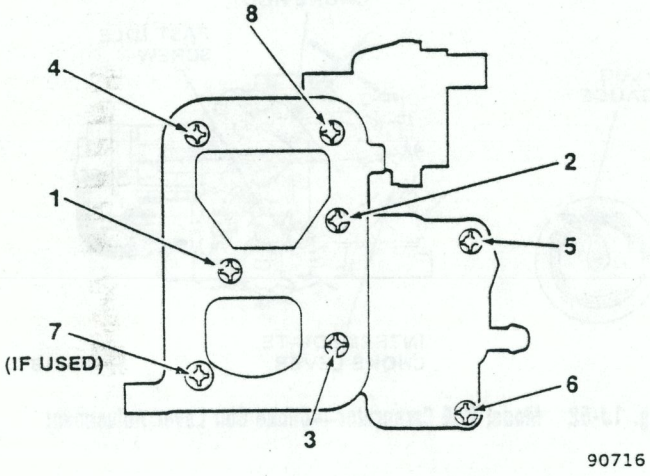

Fig. 1J-50 Model 2SE Carburetor—Air Horn Screw Tightening Sequence

(32) If equipped, install replacement seal in recess of float bowl. Install hot idle compensator valve and retain with two small attaching screws. Tighten screws securely.

(33) Install plastic bushing in hole in choke lever. Ensure small end of bushing faces retaining clip when installed. With inner choke coil lever at 12 o'clock position, insert intermediate choke rod in bushing. Retain rod with replacement clip using needlenose pliers.

NOTE: *Retaining clip is "dished." Install clip on rod with outward bend of self-locking lugs facing end of rod. Ensure that clip fully engages rod and that clip is not distorted.*

CAUTION: *Use care when tightening nut to avoid damaging vacuum break diaphragm plunger.*

(34) If removed, install solenoid in hole on bracket with large lockwasher and retaining nut. Tighten nut securely and bend back two retaining tabs on lockwasher and position in slots in bracket.

(35) Rotate solenoid bracket and insert end of vacuum break rod into inner slot and end of air valve rod into outer slot of vacuum break diaphragm plunger. Install bracket over locating lugs on air horn. Install tapered-seat screw in air horn and screw with lockwasher in throttle body. Tighten screws securely (fig. 1J-28).

NOTE: *Do not connect vacuum break hose until after vacuum break adjustment is completed (refer to Service Adjustment Procedures).*

(36) Insert pump rod in hole in pump lever by rotating lever (fig. 1J-27). Install retaining screw in pump lever, then washer. While holding down on pump plunger stem, install pump lever on air horn. Ensure shoulder on screw seats in hole in lever and washer is positioned between lever and air horn casting. Tighten screw securely.

NOTE: *The vacuum break and choke rod (fast idle cam) adjustments must be completed, and the bimetallic coil lever inside the choke housing must be indexed properly before the choke bimetallic coil and cover assembly are installed. Refer to the Service Adjustment Procedures.*

(37) Place fast idle screw on highest step of fast idle cam.

(38) Install cover and bimetallic coil assembly on choke housing, aligning notch in cover with raised casting projection on housing cover flange. Ensure coil pickup tang engages inside choke coil lever.

(39) Install three choke cover retainers with three drive rivets.

(40) With small punch and hammer, drive rivet pin into each rivet to expand and seat rivets in place.

NOTE: *Ground contact for the choke electric heater is provided by a metal plate located at the rear of the choke assembly. Do not install a gasket between the choke cover assembly and the choke housing. The choke heater will not operate unless properly grounded.*

SERVICE ADJUSTMENT PROCEDURES

Float Level Adjustment

With the air horn removed:

(1) Hold retainer pin firmly in place and push float down lightly against needle (fig. 1J-51).

(2) Using adjustable "T" scale, at a point 3/16 inch (4.8 mm) from end of float at toe, measure distance from float bowl top surface (gasket removed) to top of float at toe (fig. 1J-51).

(3) Remove float and bend float arm as necessary to adjust. Refer to Specifications.

(4) Visually check float alignment after adjustment.

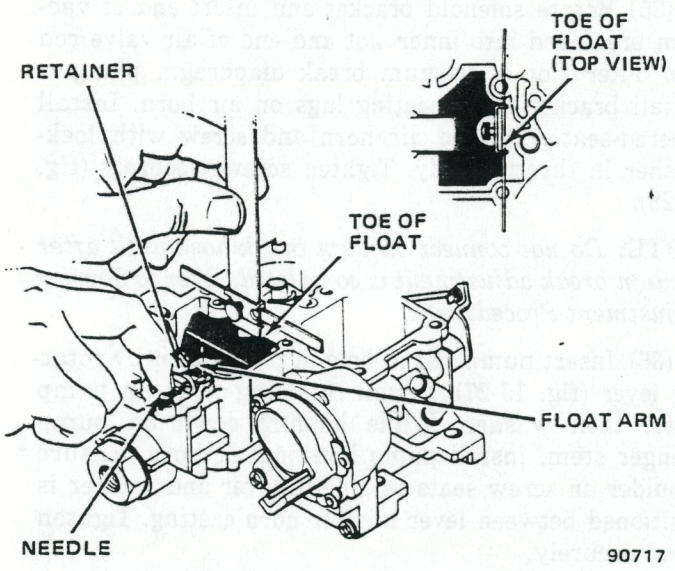

Fig. 1J-51 Model 2SE Carburetor—Float Adjustment

Accelerator Pump Adjustment

The pump adjustment should not be changed from the original factory assembly adjustment unless measurement indicates it is not within the specification. The pump lever is hardened steel and bending it is very difficult. Do not attempt to bend unless absolutely necessary.

(1) With throttle valves completely closed and fast idle adjustment screw off fast idle cam step, measure distance from air horn casting to top of pump stem. Refer to Specifications.

(2) If adjustment is necessary, remove pump lever retaining screw and lever by rotating from pump rod.

CAUTION: *Do not bend lever sideways or twist it.*

(3) Place lever in soft jawed vise and bend end of lever as necessary to obtain correct dimension.

(4) Install pump lever and retaining screw.

(5) Check adjustment and if correct tighten retaining screw securely.

(6) Open and close throttle valves to test linkage for freedom of movement and lever for correct alignment.

Fast Idle Adjustment

(1) Position fast idle adjustment screw on highest fast idle cam step.

(2) Turn fast idle adjustment screw in or out the specified number of turns. Refer to Specifications.

Choke Coil Lever Adjustment

Do not remove the rivets and retainers securing the choke cover and coil assembly unless it is necessary to inspect the choke coil lever adjustment. If the rivets and cover are removed, a choke cover retainer kit is required for assembly.

(1) Remove rivets, retainers and choke cover and coil assembly following instructions contained in choke cover retainer kit.

(2) Position fast idle adjustment screw on highest fast idle cam step.

(3) Push on intermediate choke lever and close choke valve.

(4) Insert specified plug gauge in hole adjacent to coil lever (see Specifications). Edge of lever should barely contact plug gauge (fig. 1J-52).

(5) Bend intermediate choke rod with Adjusting Wrench J-28692 to adjust clearance between lever and plug gauge (fig. 1J-52).

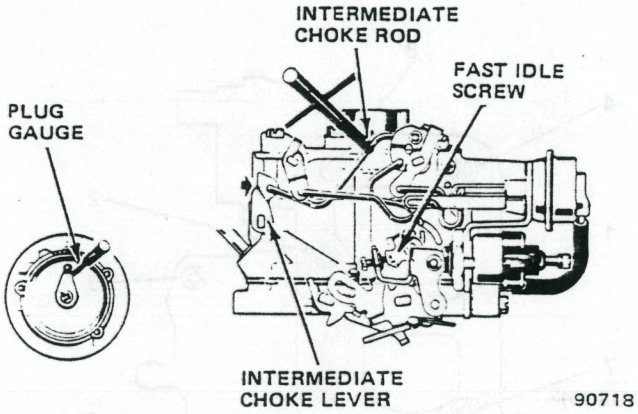

Fig. 1J-52 Model 2SE Carburetor—Choke Coil Lever Adjustment

Fast Idle Cam Position Adjustment

The choke coil lever adjustment must be correct and the fast idle adjustment must be completed before proceeding (fig. 1J-53).

(1) Rotate degree scale of Carburetor Choke Angle Gauge J-26701-A to position zero degree mark opposite pointer.

(2) With choke valve completely closed, position magnet squarely on top of choke valve. Rotate bubble until it is centered.

(3) Rotate degree scale until degree mark specified for adjustment is opposite pointer. Refer to Specifications.

(4) Position fast idle screw on second cam step adjacent to rise of high step.

(5) Close choke valve by pushing on intermediate choke lever.

(6) Push vacuum break lever toward open choke position until lever is against rear tang on choke lever.

(7) Adjust by bending fast idle cam rod with Bending Tool J-9789-111 until bubble is centered.

(8) Remove gauge.

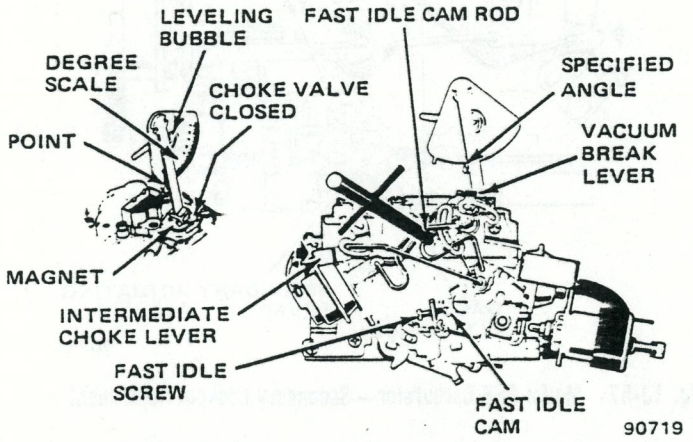

Fig. 1J-53 Model 2SE Carburetor—Fast Idle Cam Position Adjustment

Air Valve Rod Adjustment

Refer to figure 1J-54.

(1) Rotate degree scale of Carburetor Choke Angle Gauge J-26701-A to position zero degree mark opposite pointer.

(2) Close air valve and place magnet on top of it.

(3) Rotate bubble until it is centered.

(4) Rotate degree scale until specified degree mark (refer to Specifications) is opposite pointer.

(5) Seat vacuum diaphragm using external vacuum source.

NOTE: *Plug end cover with tape if purge bleed hole is used. Remove tape after adjustment.*

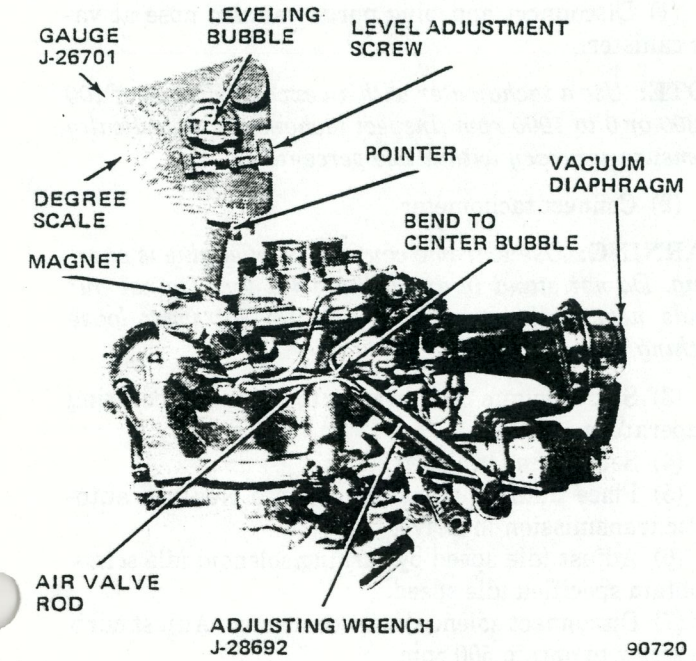

Fig. 1J-54 Model 2SE Carburetor—Air Valve Rod Adjustment

(6) Apply light pressure to air valve shaft in direction to open valve to ensure all slack is removed between air valve rod and plunger slot.

(7) Bend air valve rod with Bending Tool J-9789-111 until bubble is centered.

(8) Remove gauge.

Primary Side Vacuum Break Adjustment

Refer to figure 1J-55.

(1) Rotate degree scale of Carburetor Choke Angle Gauge J-26701-A until zero degree mark is opposite pointer.

(2) Completely close choke valve and place magnet squarely on top of it.

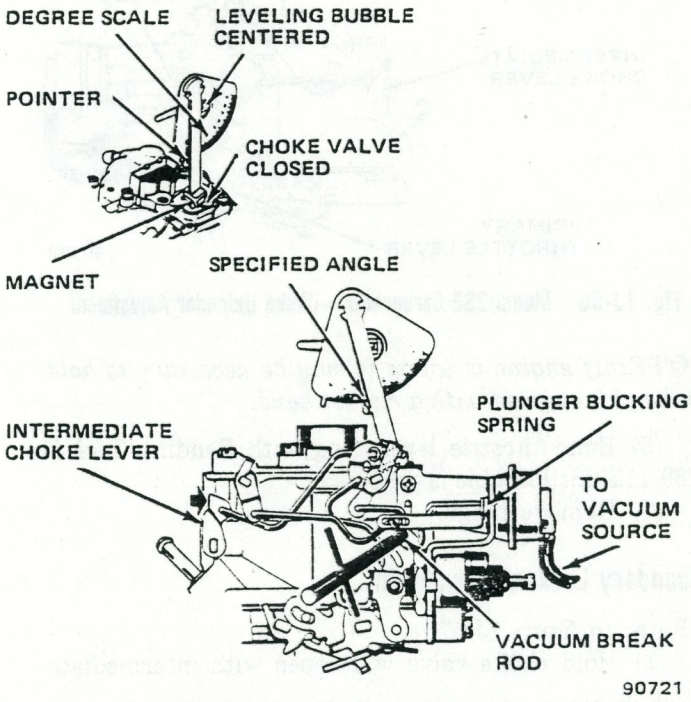

Fig. 1J-55 Model 2SE Carburetor—Primary Side Vacuum Break Adjustment

(3) Rotate bubble until it is centered.

(4) Rotate degree scale to position specified degree mark (refer to Specifications) opposite pointer.

(5) Seat choke vacuum diaphragm using external vacuum source.

(6) Hold choke valve at closed position by pushing on intermediate choke lever. Ensure plunger backing spring (if used) is compressed and seated.

(7) Bend vacuum break rod with Bending Tool J-9789-111 to center bubble.

(8) Remove gauge.

Choke Unloader Adjustment

Refer to figure 1J-56.

(1) Rotate degree scale of Carburetor Choke Angle Gauge J-26701-A until zero degree mark is opposite pointer.

(2) Close choke valve completely and set magnet squarely on top of it.

(3) Rotate bubble until it is centered.

(4) Rotate degree scale to position specified degree mark (refer to Specifications) opposite pointer.

(5) Hold primary throttle valve wide open.

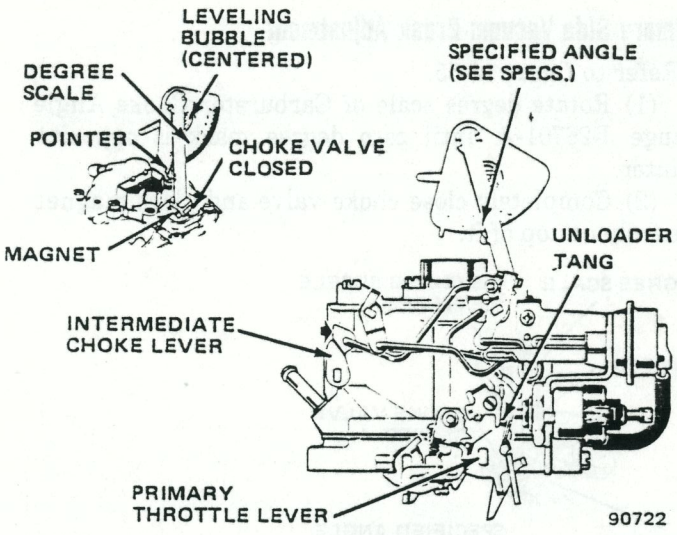

Fig. 1J-56 Model 2SE Carburetor—Choke Unloader Adjustment

NOTE: *If engine is warm it may be necessary to hold choke valve closed with a rubber band.*

(6) Bend throttle lever tang with Bending Tool J-9789-111 until bubble is centered.

(7) Remove gauge.

Secondary Lockout Adjustment

Refer to figure 1J-57.

(1) Hold choke valve wide open with intermediate choke lever.

(2) Open throttle lever until end of secondary actuating lever is opposite toe of lockout lever.

(3) Measure clearance (refer to Specifications) between toe of lockout lever and secondary actuating lever.

(4) If adjustment is necessary, bend lockout lever tang contacting fast idle cam with Bending Tool J-9789-111.

Idle Speed and Mixture Adjustment

The engine and related systems must be operating normally before performing curb (slow) idle speed adjustment. Idle mixture adjustment should not be necessary unless, during carburetor overhaul, the mixture screw position was altered.

Precautions and General Information

- Set the parking brake firmly and do not accelerate the engine.
- Ensure the engine is at normal operating temperature before adjusting idle speed and mixture.

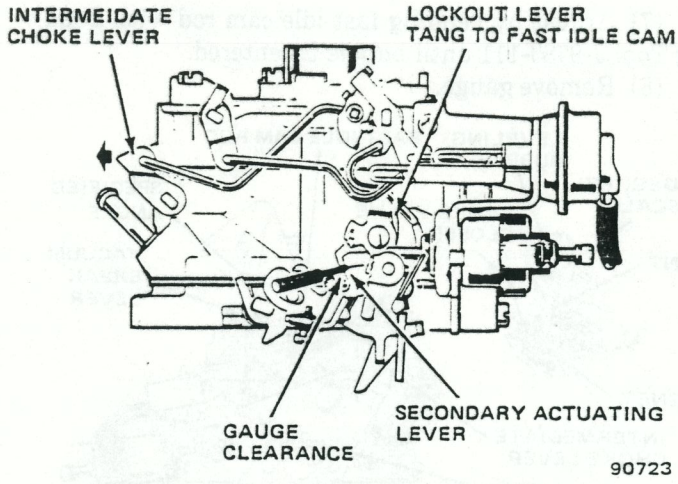

Fig. 1J-57 Model 2SE Carburetor—Secondary Lockout Adjustment

- Perform adjustment procedures with the air cleaner installed, or with air cleaner removed and associated vacuum hoses plugged. Choke must be open and deceleration valve supply hose plugged.
- Do not idle the engine more than three minutes at a time.
- If the mixture adjustment procedure requires more than three minutes, operate the engine at 2000 rpm for one minute.
- Ensure the ignition timing is correct before adjusting idle speed.
- Use extreme caution around fan, belts and other moving parts when the engine is operating. Do not wear loose clothing. Do not stand in direct line with the fan blades.

Curb (Slow) Idle Speed Adjustment

(1) Disconnect and plug purge vacuum hose at vapor canister.

NOTE: *Use a tachometer with an expanded scale of 400 to 800 or 0 to 1000 rpm. Inspect tachometer periodically to ensure accuracy within two percent.*

(2) Connect tachometer.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(3) Start engine and warm to normal operating temperature.

(4) Set parking brake firmly.

(5) Place manual transmission into Neutral, automatic transmission in Drive.

(6) Adjust idle speed by turning solenoid idle screw to obtain specified idle speed.

(7) Disconnect solenoid wire connector. Adjust curb idle screw to obtain 500 rpm.

(8) Connect solenoid wire connector.

(9) Stop engine. Disconnect tachometer. Install air cleaner (if removed) and connect vacuum hoses (if disconnected). Connect canister purge hose and deceleration valve supply hose (if disconnected).

Carburetor Model 2SE Idle Speed Adjustment Specifications

Engine	Transmission	RPM
4-Cylinder	Manual	900 (± 100) ①
	Automatic	700 (± 100) ①

①Idle speed with solenoid de-energized is 500 rpm. 90978

Fast Idle Speed Adjustment

(1) Connect tachometer.

(2) Set parking brake and place manual transmission in Neutral, automatic transmission in Drive.

(3) Connect tachometer.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(4) Start and warm engine to normal operating temperature.

(5) Disconnect and plug EGR valve vacuum hose.

(6) Open throttle slightly and rotate fast idle cam until adjustment screw is against highest step of cam.

(7) Adjust fast idle speed to specification.

(8) Quickly open throttle slightly and allow engine to return to slow idle speed.

(9) Connect EGR valve vacuum hose.

(10) Disconnect tachometer.

Idle Mixture Adjustment

Idle mixture adjustment should only be performed if the mixture adjustment screw position was disturbed or replaced during carburetor overhaul.

(1) Position manual transmission in Neutral position, automatic transmission in Drive. Set parking brake.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(2) Connect tachometer, start engine and warm to operating temperature.

NOTE: *Use a tachometer with an expanded scale of 400 to 800 or 0 to 1000 rpm. Inspect tachometer periodically to ensure accuracy within two percent.*

(3) Adjust idle speed as described above.

(4) Turn idle mixture adjustment screw lean (clockwise) until perceptible loss of rpm is noted.

(5) Turn idle mixture adjustment screw rich (counterclockwise) until highest rpm is attained. Do not turn screw any further than position where highest rpm is first attained. This is referred to as lean best idle.

NOTE: *Engine speed will increase above idle speed an amount that corresponds approximately to the lean drop specification obtained in step (6).*

(6) As final adjustment, turn idle mixture adjustment screw clockwise in increments until specified drop is attained. Refer to Idle Drop Specification.

NOTE: *If the final rpm differs more than ± 30 rpm from the originally adjusted idle speed, readjust idle speed to specification and repeat steps (6) and (7).*

Carburetor Model 2SE Idle Mixture Adjustment Idle Drop

Engine	Transmission	RPM Drop
4-Cylinder	M	100
	A	100

90979

Choke Mechanism Service

Test the choke mechanism and vacuum break for proper operation at the recommended maintenance intervals. Any binding condition that may have developed because of petroleum gum formation on the choke shaft or from damage should be corrected. Inspect the vacuum break hose for proper connection, cracks, abrasion and general deterioration. Correct or replace as necessary.

General Inspection

(1) Remove air cleaner. With engine off, hold throttle half open. Open and close choke several times. Observe linkage and ensure all links are connected and that there are no indications of damage.

(2) If choke or linkage binds, sticks or moves sluggishly, clean with AMC Choke and Linkage Cleaner, or equivalent. Use cleaner as directed on can. If cleaning does not correct the problem, replace malfunctioning parts.

(3) Visually inspect carburetor and ensure all vacuum hoses are connected. Inspect hoses for cracks, abrasion, hardness or indications of general deterioration. Replace or correct as necessary.

(4) Ensure vacuum break diaphragm shafts are fully extended when engine is off. If shafts are not fully extended, replace vacuum break assembly. Start engine; primary vacuum break diaphragm shaft should fully retract. If unit fails to retract, replace vacuum break assembly.

Electric Choke Heater

If the choke fails to operate properly, perform the following tests.

(1) Measure voltage at choke heater wire connection with engine operating. If voltage is between 12 and 15 volts, replace choke unit.

(2) If voltage is low or zero, inspect all wires and connections. If connection at oil pressure switch is faulty, low pressure warning light may also be inoperative with ignition on and engine not started. Repair wires and connections as necessary.

(3) If tests in steps (1) and (2) have normal results, replace oil pressure switch.

SPECIFICATIONS

Carburetor Model 2SE Specifications

	17081790	17081791
Pri. Throttle Bore	35 mm	35 mm
Sec. Throttle Bore	46 mm	46 mm
Pri. Venturi Diameter	28 mm	28 mm
Sec. Venturi Diameter	Var. Air Valve	Var. Air Valve
Fuel Inlet Seat Diameter	2.36 mm	2.36 mm
Idle Bypass	2.69 mm	2.65 mm
Idle Tube	0.80 mm	0.80 mm
Side Idle Air Bleed	1.32 mm	1.32 mm
Lower Idle Air Bleed	1.32 mm	1.32 mm
Spark Port Size	1.14mmx3.84mm	1.14mmx3.84mm
Main Jet	No. 162 (162 mm)	No. 178 (1.78 mm)
Pri. Metering Rod No.	17057856	17057857
Sec. Metering Rod No.	17064887	17064887
Top Well Bleed	1.78 mm	1.78 mm
Side Well Bleed	2.44 mm	2.44 mm
Power Valve Timing	1 to 5 in. Hg.	1 to 5 in. Hg.
Accelerator Nozzle Diameter	0.50 mm	0.50 mm

90981B

4-Cylinder Engine		Carburetor Number	Float Level mm(inches)	Pump Stem Height mm(inches)	Fast Idle Cam Adj.②	Fast Idle Speed ±100 rpm	Air Valve Link①	Vac. Break Pri.	Unloader	Choke	Secondary Lockout	Choke Coil Lever Plug Gauge
CJ5,7,8 (49 State)	Man. Trans.	17081790	5.3 (.208)	3.25 (.128)	25°	2400	2°	19°	32°	TR	1.27-2.03mm (.050-.080in.)	1.27-2.03mm (.050-.080in.)
CJ-7, 8 (49 State)	Auto. Trans.	17081791	5.5 (.256)	3.25 (.128)	25°	2600	2°	19°	32°	TR	2.16mm (.085in.)	2.16mm (0.85in.)

① Maximum Degree Setting

TR Tamper Resistant

② Second Step of Cam

90981A

CARBURETOR MODEL E2SE— 2 VENTURI

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GENERAL

The Model E2SE carburetor is a newly developed two-venturi, two-stage carburetor of down draft design (fig. 1J-58) for four-cylinder engines installed in CJ vehicles manufactured for sale in California. To reduce overall weight, aluminum die castings are used for the air horn, float bowl, throttle body, mixture control solenoid, and choke housing on all models. A zinc die-cast choke housing is used to reduce heat transfer and allow good engine warm-up operation.

A heat insulator gasket between the throttle body and float bowl is used to reduce heat transfer to the float bowl.

The primary stage has a triple venturi with a small 35 mm bore that provides efficient fuel control during idle and partial throttle operation. The secondary stage has a large 46 mm bore that provides for increased air capacity necessary for higher engine power requirements. An air valve is used in the secondary stage that has a single tapered metering rod.

When used with the C4 system, the Model E2SE carburetor includes special design features for optimum air/fuel mixture control during all ranges of engine operation. An electrically operated mixture control solenoid, located in the air horn, is used to control air and fuel metered to the idle and main metering systems of the carburetor. A plunger in the end of the solenoid is submerged in fuel in the fuel chamber of the float bowl. The solenoid is turned on and off (or "pulsed") by the Electronic Control Module (ECM). The ECM, responding to the amplitude of the voltage at the oxygen sensor in the exhaust manifold and other engine operating conditions, energizes the solenoid to move the plunger down to the lean position or, de-energizes it to the rich position to control fuel delivery to the idle and main metering circuits. The ECM energizes the solenoid by providing a ground to complete the path for current flow. The solenoid has 12 volts (battery voltage) applied to it at all times while the ignition switch is on. When the plunger is in the down (lean) position, fuel metering is controlled by a factory adjusted lean mixture screw located in the float bowl. When the plunger is in the up (rich position), additional fuel is metered to the main fuel well through the factory adjusted rich mixture screw located at the end of the fuel supply channel in the float bowl.

In addition, air metered to the idle circuit is controlled by the up and down movement of the mixture control solenoid plunger. The plunger either increases or decreases air supplied to the idle circuit, which is further metered by a factory adjusted idle air bleed screw.

The movement (or "cycling") of the solenoid plunger, up or down, occurs ten times per second. The ratio (duty cycle) of "on" to "off" time, or dwell period, is varied by the ECM according to the engine operating conditions. This varies the fuel and air mixture to achieve, as near as possible, optimum air/fuel mixture ratios. The exhaust gas mixture oxygen content (lean or rich), and other engine operating conditions, are constantly monitored by the C4 system microprocessor (ECM) and the air/fuel mixture is adjusted accordingly for improved exhaust emission control and good engine performance.

Identification

The carburetor model identification is stamped vertically into the float bowl at a flat area adjacent to the vacuum tube (fig. 1J-59). When replacing the fuel bowl, follow the manufacturer's instructions contained in the service repair package and ensure that the identification number is transferred to the new float bowl. Refer to the bowl part number when servicing the carburetor.

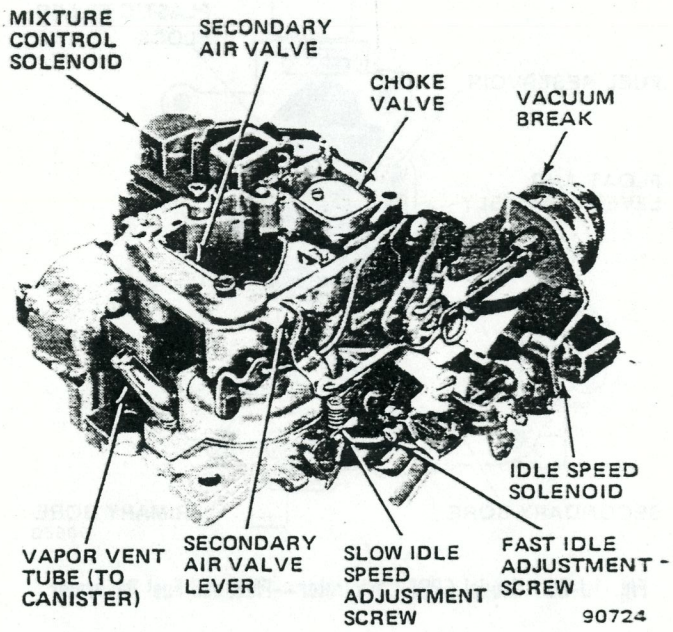

Fig. 1J-58 Model E2SE Carburetor

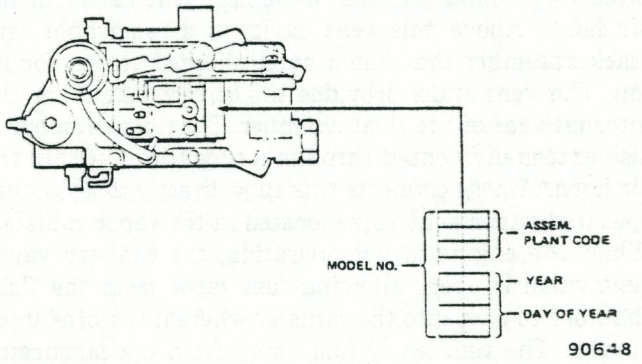

Fig. 1J-59 Model E2SE Carburetor—Identification

CARBURETOR CIRCUITS

The model E2SE carburetor has six basic circuits. They are:

- Float
- Idle
- Main Metering
- Power Enrichment
- Pump
- Choke

Float Circuit

The float chamber is located next to the primary and secondary bores (fig. 1J-60). This feature assures adequate fuel supply to both carburetor venturi bores during all normal engine operations

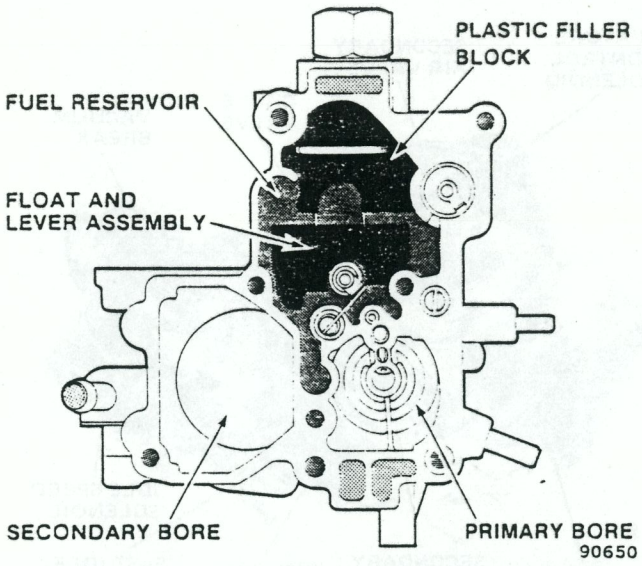

Fig. 1J-60 Model E2SE Carburetor—Float and Fuel Reservoir

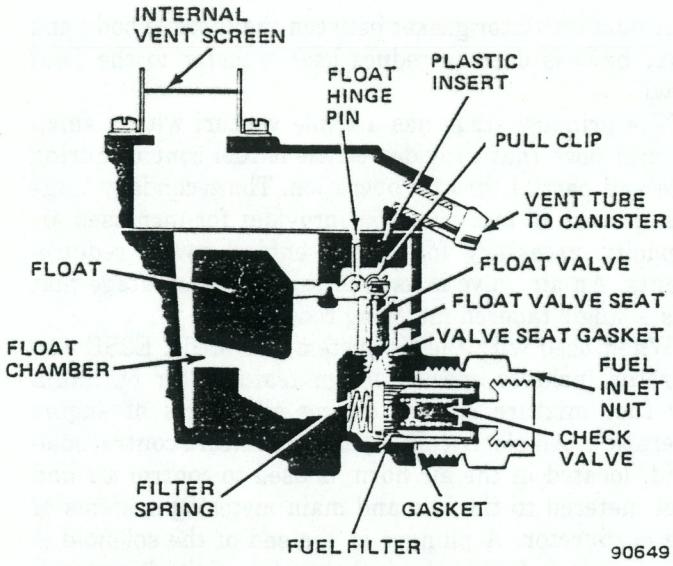

Fig. 1J-61 Carburetor Model E2SE—Float Circuit

A single pontoon float, brass needle seat, and rubber tipped float valve with pull clip are used to control the fuel level in the float chamber. The float chamber is internally vented through a vertical vent cavity in the air horn. Above this vent cavity is a removable vent stack assembly that has a small meshed screen for its top. The vent stack provides the correct height for the internal vent of the float chamber. The float chamber is also externally vented through a tube (fig. 1J-61) in the air horn. A hose connects this tube directly to a vacuum operated vapor vent valve located in the vapor canister. When the engine is not operating, the canister vapor vent valve is open, allowing fuel vapor from the float chamber to pass into the canister where it is stored until purged. The venting of fuel vapor from the carburetor float bowl to the canister conforms to evaporative emission requirements and improves hot engine starting.

A hot idle compensator assembly (when used) is located in the air horn casting. The opening and closing of the hot idle compensator valve is controlled by a bimetallic strip that is calibrated for a specific temperature. When the valve opens, additional air is allowed to bypass the throttle valves and enter the intake manifold to prevent rough idle during periods of hot engine operation.

An integral one-inch pleated-paper fuel filter, with check valve, is front mounted in the float bowl inward from the fuel inlet fitting to provide good filtration of incoming fuel (fig. 1J-61). The check valve shuts off fuel flow to the carburetor and prevents fuel leaks should vehicle roll-over occur.

Idle Circuit

Fuel for idle and partial throttle engine operation is provided by the idle circuit. Fuel flows from the main well area into the idle tube and continues through the idle cross-over passage where it is mixed with air that enters via the lower idle air bleed (fig. 1J-62).

The idle mixture adjustment screw is recessed in the throttle body casting and sealed with a hardened steel plug to discourage indiscriminate change of the factory assembly mixture adjustment, which could raise undesirable exhaust emission to a level that is beyond acceptable standards.

Main Metering Circuit

At partial throttle and cruising speed, increased airflow through the venturi creates a low pressure area in the venturi. Because air above the fuel level in the bowl is at normal pressure, fuel flows to the lower pressure area created by the venturi and amplified by the booster venturi.

The fuel flow moves past the mixture control solenoid to the main well. Air enters through the main well air bleeds. The resulting mixture of fuel and air is lighter than raw fuel, responds more quickly to changes in venturi vacuum, and is more readily vaporized when discharged into the venturi (fig. 1J-63).

Power Enrichment Circuit

Power enrichment for heavy load or high speed operation is provided by the power enrichment circuit in the secondary stage. The air/fuel mixture enrichment is accomplished by the mixture control solenoid being in the upward (rich) position the majority of the time (low dwell) and allowing fuel flow through the secondary stage of the carburetor (fig. 1J-64).

Pump Circuit

When the throttle is opened suddenly, airflow response through the carburetor is almost immediate.

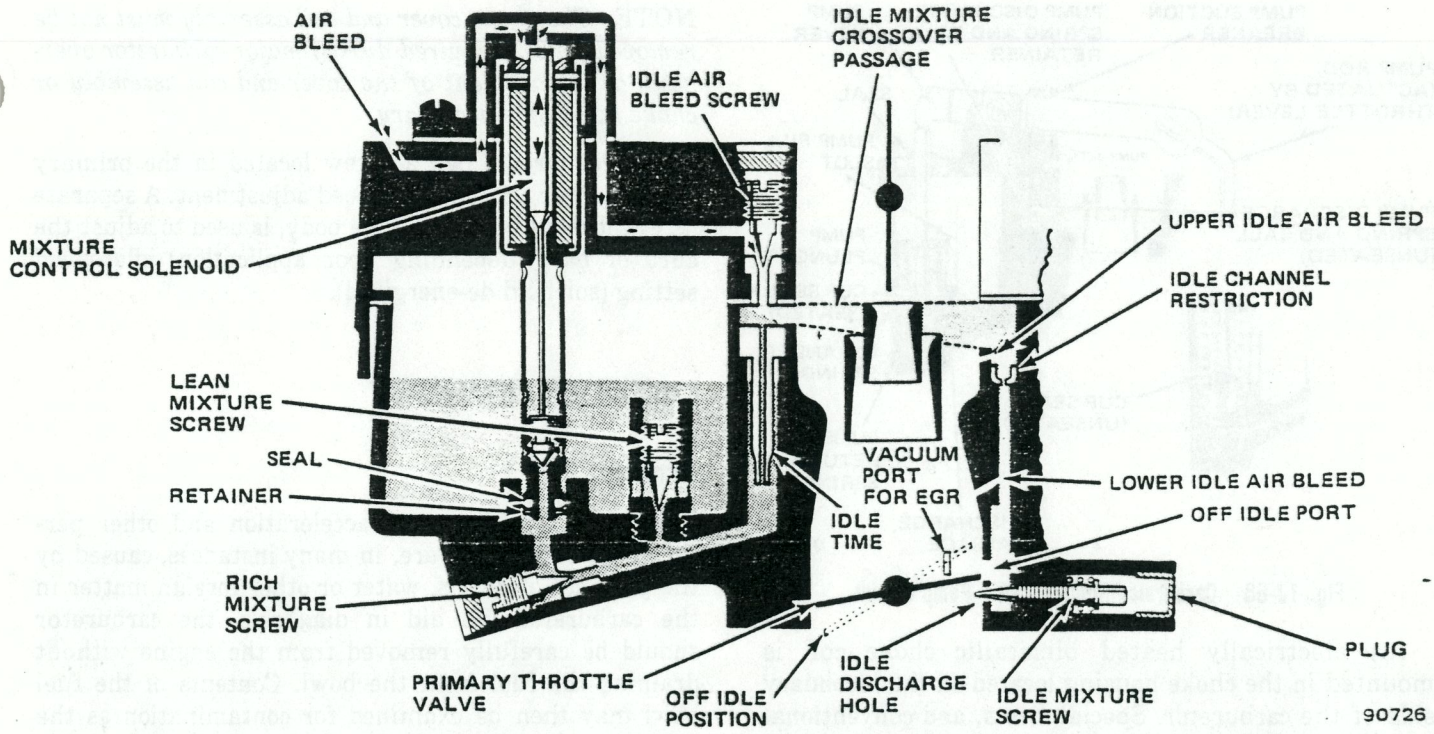

Fig. 1J-62 Carburetor Model E2SE—Idle Circuit

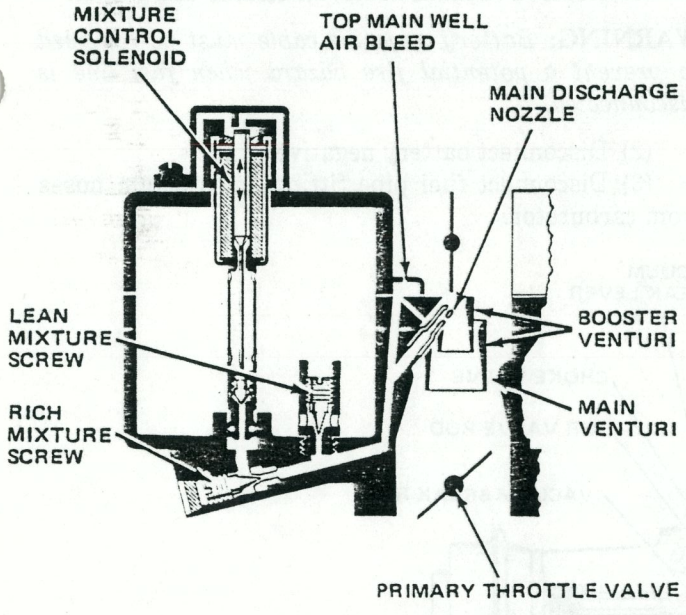

Fig. 1J-63 Carburetor Model E2SE—Main Metering Circuit

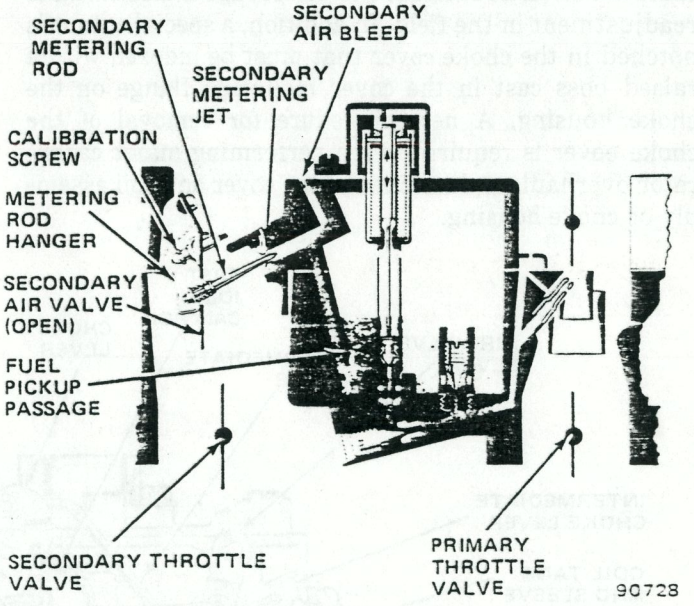

Fig. 1J-64 Carburetor Model E2SE—Power Enrichment Circuit

There is a brief time lag before fuel inertia is overcome. This lag causes the desired air/fuel ratio to be leaned out. A piston-type accelerating pump system mechanically supplies the fuel necessary to overcome this deficiency (fig. 1J-65). Fuel is drawn into the pump cylinder from the fuel bowl, past the pump piston on the upward movement of the accelerator pump shaft. As the throttle lever is moved, the pump link, operating through a system of levers and assisted by the pump drive spring, pushes the pump piston down. Fuel is forced through a passage, past the pump discharge check ball, and out the pump discharge jets in the venturi cluster.

Choke Circuit

The choke circuit in the model E2SE carburetor (fig. 1J-66) employs a single vacuum break unit that is mounted on the idle speed solenoid bracket located on the primary side of the carburetor.

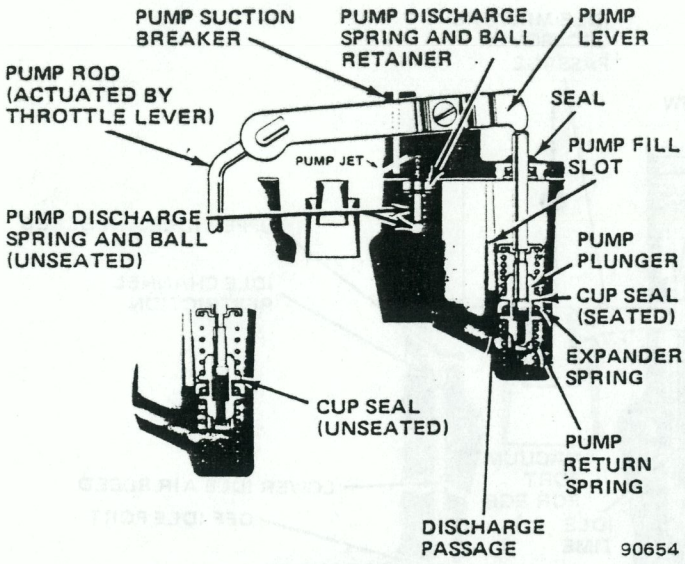

Fig. 1J-65 Carburetor Model E2SE—Pump Circuit

An electrically heated bimetallic choke coil is mounted in the choke housing located on the secondary side of the carburetor. Special rivets, and conventional retainers, are installed to retain the factory assembly adjustment of the bimetallic choke coil. They provide a tamper-resistant enclosure to discourage indiscriminate readjustment in the field. In addition, a special cutout is notched in the choke cover that must be indexed with a raised boss cast in the cover mounting flange on the choke housing. A new procedure for removal of the choke cover is required when performing major carburetor overhaul, replacement of the cover and coil assembly or choke housing.

NOTE: *The choke cover and coil assembly must not be removed unless required during major carburetor overhaul, or replacement of the cover and coil assembly or choke housing is necessary.*

The carburetor has a screw located in the primary throttle lever for fast idle speed adjustment. A separate screw, located in the throttle body, is used to adjust the curb or base (depending upon application) idle speed setting (solenoid de-energized).

CARBURETOR REPLACEMENT

Removal

Flooding, hesitation on acceleration and other performance complaints are, in many instances, caused by the presence of debris, water or other foreign matter in the carburetor. To aid in diagnosis, the carburetor should be carefully removed from the engine without draining the fuel from the bowl. Contents of the fuel bowl may then be examined for contamination as the carburetor is disassembled. Also, the filter should be examined for contamination.

(1) Remove vacuum hoses, air cleaner and gasket.

WARNING: *Battery negative cable must be removed to prevent a potential fire hazard when fuel line is disconnected.*

(2) Disconnect battery negative cable.

(3) Disconnect fuel pipe fitting and vacuum hoses from carburetor.

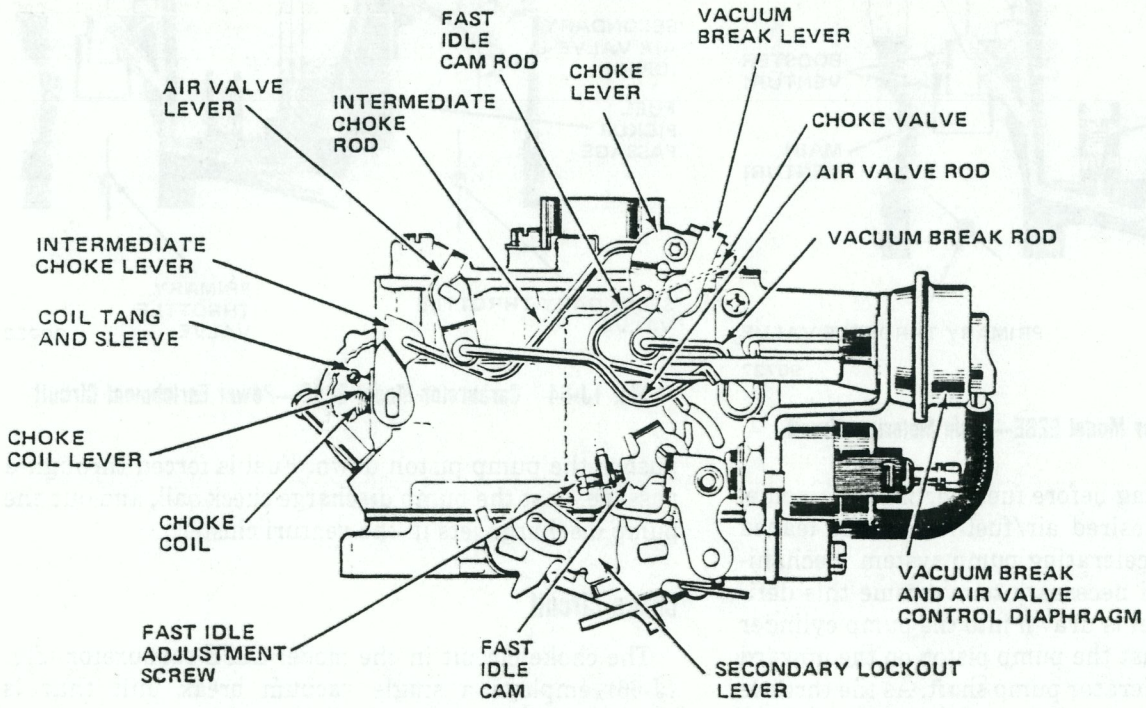

Fig. 1J-66 Carburetor Model E2SE—Choke Circuit

(4) Disconnect throttle linkage and electrical connectors.

(5) Remove carburetor attaching bolts and nuts, and remove carburetor and gasket.

Installation

Fill the carburetor bowl with fuel before installing the carburetor. This reduces strain on the starter motor and battery, and reduces the possibility of backfire while attempting to start the engine. A small supply of no-lead fuel will also enable the carburetor float and inlet needle and seat assembly operation to be tested. Operate throttle lever several times and observe discharge from pump jets before installing carburetor.

(1) Ensure throttle body and intake manifold sealing surfaces are clean.

(2) Install manifold gasket on replacement carburetor.

(3) Place carburetor in position and loosely install attaching bolts and nuts.

(4) Install vacuum hoses and loosely connect fuel pipe fitting.

(5) Tighten attaching bolts and nuts with 145 inch-pounds (16 N•m) torque.

(6) Tighten fuel pipe fitting with 18 foot-pounds (24 N•m) torque.

(7) Connect throttle linkage and electrical connectors.

(8) Connect battery negative cable.

NOTE: *Plug disconnected vacuum hoses.*

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(9) Adjust idle speed. Refer to Specifications.

(10) Install air cleaner, gasket and vacuum hoses.

CARBURETOR OVERHAUL

The following procedures apply to a complete overhaul with the carburetor removed from the engine.

A complete disassembly is not necessary for performing routine service adjustments. In most instances, service adjustments of the individual circuits can be performed without removing the carburetor from the engine. Refer to Service Adjustment Procedures.

A complete carburetor overhaul includes disassembly, thorough cleaning, inspection and replacement of the gaskets and worn or damaged parts. It also includes idle speed and mixture adjustment (if necessary) and fast idle adjustment after the carburetor is installed.

NOTE: *When using an overhaul kit, use all parts included in the kit.*

NOTE: *Flooding, hesitation on acceleration, and other performance problems are in many instances caused by the presence of debris, water, or other foreign matter in the carburetor. To aid in diagnosing a problem, carefully remove the carburetor from the engine without removing the fuel from the bowl. Examine the bowl contents and filter for contamination as the carburetor is disassembled.*

CAUTION: *Before performing any service on the carburetor, it is essential that it be placed on a holding fixture. Without the use of the holding fixture, it is possible to damage the throttle valves.*

Disassembly

(1) If clip is used to secure pump rod, remove clip and remove pump rod from hole in pump lever.

NOTE: *Do not remove pump lever retaining screw, pump lever, and washer from air horn assembly.*

(2) If clip is **not** used to secure pump rod (clipless design), remove pump lever retaining screw and washer from air horn (fig. 1J-67). Rotate pump lever to remove from pump rod.

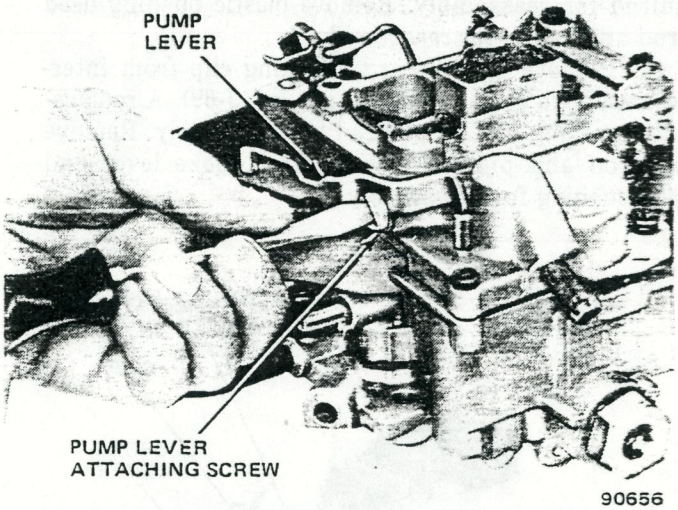

Fig. 1J-67 Carburetor Model E2SE—Pump Lever Screw Removal

(3) Remove hose from primary side vacuum break assembly and throttle body.

(4) Remove idle speed solenoid-vacuum break bracket attaching screws from air horn and throttle body (fig. 1J-68). Rotate vacuum break and bracket assembly to remove vacuum break rod and air valve rod from vacuum break diaphragm plunger. If not removed previously, remove idle speed solenoid from bracket.

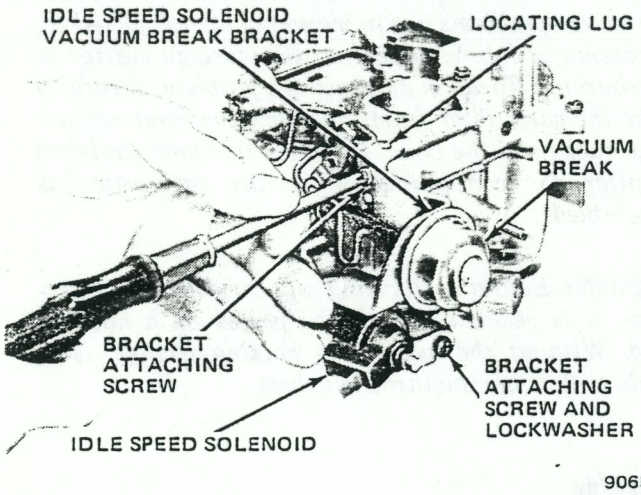

Fig. 1J-68 Carburetor Model E2SE—Vacuum Break Removal

CAUTION: *Do not place vacuum break assembly and solenoid in carburetor cleaning solution. Immersion in solution will damage vacuum break diaphragm and solenoid.*

(5) It is not necessary to remove the secondary side vacuum break rod from linkage unless replacement of vacuum rod is necessary. If necessary to replace secondary side vacuum break rod, remove and discard retaining clip from end of rod. A replacement retaining clip is required for reassembly. Remove plastic bushing used on rod and retain for reassembly.

(6) Remove and discard retaining clip from intermediate choke rod at choke lever (fig. 1J-69). A replacement retaining clip is required for reassembly. Remove choke rod and plastic bushing from choke lever and retain bushing for reassembly.

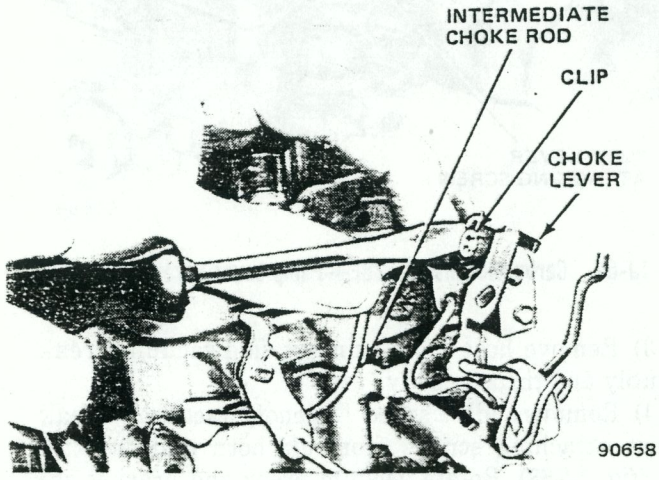

Fig. 1J-69 Carburetor Model E2SE—Intermediate Choke Rod and Clip Removal

(7) Remove three mixture control solenoid screws in air horn. Using slight twisting motion, carefully lift solenoid out of air horn (fig. 1J-70). Remove and discard solenoid gasket.

(8) Remove seal retainer and rubber seal from end of solenoid plunger. Do not damage or nick end of solenoid plunger. Discard seal and retainer.

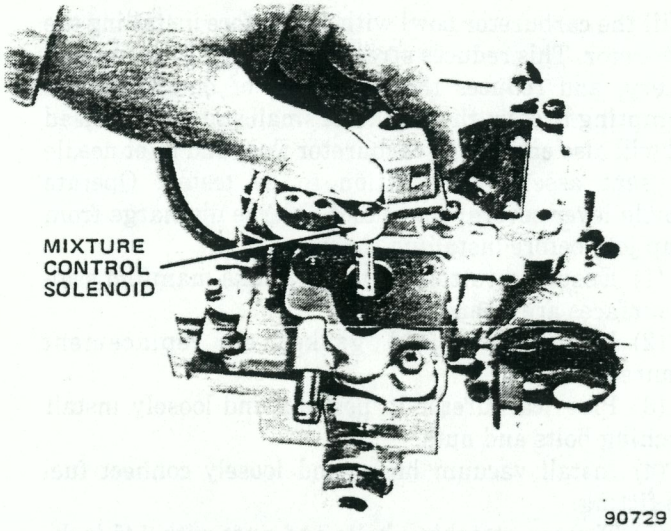

Fig. 1J-70 Carburetor Model E2SE—Mixture Control Solenoid Removal

(9) If equipped, remove two small screws that retain hot idle compensator valve (fig. 1J-71). Remove valve and seal from air horn. Discard seal. Hot idle compensator valve must be removed to gain access to short air horn-to-bowl attaching screw.

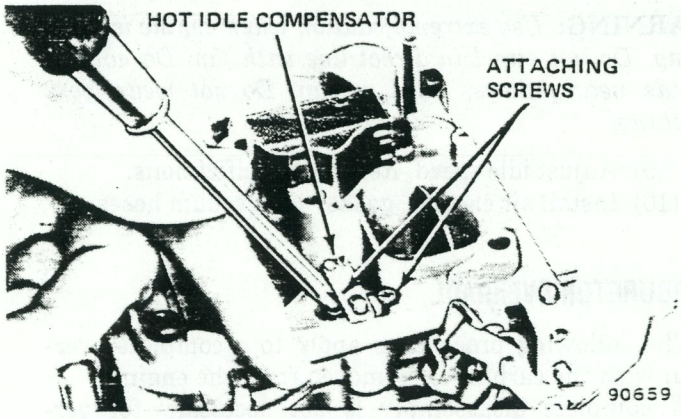

Fig. 1J-71 Carburetor Model E2SE—Hot Idle Compensator Valve Removal

(10) Remove six air horn-to-bowl attaching screws and lockwashers (fig. 1J-72).

(11) Rotate fast idle cam to full UP position and remove air horn assembly by tilting to disengage fast idle cam rod from slot in fast idle cam (fig. 1J-73). Air horn gasket should remain on float bowl for removal later. Do not remove fast idle cam screw and cam from float bowl.

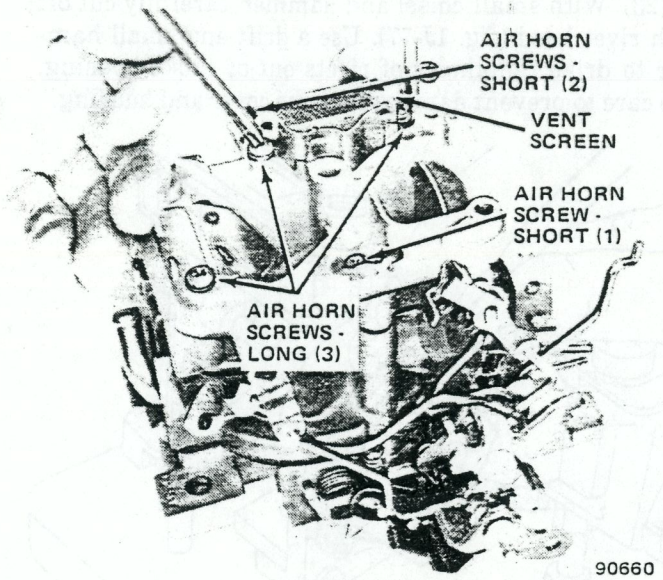

Fig. 1J-72 Carburetor Model E2SE—Air Horn Screws and Vent Screen

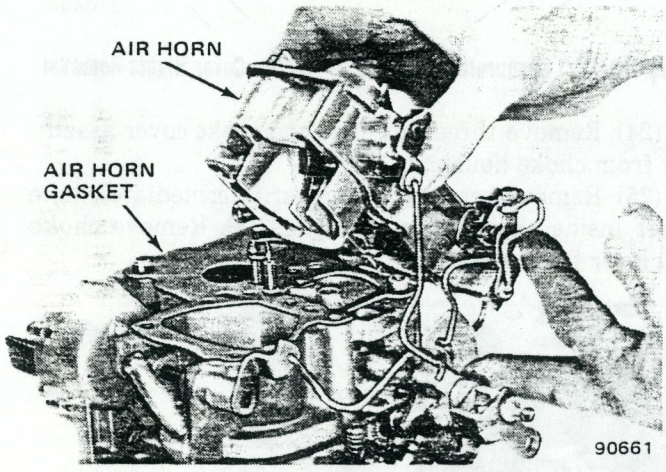

Fig. 1J-73 Carburetor Model E2SE—Air Horn Removal

NOTE: *These parts are not serviced separately and are to remain permanently in place as installed during original assembly. The new service replacement float bowl will include the secondary lockout lever, fast idle cam and screw installed as required.*

(12) Remove fast idle cam rod from choke lever by rotating rod to align tang on rod with small slot in lever.

(13) If necessary, remove two small screws and remove vent/screen assembly.

(14) Further disassembly of air horn is not required for cleaning purposes. If component replacement is required, remove staking on two choke valve attaching screws. Remove screws, choke valve, and shaft from air horn.

NOTE: *The air valve screws are permanently staked in place and should not be removed. Do not attempt to remove the secondary metering rod from the air valve assembly. Also, do not remove the plugs covering the idle air bleed screw during routine servicing. This adjustment screw is preset during original assembly and no attempt should be made to change the adjustment in the field except during air horn or float bowl replacement, at which time service instructions must be followed carefully. If air horn replacement is required during carburetor service, the new service air horn assembly will include the secondary metering rod-air valve assembly preset as required.*

(15) It is not necessary to remove vacuum break rod, or air valve rod from levers in air horn unless replacement of rods is necessary. Plastic bushings on levers may be cleaned in carburetor cleaning solution.

NOTE: *If necessary to replace the vacuum break rod, or air valve rod, remove and discard retaining clips from end of rods. Replacement retaining clips are required for reassembly. Remove plastic bushing used on rods and retain for reassembly.*

(16) Remove pump plunger from pump well.

(17) Remove pump return spring from pump well.

(18) Remove plastic filler block located over float valve.

(19) Remove float assembly and float valve by pulling up on retaining pin. Remove float valve seat and gasket with Seat Remover Tool J-22769 (fig. 1J-74).

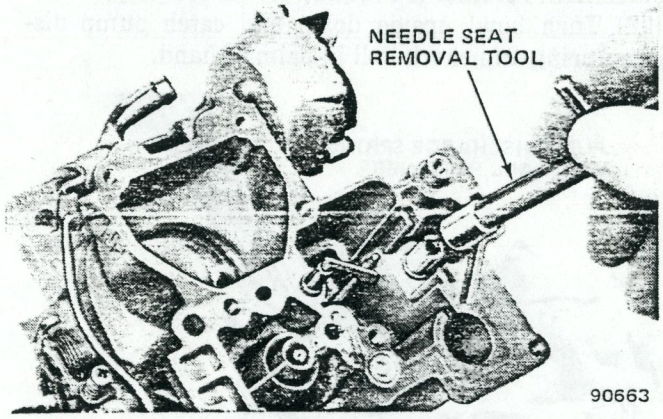

Fig. 1J-74 Carburetor Model E2SE—Inlet Needle Seat Removal

(20) With removal Tool J-22769 or a wide-blade screwdriver that fully fits slot in top of jet, remove extended main metering jet from float bowl (fig. 1J-75).

NOTE: *Do not remove or change adjustment of the small calibration screw located deep inside the metering jet during routine servicing. The adjustment screw is preset during original assembly and no attempt should be made to change this adjustment in the field except during air horn or float bowl replacement, at which time service instructions must be followed carefully.*

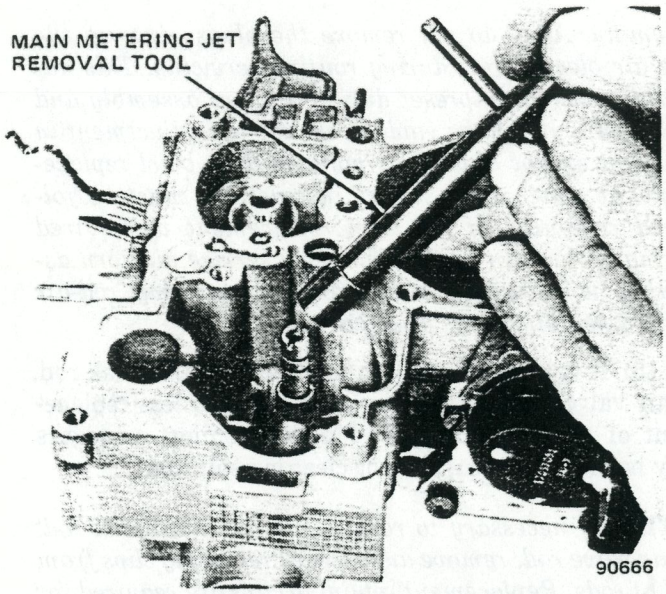

Fig. 1J-75 Carburetor Model E2SE—Extended Main Metering Jet Removal

CAUTION: *Do not attempt to remove plastic retainer by prying out with a tool such as a punch or screwdriver. This will damage the sealing beads on the bowl casting surface and necessitate complete float bowl replacement.*

(21) Using needlenose pliers, or equivalent, remove plastic retainer holding pump discharge spring and check ball in place (fig. 1J-76). Discard plastic retainer (replacement retainer is required for reassembly).

(22) Turn bowl upside down and catch pump discharge spring and check ball in palm of hand.

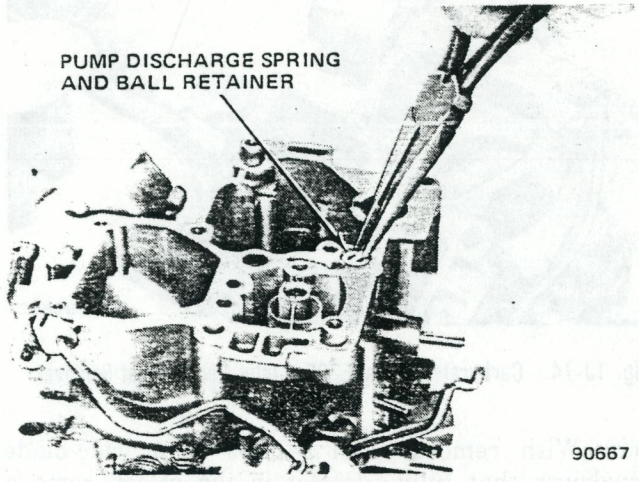

Fig. 1J-76 Carburetor Model E2SE—Pump Discharge Retainer Removal

NOTE: *The tamper-resistant choke cover design is used to discourage indiscriminate readjustment of the choke cover and coil assembly in the field. However, it is necessary to remove the cover and coil assembly during normal carburetor disassembly for cleaning and overhaul.*

(23) With small chisel and hammer, carefully cut off each rivet head (fig. 1J-77). Use a drift and small hammer to drive remainder of rivets out of choke housing. Use care to prevent damage to choke cover and housing.

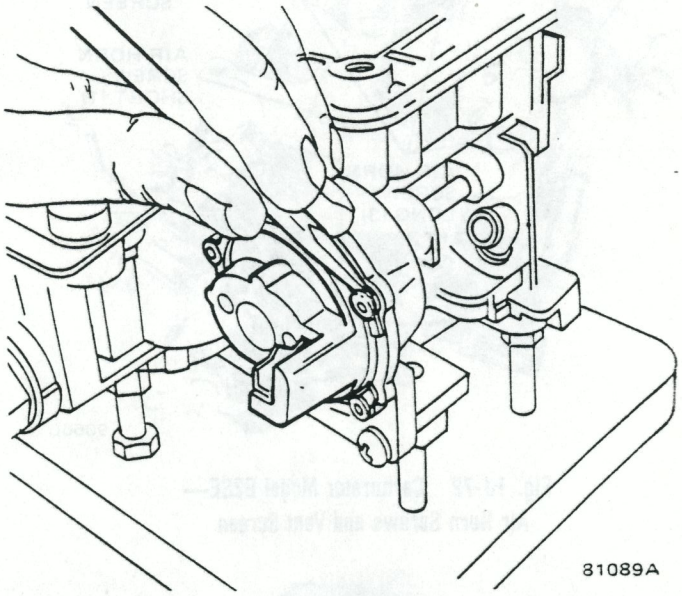

Fig. 1J-77 Carburetor Model E2SE—Choke Cover Rivets Removal

(24) Remove three retainers and choke cover assembly from choke housing.

(25) Remove screw from end of intermediate choke shaft inside choke housing (fig. 1J-78). Remove choke coil lever from shaft.

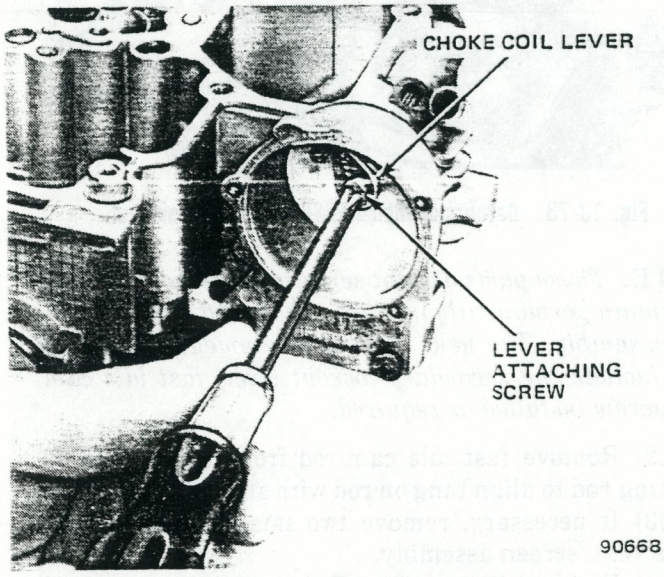

Fig. 1J-78 Carburetor Model E2SE—Choke Coil Lever Removal

(26) Remove intermediate choke shaft and lever assembly from float bowl by sliding rearward out throttle lever side (fig. 1J-79).

(27) Remove choke housing by removing two attaching screws in throttle body (fig. 1J-80).

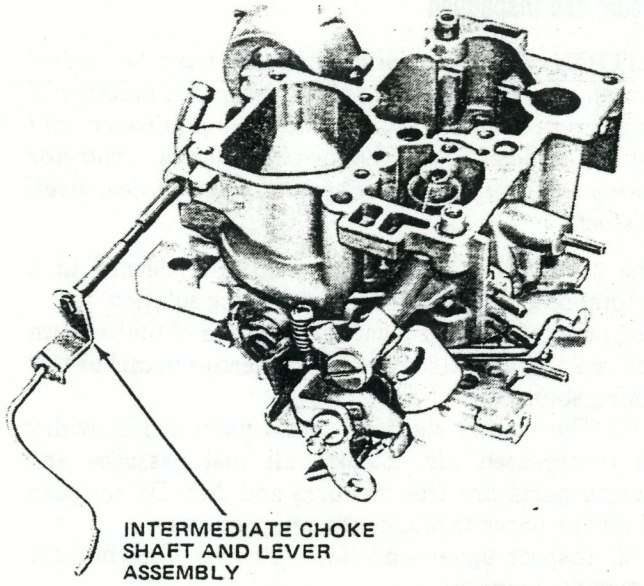

Fig. 1J-79 Carburetor Model E2SE—Intermediate Choke Shaft Removal

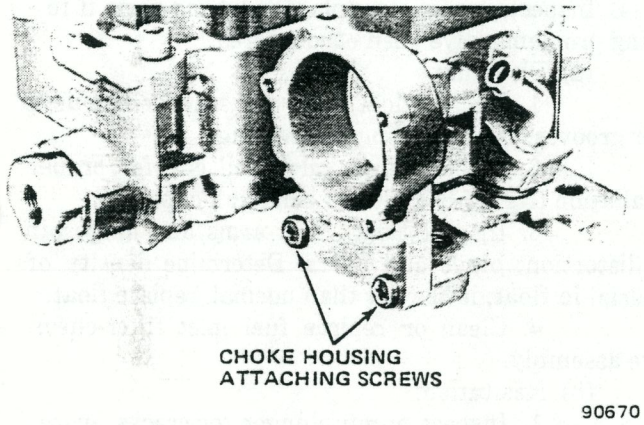

Fig. 1J-80 Carburetor Model E2SE—Choke Housing Screws

(28) Remove fuel inlet fitting, gasket, check valve/filter assembly, and spring.

(29) Remove four throttle body-to-bowl attaching screws and lockwashers and remove throttle body assembly (fig. 1J-81).

(30) Remove throttle body-to-bowl insulator gasket.

(31) Hold primary throttle lever wide-open and disengage pump rod from throttle lever by rotating rod until tang on rod aligns with slot in lever.

(32) If replacement is necessary, remove fast idle adjustment screw and clip in primary throttle lever.

(33) If required, remove curb or base idle speed adjustment screw and spring from throttle body.

NOTE: *Further disassembly of the throttle body is not required for cleaning purposes. The primary and secondary throttle valve screws are permanently staked in place and should not be removed. The throttle body is serviced as a complete assembly (fig. 1J-82).*

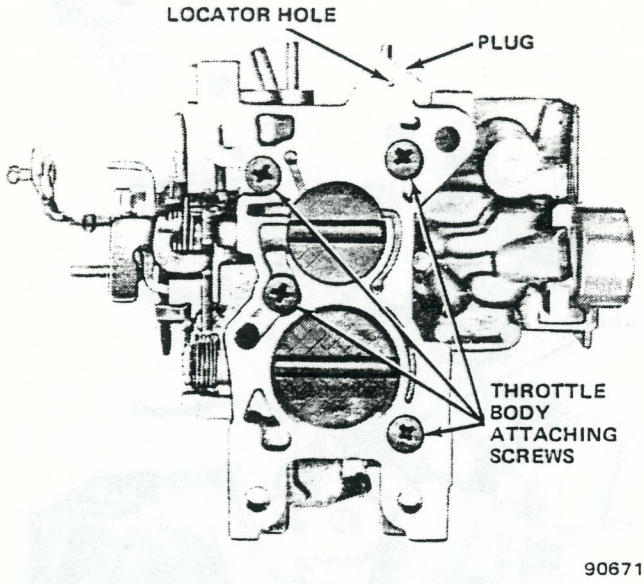

Fig. 1J-81 Carburetor Model E2SE—Throttle Body Screws

NOTE: *DO NOT remove plug covering idle mixture adjustment screw unless it is necessary to replace it or normal soaking and air pressure fail to clean the idle mixture passages.*

(34) Remove idle mixture plug and screw as follows:

(a) Invert throttle body and place on carburetor holding fixture—manifold side up.

(b) Place a punch in locator hole in throttle body beneath idle mixture screw plug (manifold side). Refer to figure 1J-83 for locating hole. Holding punch vertical, drive punch through locator until hardened steel plug breaks. Holding punch at 45 degree angle, break out throttle body casting to gain access to mixture screw plug. Drive out plug.

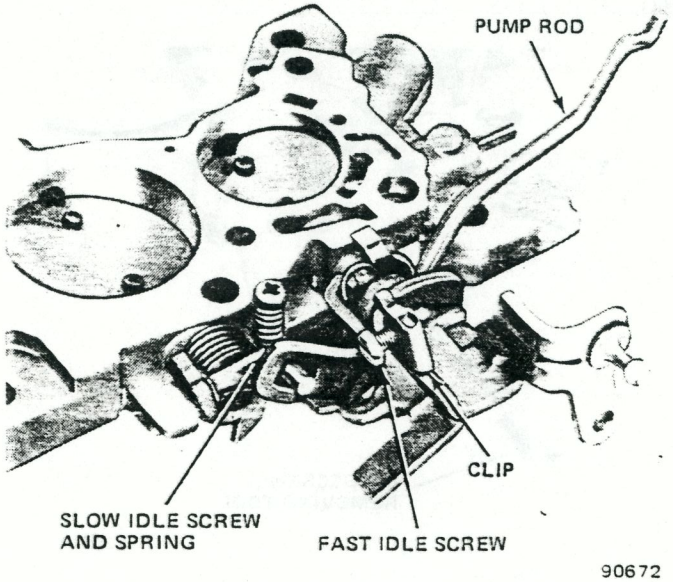

Fig. 1J-82 Carburetor Model E2SE—Throttle Body Assembly

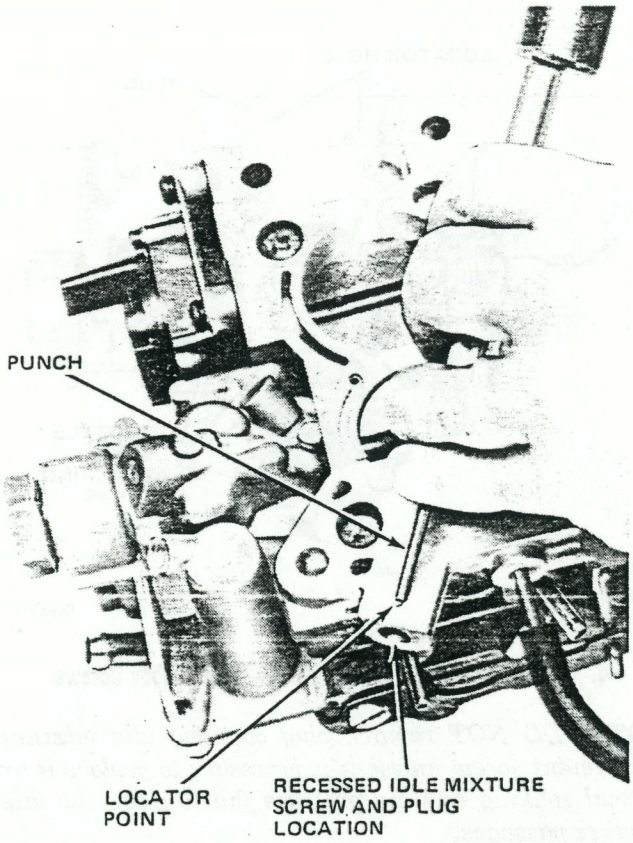

Fig. 1J-83 Carburetor Model E2SE—Idle Mixture Screw Plug Removal

NOTE: *The hardened plug will break rather than remain intact. It is not necessary to remove the plug completely; instead, remove loose pieces to allow use of Idle Mixture Adjusting Tool J-29030, or equivalent.*

(c) Using Tool J-29030, or equivalent, remove idle mixture screw and spring from throttle body (fig. 1J-84).

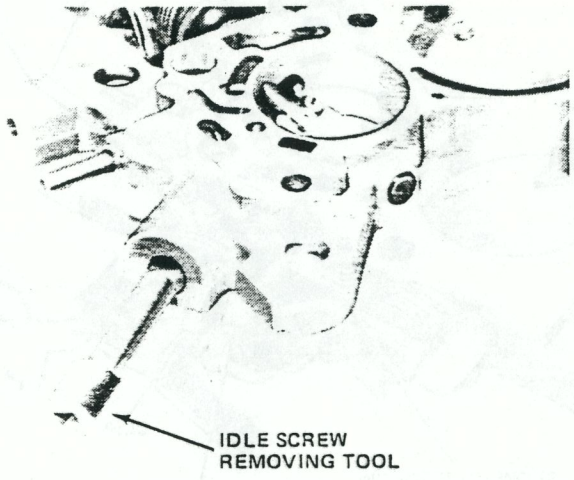

Fig. 1J-84 Carburetor Model E2SE—Idle Mixture Screw Removal

Cleaning and Inspection

CAUTION: *The idle speed solenoid, mixture control solenoid, electrically heated choke assembly, rubber and plastic components, diaphragms, pump plunger and plastic filler block must NOT be immersed in carburetor cleaning solution because they will either harden, swell or distort.*

The carburetor components should be cleaned in a cold immersion-type carburetor cleaning solution.

The plastic bushings located on the end of the vacuum break rod and air valve rod may be cleaned in carburetor cleaning solution.

(1) Thoroughly clean all metal parts and blow dry with compressed air. Ensure all fuel passages and metering parts are free of burrs and dirt. Do not pass drill bits or wires through jets and passages.

(2) Inspect upper and lower surface of carburetor castings for damage.

(3) Inspect holes in levers for excessive wear or out of round conditions. If worn, levers should be replaced. Inspect plastic bushings on levers for damage and excessive wear. Replace as required.

(4) Inspect, repair, or replace indicated parts if following problems have been encountered.

(a) Flooding:

1. Inspect float valve and seat for dirt, deep wear grooves, scores and proper seating.

2. Inspect float valve pull clip for proper installation (fig. 1J-85). Do not bend pull clip.

3. Inspect float, float arms and hinge pin for distortion, binds and burrs. Determine density of material in float; if heavier than normal, replace float.

4. Clean or replace fuel inlet filter-check valve assembly.

(b) Hesitation:

1. Inspect pump plunger for cracks, scores or excessively worn cup. A previously used pump cup will shrink when dry. If dried out, soak in fuel for eight hours before testing.

2. Inspect pump duration and return springs for weakness or distortion.

3. Examine all pump passages and jet for debris, improper seating of discharge check ball and scores in pump well. Examine condition of pump discharge check ball spring.

4. Inspect pump linkage for excessive wear; repair or replace as necessary.

(c) Hard Starting—Poor Cold Engine Operation:

1. Examine choke valve and linkage for excessive wear, binding or distortion.

2. Inspect choke vacuum diaphragm(s) for leaks.

3. Clean or replace carburetor fuel filter.

4. Inspect float valve for sticking condition, debris, etc.

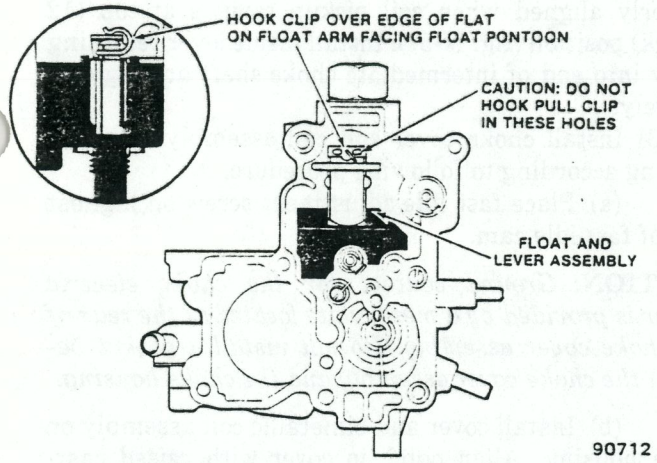

Fig. 1J-85 Carburetor Model E2SE—Float Valve Pull Clip

5. Also inspect items listed under Flooding (4a) above.

(d) Poor Engine Performance—Poor Fuel Economy:

1. Clean all fuel and vacuum passages in castings.

2. Inspect choke valve for freedom of movement.

CAUTION: *DO NOT attempt to readjust the lean mixture screw located inside the extended main metering jet during routine servicing. The screw is adjusted during carburetor flow testing and misadjustment can affect carburetor calibration.*

3. Inspect main metering jet for debris, looseness or damage.

4. Inspect air valve and secondary metering rod for binding condition. If air valve or metering rod is damaged or metering rod adjustment has been changed from original factory assembly setting, air horn assembly must be replaced.

5. Examine mixture control solenoid for sticking condition, binding or leakage. Refer to testing procedure listed below.

(e) Rough Idle:

1. Inspect gasket and gasket mating surfaces on castings for damage to sealing beads, nicks, burrs and other defects.

2. Clean all idle fuel passages.

3. If removed, inspect idle mixture screw for ridges, burrs or being bent.

4. Inspect throttle lever and valves for binding, nicks and other damage.

5. Examine all diaphragms for possible ruptures or leaks.

CAUTION: *Clean plastic parts only in a low volatile cleaning solvent—never in gasoline.*

Testing Mixture Control (MC) Solenoid

If the mixture control solenoid is suspected of either sticking, binding or leaking, test according to the following procedure (fig. 1J-86).

(1) Connect one end of jumper wire to either terminal of MC solenoid connector and other end to positive (+) terminal of 12 volt battery source.

(2) Connect one end of second jumper wire to other terminal of MC solenoid connector and other end to known good ground.

(3) With rubber seal and retainer removed from end of MC solenoid stem, attach hose from hand vacuum pump.

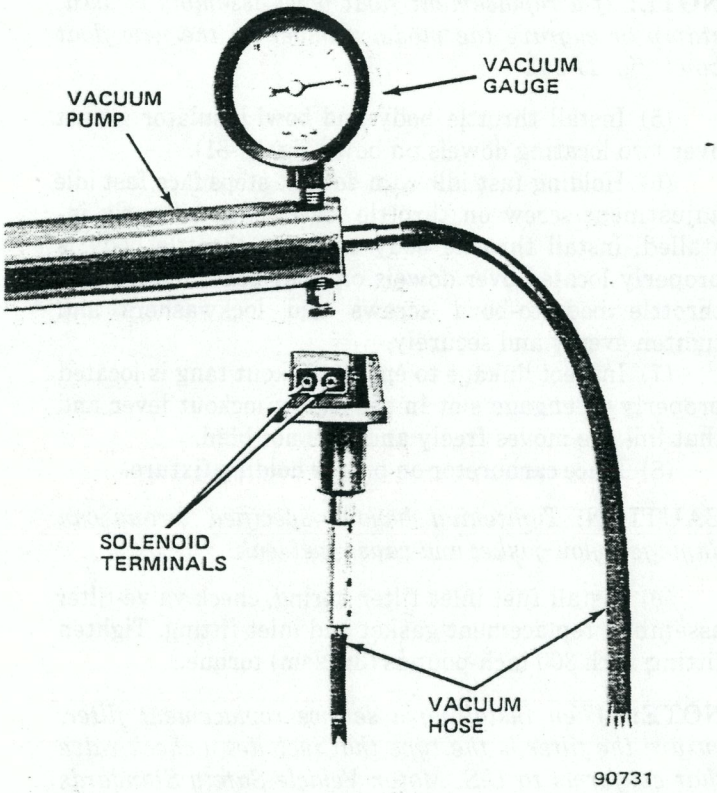

Fig. 1J-86 Carburetor Model E2SE—Testing Mixture Control Solenoid

(4) With MC solenoid energized (lean position), apply at least 25 in. Hg (84 kPa) of vacuum and time leak-down rate from 20 in. Hg (67 kPa) to 15 in. Hg (51 kPa). Leak-down rate should not exceed 5 in. Hg (17 kPa) in 5 seconds. If leakage exceeds that amount, replace MC solenoid.

(5) To test solenoid for sticking in down (de-energised) position, remove jumper wire connected to 12 volt source and observe hand vacuum pump gauge pointer. It should move to zero in less than one second. If not, replace MC solenoid.

Assembly

CAUTION: *Place throttle body assembly on carburetor holding fixture to avoid damaging throttle valves.*

(1) Install curb or base idle speed adjustment screw and spring, if removed, in throttle body (fig. 1J-82).

(2) If removed, install fast idle adjustment screw and clip in primary throttle lever (fig. 1J-82).

(3) Holding primary throttle lever wide open, install lower end of pump rod in throttle lever by aligning tang on rod with slot in lever. End of rod should point outward toward throttle lever.

(4) If removed, install idle mixture adjustment screw and spring with Tool J-29030 (fig. 1J-84). Lightly seat screw and then back out three turns for a preliminary idle mixture adjustment. Final idle mixture adjustment must be performed with carburetor installed on engine.

NOTE: *If a replacement float bowl assembly is used, stamp or engrave the model number on the new float bowl (fig. 1J-59).*

(5) Install throttle body and bowl insulator gasket over two locating dowels on bowl (fig. 1J-81).

(6) Holding fast idle cam so that steps face fast idle adjustment screw on throttle lever when properly installed, install throttle body ensuring throttle body is properly located over dowels on float bowl. Install four throttle body-to-bowl screws and lockwashers and tighten evenly and securely.

(7) Inspect linkage to ensure lockout tang is located properly to engage slot in secondary lockout lever and that linkage moves freely and does not bind.

(8) Place carburetor on proper holding fixture.

CAUTION: *Tightening beyond specified torque can damage nylon gasket and cause fuel leak.*

(9) Install fuel inlet filter spring, check valve-filter assembly, replacement gasket and inlet fitting. Tighten fitting with 300 inch-pounds (34 N•m) torque.

NOTE: *When installing a service replacement filter, ensure the filter is the type that includes a check valve that conforms to U.S. Motor Vehicle Safety Standards (M.V.S.S.).*

NOTE: *When properly installed, hole in filter faces toward inlet fitting. Ribs on closed end of filter element prevent filter from being installed incorrectly unless forced.*

(10) Install choke housing on throttle body. Ensure raised boss and locating lug on rear of housing fit into recesses in float bowl casting (fig. 1J-80). Install two choke housing attaching screws and lockwashers in throttle body and tighten screws evenly and securely.

(11) Install intermediate choke shaft and lever assembly in float bowl by pushing through from throttle lever side (fig. 1J-79).

(12) With intermediate choke lever in UP (12 o'clock) position, install bimetallic coil lever inside choke housing onto flats on intermediate choke shaft. Coil lever is properly aligned when coil pickup tang is at top (12 o'clock) position (fig. 1J-87). Install inside lever retaining screw into end of intermediate choke shaft and tighten securely.

(13) Install choke cover and coil assembly on choke housing according to following procedure.

(a) Place fast idle adjustment screw on highest step of fast idle cam.

CAUTION: *Ground contact for the choke electric heater is provided by a metal plate located at the rear of the choke cover assembly. Do not install a gasket between the choke cover assembly and the choke housing.*

(b) Install cover and bimetallic coil assembly on choke housing. Align notch in cover with raised casting projection on housing cover flange. Ensure coil pickup tang engages inside choke coil lever.

(c) Install three cover retainers and rivets.

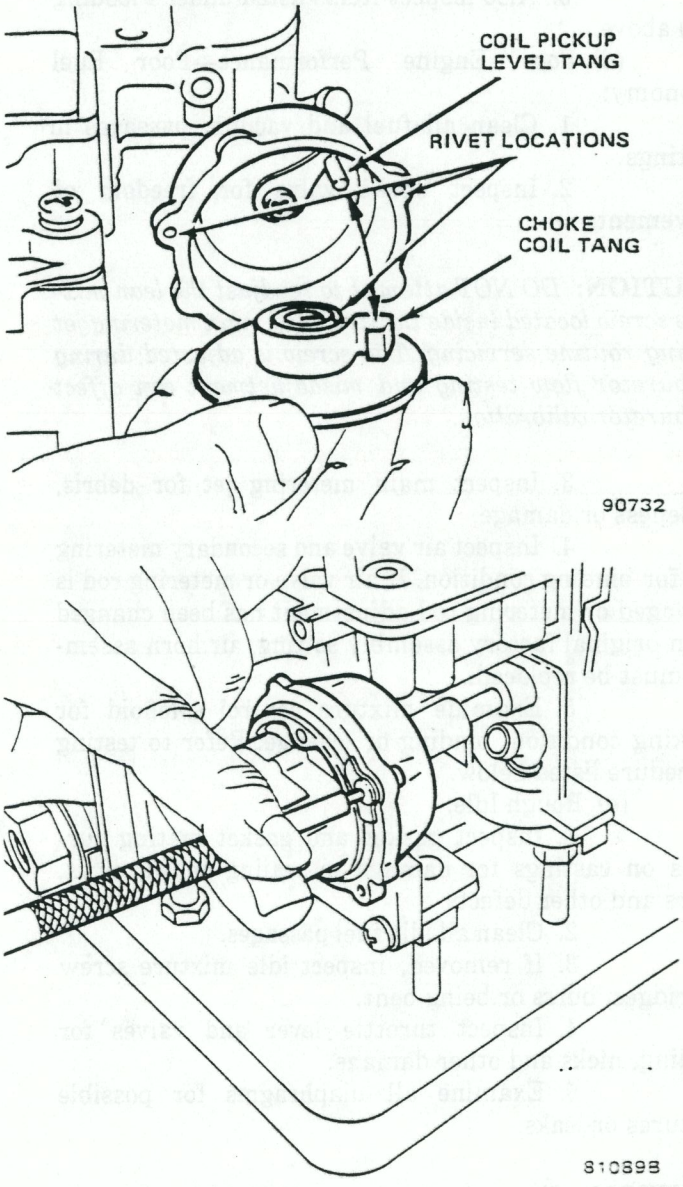

Fig. 1J-87 Carburetor Model E2SE—Choke Coil and Cover Installation

(14) Install pump discharge steel check valve ball and spring in passage next to float chamber. Insert end of replacement plastic retainer into end of spring and install retainer in float bowl. Tap lightly in place until top of retainer is flush with bowl casting surface.

(15) Using Tool J-22769 or a screwdriver that fully fits slot in top, install extended main metering jet into bottom of float chamber. Tighten jet securely.

(16) Install inlet needle seat assembly, with gasket, using Seat Installer Tool J-22769 (fig. 1J-74).

(17) For easier adjustment, carefully bend float arm upward at notch in arm before assembly.

(18) Install float valve onto float arm by sliding float lever under pull clip. Correct installation of pull clip is to hook clip over edge of float on float arm facing float pontoon (fig. 1J-85).

(19) Install float retaining pin into float arm with end of loop of pin facing pump well. Install float assembly by aligning valve in seat and float retaining pin into locating channels in float bowl.

(20) Adjust float level:

(a) Refer to figure 1J-88. Hold float retaining pin firmly in place and push down lightly on float arm at outer end against top of float valve.

(b) Using adjustable "T" scale, measure from top of float bowl casting surface (air horn gasket removed) to top of float at toe. Measuring point is 3/16 inch back from end of float at toe.

(c) Bend float arm as necessary for proper adjustment by pushing on pontoon (refer to Specifications).

(d) Visually inspect float alignment after adjustment.

(21) Install plastic filler block over float valve by pressing downward until properly seated (flush with bowl casting surface).

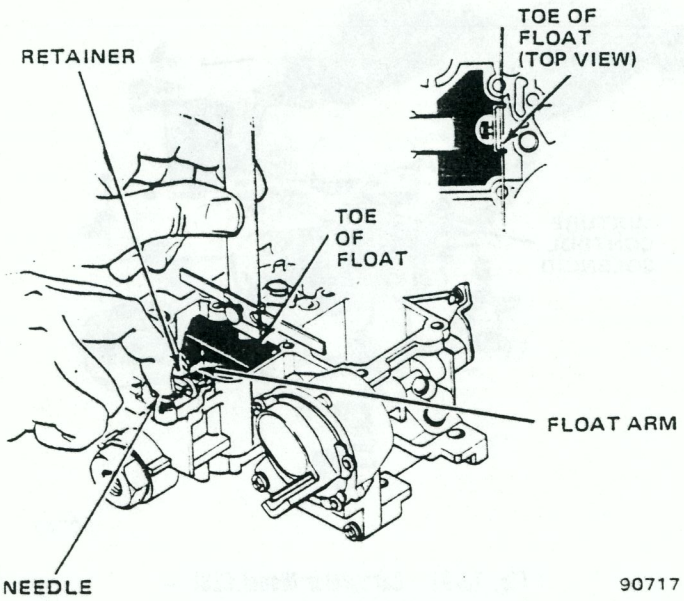

Fig. 1J-88 Carburetor Model E2SE—Float Level Adjustment

(22) Install air horn gasket on float bowl. Locate gasket over two dowel locating pins on bowl.

(23) Install pump return spring in pump well.

(24) Install pump plunger assembly in pump well.

(25) If removed, install vent/screen assembly and two small attaching screws. Tighten screws securely.

CAUTION: *Test choke valve for freedom of movement and proper alignment before staking screws in place.*

(26) If removed, install choke shaft, choke valve, and two attaching screws. Tighten screws securely and stake lightly in place.

(27) If used, install new pump plunger stem seal and retainer in air horn casting. Lightly stake seal retainer in three places. Choose locations that are different from original staking positions.

(28) Install fast idle cam rod in lower hole of choke lever. Align tang on rod with small slot in lever.

(29) If removed, install plastic bushing in hole in vacuum break lever. Ensure small end of bushing faces retaining clip when installed. Insert end of vacuum break rod through bushing in lever. Retain rod with replacement clip. Press clip in place using needlenose pliers. Ensure clip has full contact on rod but is not seated tightly against bushing. Rod-to-bushing clearance should be 0.030 inch (0.8 mm). Retaining clip is "dished." Install clip on rod with outward bend of self-locking clip facing end of rod. Ensure that clip fully engages rod and that it is not distorted.

(30) If removed, install plastic bushing in hole in air valve lever. Ensure small end of bushing faces retaining clip when installed. Insert end of air valve rod through bushing in lever. Retain with replacement clip. Press clip in place with needlenose pliers. Ensure clip has full contact on rod but is not seated tightly against bushing. Rod-to-bushing clearance should be 0.030 inch (0.8 mm). Retaining clip is "dished." Install clip on rod with outward bend of self-locking clip facing end of rod. Ensure that clip fully engages rod and that it is not distorted.

(31) Prior to installing air horn on float bowl, apply a light coat of silicone grease or light weight engine oil to stem on pump plunger in bowl to aid insertion of stem through seal on air horn.

CAUTION: *Do not force air horn assembly onto bowl, gently lower in place.*

(32) Rotate fast idle cam to full UP position and tilt air horn assembly to engage lower end of fast idle cam rod in slot in fast idle cam. Holding down on pump plunger assembly, carefully lower air horn assembly onto float bowl. Guide pump plunger stem through seal in air horn casting.

(33) Install six air horn to bowl attaching screws and lockwashers. Three long air horn screws are located in primary and secondary venturi area. Two short screws are located on fuel inlet side and one short screw is located in area beneath hot idle compensator valve. All

air horn screws must be tightened evenly and securely. Refer to figure 1J-89 for proper tightening sequence.

(34) If equipped, install replacement seal in recess of float bowl. Install hot idle compensator valve and retain with two small attaching screws. Tighten screws securely.

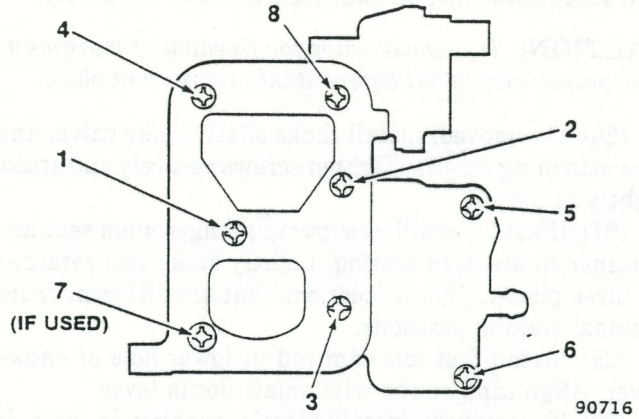

Fig. 1J-89 Carburetor Model E2SE—Air Horn Screw Tightening Sequence

(35) If not tested previously, test mixture control solenoid for sticking, binding and leakage following procedure listed within Cleaning and Inspection. Install replacement rubber seal on mixture control solenoid stem. Position seal up against boss on solenoid stem. Using 3/16-inch socket and small hammer, carefully drive retainer on stem (fig. 1J-90). Drive retainer on stem only far enough to retain rubber seal on stem. Leave small clearance between retainer and seal to allow for seal expansion.

CAUTION: *A slight twisting motion of the solenoid is required during installation to ensure rubber seal on stem is guided into recess in the bottom of the bowl and to prevent distortion or damage to the rubber seal.*

(36) Prior to installing mixture control solenoid, lightly coat rubber seal on end of solenoid stem with silicone grease or light weight engine oil. With replacement mounting gasket, install mixture control solenoid on air horn. Carefully align solenoid stem with recess in bottom of bowl (fig. 1J-91).

(37) Install three solenoid attaching screws and tighten securely.

(38) Install plastic bushing in hole in choke lever. Ensure small end of bushing faces retaining clip when installed.

(39) With inner coil lever and intermediate choke lever at 12 o'clock position, install intermediate choke rod in bushing. Retain rod with replacement clip. Press lip securely in place with needlenose pliers. Ensure clip has full contact on rod but is not seated tightly against bushing. Rod-to-bushing clearance should be 0.030 inch (0.8 mm). Retaining clip is "dished." Install clip on rod with outward bend of self-locking clip facing end of rod. Ensure that clip fully engages rod and that it is not distorted.

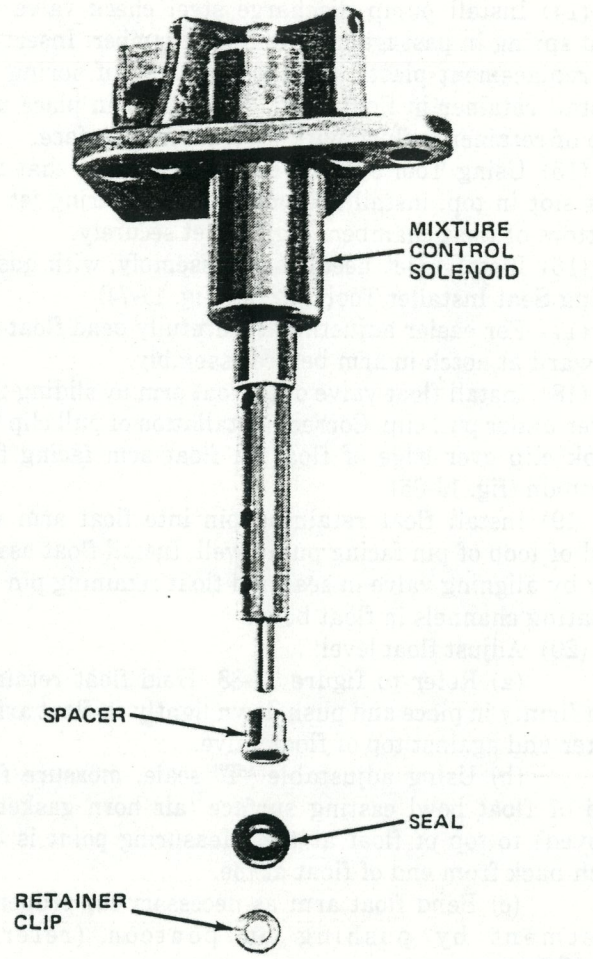

Fig. 1J-90 Carburetor Model E2SE—Mixture Control Solenoid Seal and Retainer

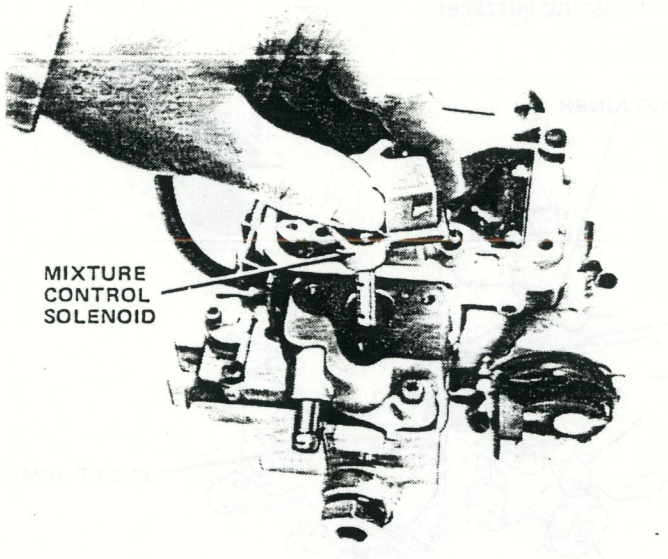

Fig. 1J-91 Carburetor Model E2SE—Installing Mixture Control Solenoid

CAUTION: *Use care when tightening idle speed solenoid retaining nut with wrench to avoid damaging vacuum break plunger.*

(40) If removed, install idle speed solenoid, lockwasher and retaining nut on primary side vacuum bracket. Tighten nut securely. Bend back two retaining tabs on lockwasher to fit in slots in bracket.

(41) Rotate vacuum break bracket and insert end of vacuum break rod into inner slot of vacuum break diaphragm plunger and end of air valve rod into outer slot of vacuum break diaphragm plunger. Install bracket over locating lugs on air horn with taper-seat screw in air horn and screw with lockwasher in throttle body. Tighten screws securely.

(42) Insert pump rod in hole in pump lever by rotating lever. Install retaining screw in pump lever, then install washer. Holding down on pump plunger stem, install pump lever on air horn. Ensure shoulder on screw seats in hole in lever and washer is between lever and air horn casting. Tighten screw securely.

SERVICE ADJUSTMENT PROCEDURES

Refer to Service Adjustment Procedures within Model 2SE Carburetor section and to General Service and Diagnosis—Chapter 1A.

Idle Speed Adjustments

The engine and related systems must be performing properly before initiating the idle speed adjustments.

Precautions and General Information.

- Place manual transmission in neutral, automatic transmission in drive. Set the parking brake firmly and do not accelerate the engine.
- Ensure the engine is at normal operating temperature before adjusting the idle speed.
- Perform the procedure with the air cleaner installed or with air cleaner removed and associated vacuum hoses plugged, choke open and deceleration valve supply hose plugged.
- Do not idle the engine more than three minutes at a time.
- If the idle speed adjustment procedure requires more than three minutes, operate the engine at 2000 rpm for one minute.
- Ensure the ignition timing is correct before adjusting idle speed.
- Use extreme caution around fan, belts and other moving parts when the engine is operating. Do not wear loose clothing. Do not stand in direct line with the fan blades.

Slow (Curb) Idle Speed Adjustment Procedure

(1) Disconnect and plug purge vacuum hose at vapor canister.

(2) Connect dwell meter to single light blue wire taped to mixture control solenoid wires at carburetor. Set dwell meter on "6-cylinder" scale. Connect tachometer at distributer side of filter.

NOTE: *Use a tachometer with an expanded scale of 400 to 800 or 0 to 1000 rpm. Inspect tachometer periodically to ensure accuracy within two percent.*

(3) Set parking brake firmly. Manual transmission in neutral position, automatic transmission in drive.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(4) Start engine and warm to normal operating temperature. Dwell meter pointer should now be oscillating. Pointer should be generally located between 10 and 50 degrees with maximum sweep of pointer oscillation covering a segment of 15 degrees. If not, refer to C4 System Operational Test.

(5) Open throttle momentarily to ensure idle speed solenoid is fully extended. Adjust idle speed by turning solenoid idle adjustment screw to obtain specified idle speed. Refer to Specifications.

(6) Disconnect solenoid wire. Adjust curb idle to 500 rpm.

(7) Connect solenoid wire.

(8) Stop engine. Disconnect and remove dwell meter and tachometer. Install air cleaner and connect vacuum hoses, if removed. Connect canister purge vacuum hose and deceleration valve supply hose.

Model E2SE Carburetor Idle Speed Adjustment Specifications

Transmission	RPM
Manual	900 (± 100) ①
Automatic	700 (± 100) ①

①Idle speed with solenoid de-energized is 500 rpm. 90934

Fast Idle Speed Adjustment Procedure

(1) Connect tachometer at distributor side of filter.

(2) Set parking brake. Place manual transmission in neutral position, automatic transmission in drive.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(3) Start and warm engine to normal operating temperature.

(4) Disconnect and plug EGR valve vacuum hose.

(5) Open throttle slightly and rotate fast idle cam until screw is against highest step of cam.

(6) Adjust fast idle speed to specified rpm.

(7) Quickly open throttle slightly and allow engine to return to slow idle speed.

(8) Connect EGR valve vacuum hose.

Idle Mixture Adjustment

Refer to Carburetor Model E2SE Idle Mixture Adjustment procedure listed within Feedback System section.

Idle mixture adjustment should not normally be necessary; only after carburetor overhaul and if original mixture screw adjustment has been altered.

Choke Mechanism Service

Refer to Service Adjustment Procedures within Model 2SE Carburetor section.

SPECIFICATIONS

Model E2SE Carburetor Specifications

List Number	17081796	17081797
Pri. Throttle Bore	35 mm	35 mm
Sec. Throttle Bore	46 mm	46 mm
Pri. Venturi Diameter	28 mm	28 mm
Sec. Venturi Diameter	Var. Air Valve	Var. Air Valve
Fuel Inlet Seat Diameter	2.36 mm	2.36 mm
Idle Bypass	mm	mm
Idle Tube	0.80 mm	0.80 mm
Side Idle Air Bleed	1.17 mm	1.17 mm
Lower Idle Air Bleed	1.32 mm	1.32 mm
Spark Port Size	1.14 mm x 3.84 mm	1.14 mm x 3.84 mm
Main Jet	No. 4 (1.752 mm)	No. 4 (1.752 mm)
Pri. Metering Rod. No.	N/A	N/A
Sec. Metering Rod No.	17062528	17062528
Top Well Bleed	0.90 mm	0.90 mm
Side Well Bleed	1.02 mm	1.02 mm
Power Valve Timing	N/A	N/A
Accelerator Nozzle Diameter	0.50 mm	0.50 mm

90736

4-Cylinder Engine		Carburetor Number	Float Level mm (inches)	Pump Stem Height mm (inches)	Fast Cam Adj. 2nd Step	Fast Idle Speed ±100 rpm	Air Valve Link ①	Vac. Break Pri.	Unloader	Choke	Secondary Lockout	Choke Coil Lever Plug Gauge
CJ (Calif. only)	Man. Trans.	170811796	5.30 (.208)	3.25 (.128)	25°	2400	2°	19°	32°	TR	1.27-2.03 mm (.050-.080 in.)	1.27-2.03 mm (.050-.080 in.)
	Auto. Trans.	17081797	5.30 (.208)	3.25 (.128)	25°	2600	2°	19°	32°	TR	2.16 mm (.085 in.)	2.16 mm (.085 in.)

① Maximum Degree Setting
TR Tamper Resistant

90735

CARBURETOR MODEL BBD-2 VENTURI

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GENERAL

The Carter Model BBD two-venturi carburetor incorporates three lightweight aluminum assemblies, the air horn, main body and throttle body (fig. 1J-92).

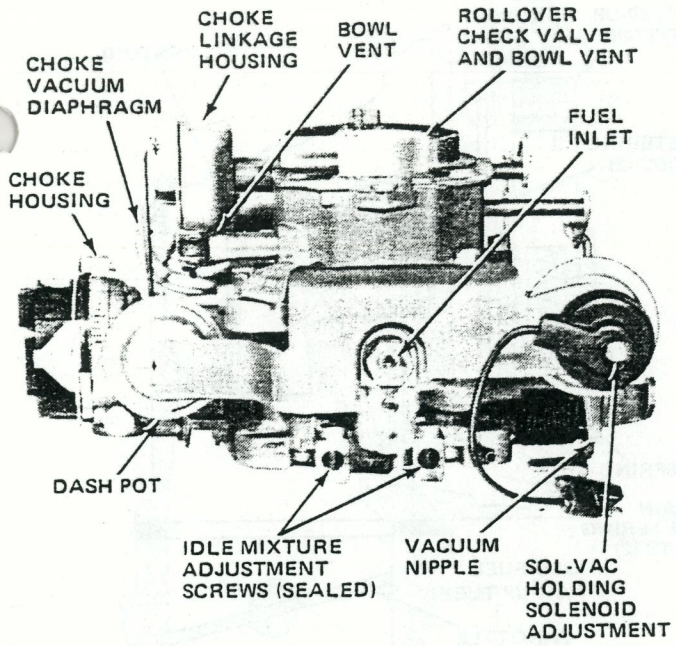
The air horn contains the choke valve assembly, mechanical linkage for accelerator pump and metering rods, and bowl vent.

The main body contains the fuel bowl, accelerator pump, vacuum piston and metering rod assembly, venturi assembly and solenoid.

The throttle body contains throttle valves and levers, choke housing, choke vacuum diaphragm and idle mixture adjustment screws.

Identification

The carburetor is identified by a code number and build date. Both are stamped on the identification tag. Each carburetor build month is coded alphabetically beginning with the letter A in January and ending with the letter M in December (the letter I is not used). The



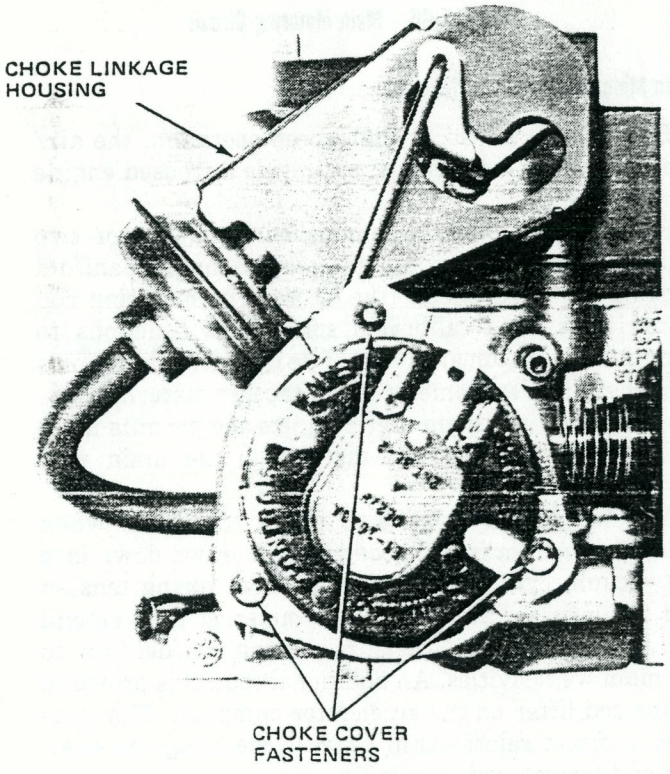


Fig. 1J-92 Model BBD Carburetor Assembly

tag is attached to the carburetor and must remain with the carburetor to assure proper identification (fig. 1J-17).

CARBURETOR CIRCUITS

Five conventional circuits are used:

- Float (fuel inlet)
- Idle (low speed) Metering

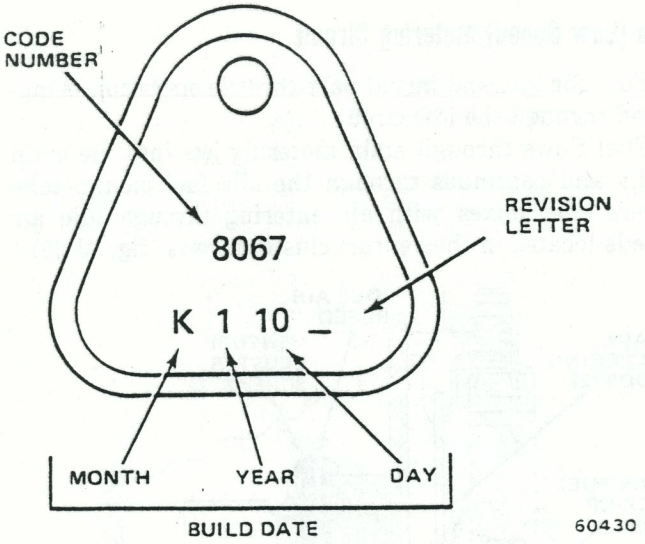


Fig. 1J-93 Identification Tag

- Main (high speed) Metering
- Pump (acceleration)
- Choke

Float (Fuel Inlet) Circuit

The float circuit maintains the specified fuel level in the bowl to provide sufficient fuel to the metering circuits for all engine operating conditions (fig. 1J-94).

Fuel flows into the bowl through a needle and seat assembly controlled directly by dual floats hinged to the float fulcrum pin.

When the fuel in the bowl fills to the proper level, the float lever pushes the needle toward its seat and restricts incoming fuel, admitting only enough to replace that being used.

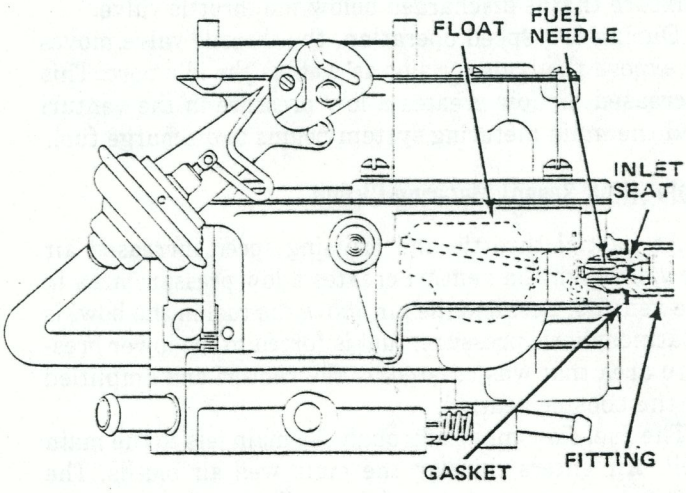


Fig. 1J-94 Float Circuit

Idle (Low Speed) Metering Circuit

Fuel for idle and initial part-throttle operation is metered through the idle circuit.

Fuel flows through main metering jets into the main wells and continues through the idle fuel pickup tube where fuel mixes with air entering through idle air bleeds located in the venturi cluster screws (fig. 1J-95).

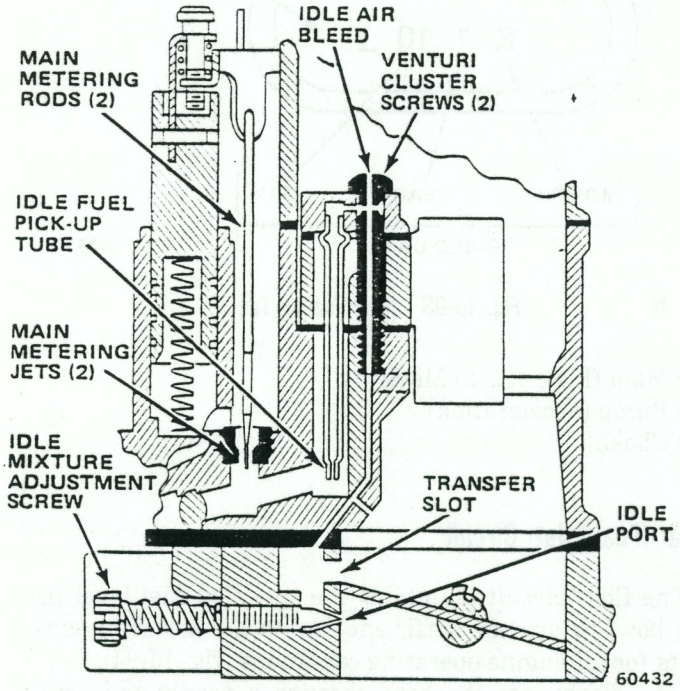


Fig. 1J-95 Idle Circuit

At curb idle speed, the air/fuel mixture flows down the idle channel and is further mixed with air entering the idle channel through the transfer slot, which is above the position of the throttle valve at curb idle speed. The mixture then flows past the idle mixture adjustment screw, which controls the volume of the mixture that is discharged below the throttle valve.

During low speed operation, the throttle valve moves to expose the transfer slot as well as the idle port. This increased airflow creates a low pressure in the venturi and the main metering system begins to discharge fuel.

Main (High Speed) Metering Circuit

At partial throttle and cruising speed increased air flow through the venturi creates a low pressure area in the venturi. Because the air above the fuel in the bowl is at atmospheric pressure, fuel is forced to the lower pressure area that was created by the venturi and amplified by the booster venturi.

The fuel flow moves through the main jets to the main well. Air enters through the main well air bleeds. The resulting mixture of air and fuel is lighter than raw fuel, responds more quickly to changes in venturi vacuum, and is more readily vaporized when discharged into the venturi (fig. 1J-96).

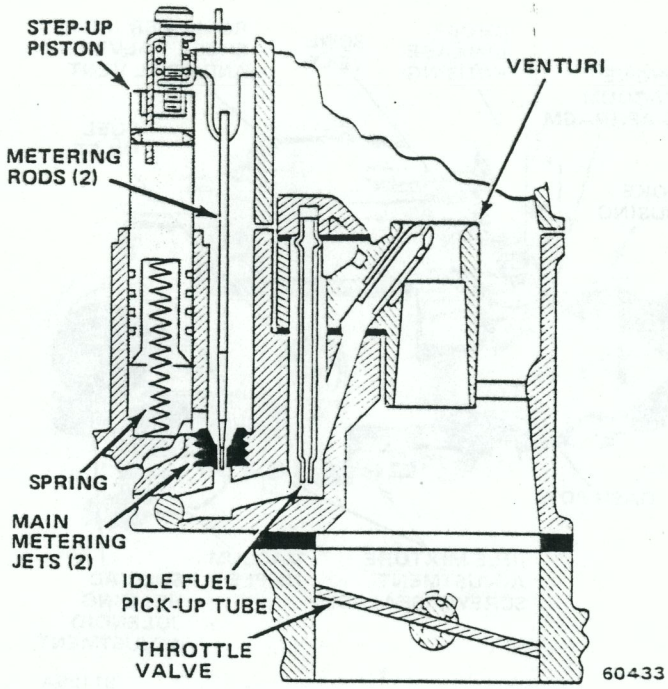


Fig. 1J-96 Main Metering Circuit

Main Metering Circuit Enrichmant

During heavy load or high speed operation, the air/fuel ratio must be enriched to provide increased engine power.

Fuel enrichment is accomplished by means of two calibrated metering rods connected to a single manifold vacuum actuated piston (fig. 1J-96). The metering rod piston rides on a calibrated spring that functions to maintain the piston at the top of its cylinder. This allows only the smallest diameter of the tapered metering rods to extend into the main metering jets and permits maximum fuel flow through the jets to the main well cavities.

At idle, partial throttle or cruise conditions when manifold vacuum is high, the piston is drawn down into the vacuum cylinder against calibrated spring tension and the larger diameters of the metering rods extend into the main metering jets, restricting the fuel flow to the main well cavities. An additional control is provided by the rod lifter on the accelerator pump rod. This provides a direct relationship between metering rod position and throttle valve opening.

Pump (Acceleration) Circuit

When the throttle is opened suddenly, airflow response through the carburetor is almost immediate. There is a brief time lag before fuel inertia can be overcome. This lag causes the desired air/fuel ratio to be leaned out.

A piston-type accelerating pump system mechanically supplies the fuel necessary to compensate for this deficiency (fig. 1J-97).

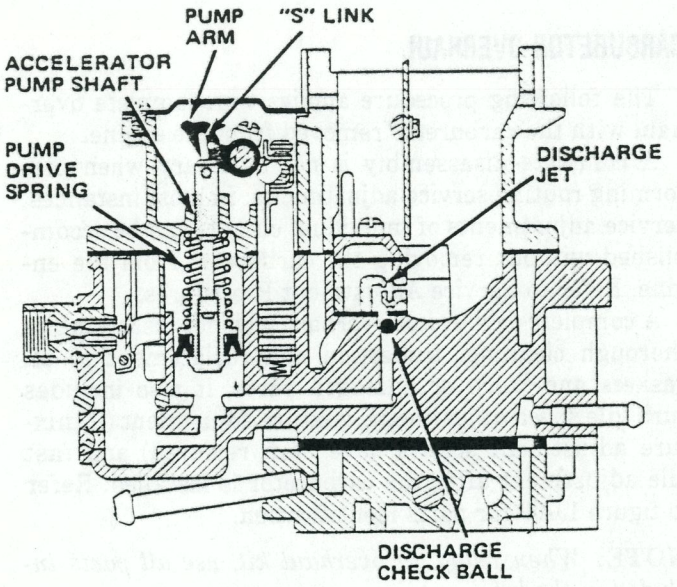


Fig. 1J-97 Pump Circuit

Fuel is forced into the pump cylinder from the fuel bowl past the pump piston on the upward movement of the accelerator pump shaft. When the engine is turned off, fuel vapors in the pump cylinder vent through the area between the pump rod and pump piston.

As the throttle lever is moved, the pump link, operating through a system of levers and assisted by the pump drive spring, pushes the pump piston down. Fuel is forced through a passage, past the pump discharge check valve ball, and out the pump discharge jets in the venturi cluster.

Choke Circuit

The choke valve, located in the air horn assembly, provides a high vacuum both above and below the throttle valves when closed. During engine start, vacuum above the throttle valve causes fuel to flow from the main metering and idle circuits and provides the richer air/fuel mixture ratio needed for cold engine starting (fig. 1J-98).

The choke shaft is connected by linkage to a bimetallic coil located within the choke cover, which winds up (contracts) when cold and unwinds (expands) when heated. When the engine is cold, the tension of the coil holds the choke valve closed. When the engine starts, manifold vacuum is applied to the diaphragm assembly to open the choke valve slightly. This is referred to as the initial choke valve clearance.

As the coil is warmed by the electric heater, it expands and exerts pressure to further open the choke valve, keeping it fully open at normal engine operating temperature.

If the engine is accelerated during the warm-up period, the corresponding drop in the manifold vacuum

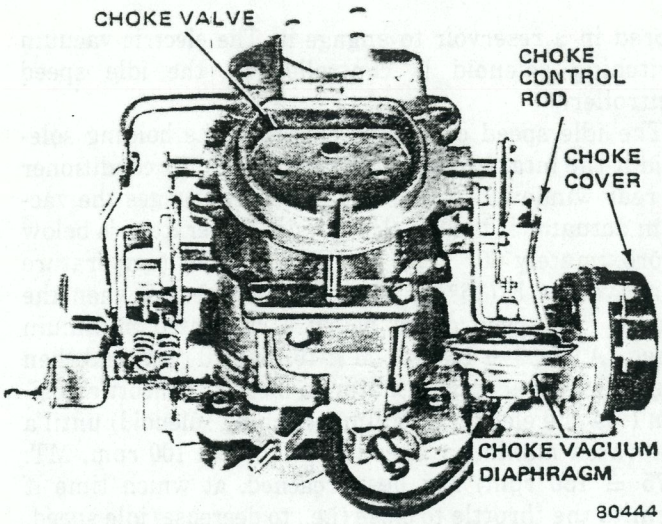


Fig. 1J-98 Choke Circuit Components

allows the coil to momentarily close the choke valve to provide a richer air/fuel mixture.

A faster idle speed is provided to prevent stalling during warm-up. The fast idle cam, actuated by the choke shaft through connecting linkage, rotates into position against the fast idle screw. The cam is progressively stepped to provide the correct idle speed in proportion to the choke valve opening. When the choke valve reaches its fully open position, the cam rotates free of the fast idle screw and allows the throttle lever to return to the curb idle speed position when released.

If the engine is flooded during starting, the choke valve may be opened to vent excess fuel by depressing the accelerator pedal to the floor and rotating the engine with the starter motor. With the accelerator linkage in this position, a tang on the throttle lever contacts the fast idle cam and causes the choke rod to move upward to open the choke valve a predetermined distance.

IDLE SPEED CONTROL

The idle speed control Sol-Vac throttle positioner is part of the BBD carburetor assembly. It is activated in two ways, by an electric holding solenoid and by a pneumatic vacuum actuator. The holding solenoid is capable of maintaining a preset throttle position, but it does not have the capability of moving the throttle out to a new position. The vacuum actuator portion of the Sol-Vac throttle positioner, however, is capable of moving the throttle to a new position when manifold vacuum is applied to it. Once the throttle is positioned by the vacuum actuator, the holding solenoid maintains the position.

The Sol-Vac throttle positioner has three positions: Off, or deactivated, position (curb idle); holding solenoid position; and vacuum actuator position. Manifold vacuum is applied to the vacuum actuator through an electric vacuum switching solenoid that allows vacuum

stored in a reservoir to engage it. The electric vacuum switching solenoid is controlled by the idle speed controller.

The idle speed controller energizes the holding solenoid if the intake manifold heater (EFE), air conditioner or rear window defogger are in use; it engages the vacuum actuator if the air cleaner air temperature is below approximately 60° F(16° C). When the air temperature is above 60° F (16° C), the controller reacts when the engine idle speed drops below a calibrated minimum speed (AT: 435 ± 10 rpm, MT: 462.5 ± 10 rpm) and then engages the vacuum actuator to move the throttle position (via the electric vacuum switching solenoid) until a calibrated maximum speed (AT: 1050 ± 100 rpm, MT: 1175 ± 150 rpm) has been reached, at which time it permits the throttle to close (i.e., to decrease) idle speed, either to the holding solenoid position (if the intake manifold heater, A/C or rear window defogger are in use) or to the normal curb idle speed position.

CARBURETOR REPLACEMENT

Removal

(1) Remove air cleaner. Plug vacuum hoses.

(2) Identify all hoses attached to carburetor for aid during installation.

(3) Remove throttle cable from throttle lever and disconnect vacuum hoses, return spring, PCV hose, fuel pipe fitting, choke heat wire connector, solenoid wire connector and stepper motor wire harness connector, if equipped.

(4) Remove carburetor retaining nuts. Remove carburetor. Remove carburetor gasket from spacer.

Installation

(1) Clean gasket mounting surface of spacer. Install replacement gasket on spacer. Position carburetor on spacer and gasket and install nuts. To prevent leakage, distortion or damage to carburetor body flange, alternately tighten nuts in crisscross pattern.

(2) Connect fuel pipe fitting, throttle cable, choke heater wire connector, PCV hose, return spring, all vacuum hoses, solenoid wire connector and stepper motor wire harness connector, if equipped.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(3) Adjust engine curb idle speed. Refer to Chapter 1A—General Service and Diagnosis.

(4) Install air cleaner and vacuum hoses.

CARBURETOR OVERHAUL

The following procedure applies to a complete overhaul with the carburetor removed from the engine.

A complete disassembly is not necessary when performing routine service adjustments. In most instances, service adjustments of individual circuits can be accomplished without removing the carburetor from the engine. Refer to Service Adjustment Procedures.

A complete carburetor overhaul includes disassembly, thorough cleaning, inspection and replacement of all gaskets and worn or damaged parts. It also includes curb idle speed adjustment, mixture adjustment (if mixture adjustment screws have been removed) and fast idle adjustment after the carburetor is installed. Refer to figure 1J-99 for parts identification.

NOTE: *When using an overhaul kit, use all parts included in the kit.*

NOTE: *Flooding, hesitation on acceleration, and other performance problems are in many instances caused by the presence of debris, water, or other foreign matter in the carburetor. To aid in diagnosing the problem, carefully remove the carburetor from the engine without removing the fuel from the bowl. Examine the bowl contents for contamination as the carburetor is disassembled.*

Disassembly

(1) Place carburetor on repair stand to protect throttle valves from damage and to provide stable work base. Remove stepper motor, if equipped.

(2) Remove retaining clip from accelerator pump arm link and remove link (fig. 1J-100).

(3) Remove cover and gasket from top of air horn.

(4) Remove screws and locks from accelerator pump arm and vacuum piston rod lifter. Slide pump lever out of air horn. Remove pump arm and rod lifter. Lift vacuum piston and metering rod assembly straight up and out of air horn. Remove vacuum piston spring (fig. 1J-101).

(5) Disconnect clips and remove choke rod from choke housing lever and choke lever.

(6) Remove screw and lever from choke shaft.

(7) Remove vacuum hose from carburetor main body and choke vacuum diaphragm. Remove choke diaphragm, linkage and bracket assembly. Place diaphragm aside to be cleaned separately.

(8) Remove fast idle cam retaining screw. Remove fast idle cam, choke link and clip.

(9) Grind off head of torque-head screws and remove choke cover assembly and housing from throttle body.

NOTE: *When cover is removed from housing, remove remaining portion of screws from housing by twisting counterclockwise with locking pliers.*

Stepper Motor

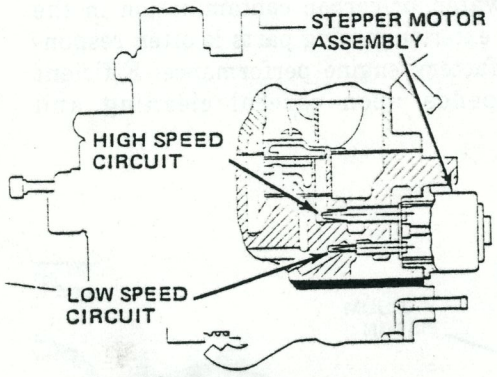
The stepper motor used with feedback carburetors has two tapered metering pins that interact with two air cavities located inside the main body of the carburetor.

The air intake for the feedback air input is located behind the main cluster inside the carburetor.

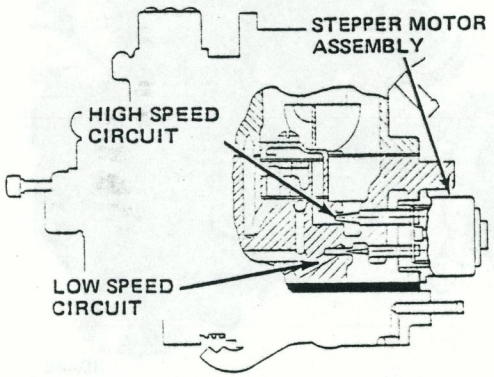
When the stepper motor "steps" to the rich "rail," each metering pin is moved the maximum distance into an air cavity.

When the stepper motors "steps" to the "lean" rail, each metering pin is pulled the maximum distance out of an air cavity.

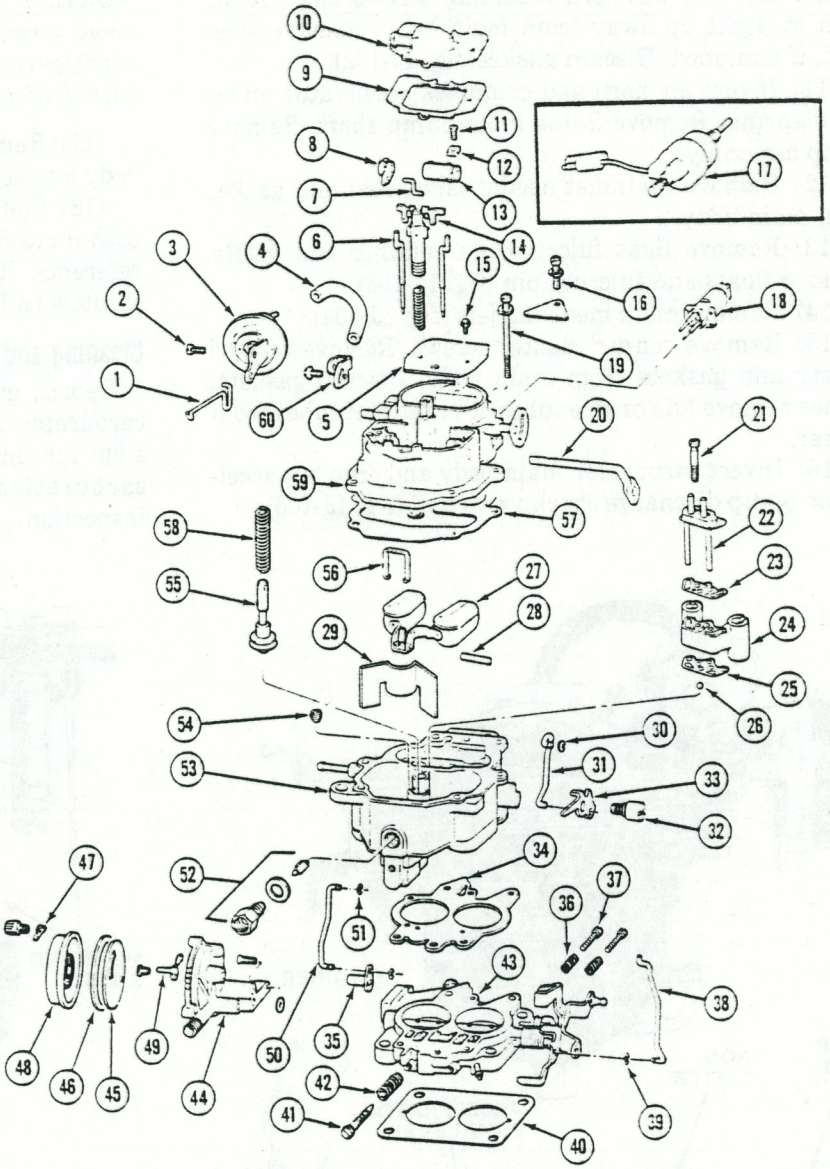
Refer to Computerized Emission Control (CEC) System for additional information.



Metering Pins in Cavities (Rich)



Metering Pins Out of Cavities (Lean)



1. DIAPHRAGM CONNECTOR LINK
2. SCREW
3. CHOKE VACUUM DIAPHRAGM
4. HOSE
5. VALVE
6. METERING ROD
7. S-LINK
8. PUMP ARM
9. GASKET
10. ROLLOVER CHECK VALVE
11. SCREW
12. LOCK
13. ROD LIFTER
14. VACUUM PISTON
15. PISTON
16. AIR HORN RETAINING SCREW (SHORT)
17. SOLENOID
18. STEPPER MOTOR (CALIF. ONLY)
19. AIR HORN RETAINING SCREW (LONG)
20. PUMP LEVER
21. VENTURI CLUSTER SCREW
22. IDLE FUEL PICK-UP TUBE
23. GASKET
24. VENTURI CLUSTER
25. GASKET
26. CHECK BALL (SMALL)
27. FLOAT
28. FULCRUM PIN
29. BAFFLE
30. CLIP
31. CHOKE LINK
32. SCREW
33. FAST IDLE CAM
34. GASKET
35. THERMOSTATIC CHOKE SHAFT
36. SPRING
37. SCREW
38. PUMP LINK
39. CLIP
40. GASKET
41. MIXTURE SCREW
42. SPRING
43. THROTTLE BODY
44. CHOKE HOUSING
45. BAFFLE
46. GASKET
47. RETAINER
48. CHOKE COIL
49. LEVER
50. CHOKE ROD
51. CLIP
52. NEEDLE AND SEAT ASSEMBLY
53. MAIN BODY
54. MAIN METERING JET
55. ACCELERATOR PUMP PLUNGER
56. FULCRUM PIN RETAINER
57. GASKET
58. SPRING
59. AIR HORN
60. LEVER

Fig. 1J-99 Parts Identification—Carter Model BBD Carburetor

(10) Remove air horn retaining screws and lift air horn straight up away from main body. Remove solenoid, if equipped. Discard gasket (fig. 1J-102).

(11) Invert air horn and compress accelerator pump drive spring. Remove S-link from pump shaft. Remove pump assembly.

(12) Remove fuel inlet needle valve, seat and gasket from main body.

(13) Remove float fulcrum pin retainer and baffle. Remove floats and fulcrum pin (fig. 1J-103).

(14) Remove main metering jets (fig. 1J-104).

(15) Remove venturi cluster screws. Remove venturi cluster and gaskets from main body. Discard gaskets. Do not remove idle orifice tubes or main vent tubes from cluster.

(16) Invert carburetor main body and drop out accelerator pump discharge check valve ball (fig. 1J-105).

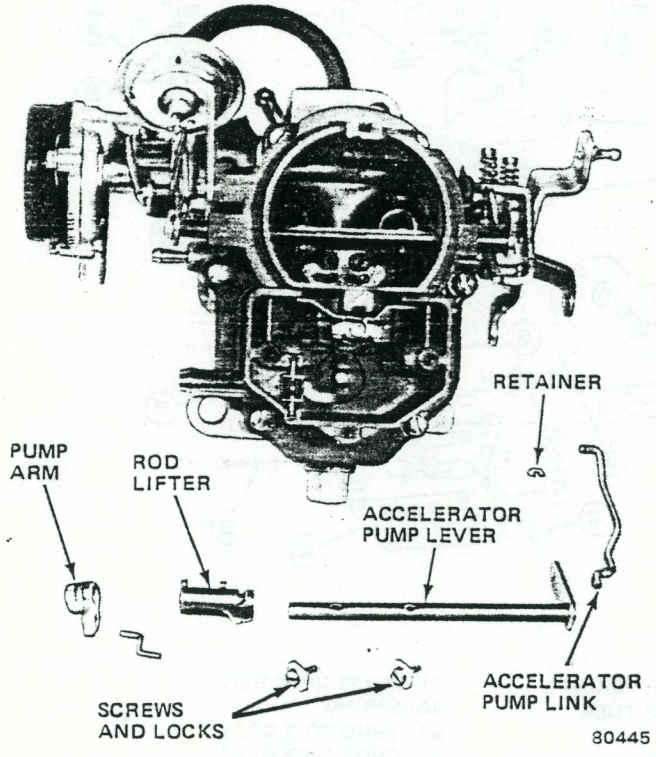


Fig. 1J-100 Accelerator Pump and Lever

The cleaning and inspection procedure listed below does not include those parts contained in the carburetor overhaul repair kit. Install all gaskets and parts included in the repair kit when the carburetor is assembled. Discard original gaskets and replaced parts.

CAUTION: *Do not use a wire brush to clean any part. Do not use a drill or wire to clean openings or passages. This may enlarge the passages and alter the calibration of the carburetor.*

NOTE: *If it is necessary to remove idle mixture adjustment screws because air pressure or soaking did not sufficiently clean the air passages, remove dowel pins with drill and punch.*

(17) Remove screws attaching throttle body to main body and separate bodies. Discard gasket.

(18) Count number of turns required to lightly seat each mixture adjustment screw and record for assembly reference. Remove idle mixture screws and springs from throttle body.

Cleaning and Inspection

Debris, gum, water, or carbon contamination in the carburetor or on exterior moving parts is often responsible for unsatisfactory engine performance. Efficient carburetion depends upon careful cleaning and inspection.

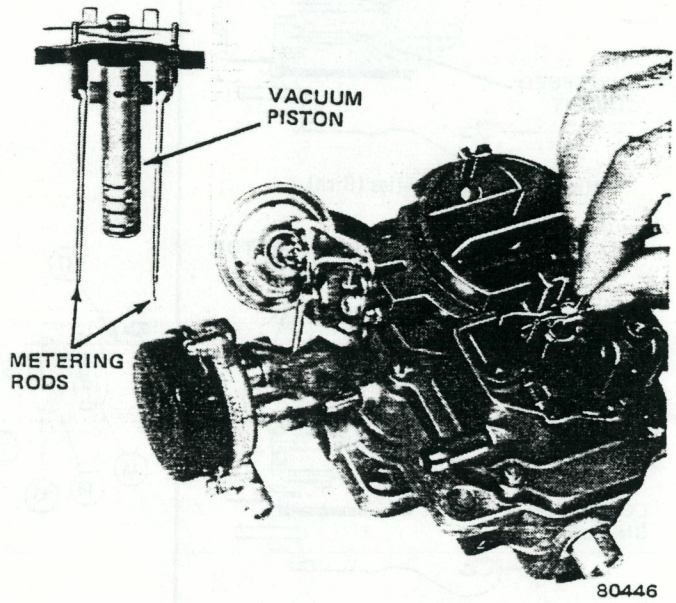


Fig. 1J-101 Removing Piston and Metering Rods

Wash all parts, except vacuum diaphragm, in clean commercial carburetor cleaning solvent. If a commercial solvent is not available, use mineral spirits, lacquer thinner or denatured alcohol.

(5) Clean passages and ball seat if leakage is evident. If leakage persists, replace main body.

(6) Install replacement gaskets on venturi cluster, install cluster screws and tighten securely.

(7) Install main metering jets.

(8) Install float assembly with fulcrum pin and pin retainer in main body. Install needle, seat and gasket and tighten securely. Adjust float level. Refer to Service Adjustment Procedures. Install baffle plate.

(9) Place accelerator pump drive spring on pump plunger shaft and insert shaft into air horn. Compress spring and insert S-link.

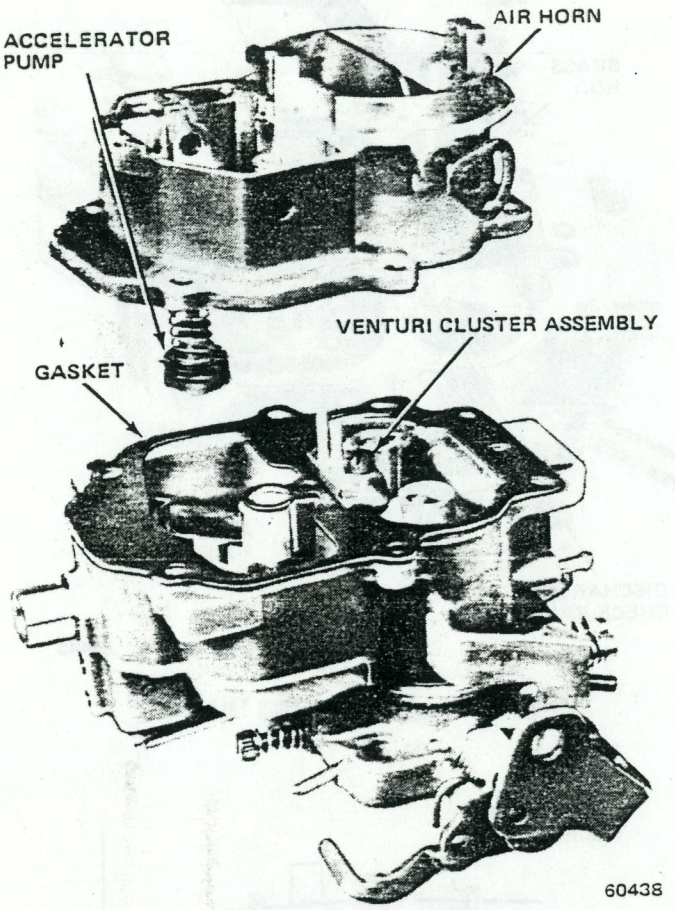


Fig. 1J-102 Removing Air Horn

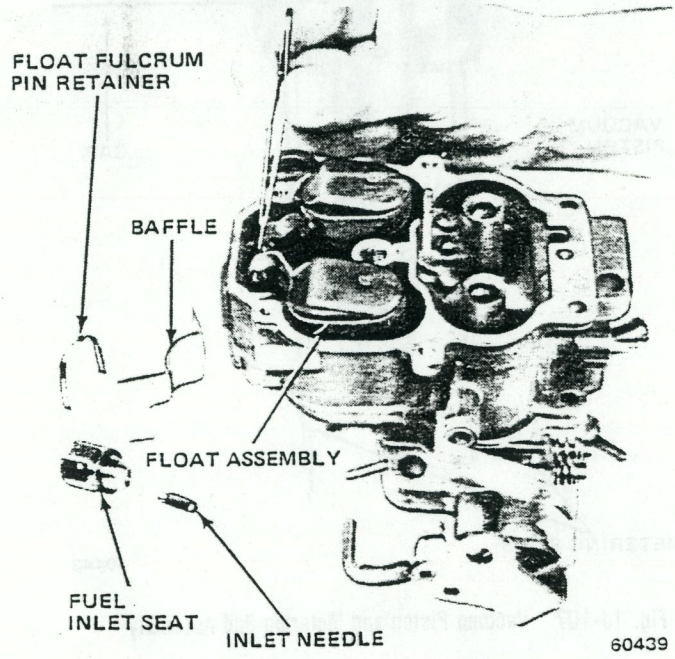


Fig. 1J-103 Float Assembly

If commercial solvent is used, rinse the cleaned parts in hot water to remove all traces of solvent, then blow dry with compressed air. Wipe the parts that cannot be

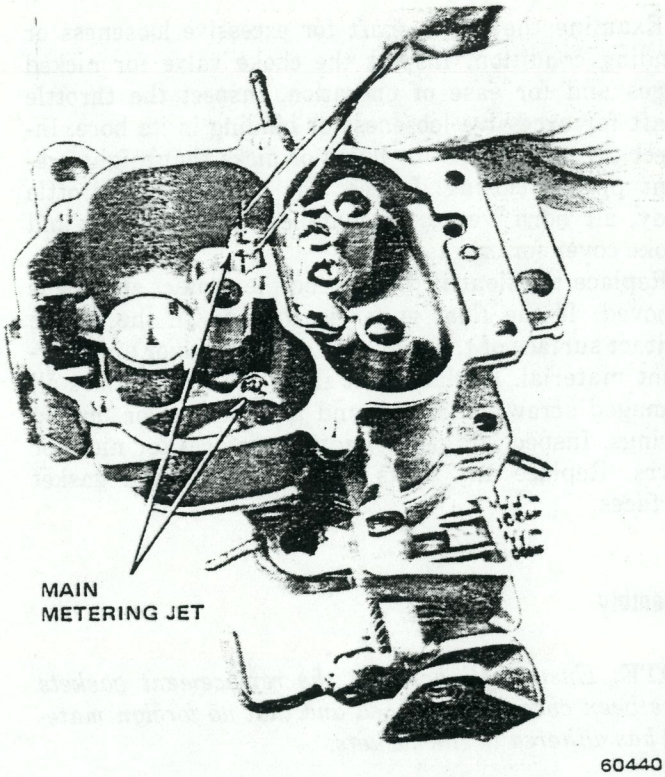


Fig. 1J-104 Main Metering Jets

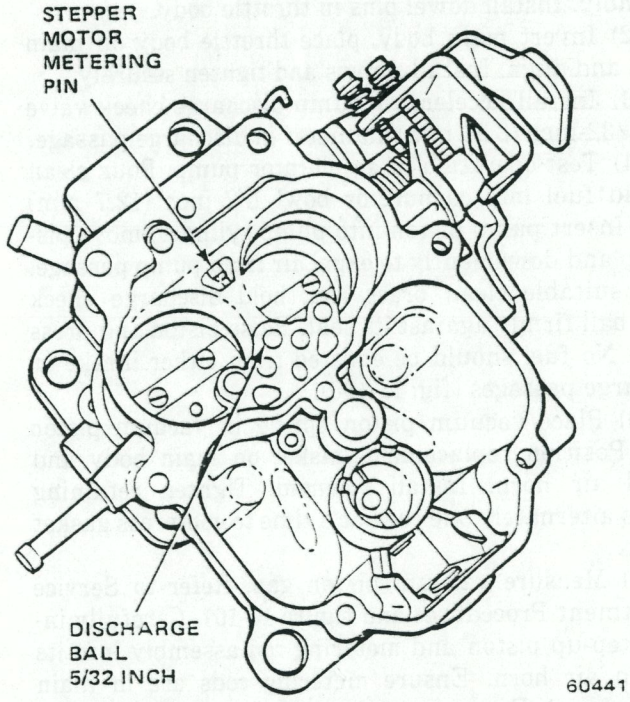


Fig. 1J-105 Check Valve Ball Location

immersed in solvent with a clean, soft, dry cloth. Ensure all residue, gum, carbon and other foreign matter are removed from all parts.

Force compressed air through all passages of the carburetor.

Examine the choke shaft for excessive looseness or binding condition. Inspect the choke valve for nicked edges and for ease of operation. Inspect the throttle shaft for excessive looseness or binding in its bore. Inspect throttle valves for burrs or nicks that might prevent proper closing. Inspect the main body, throttle body, air horn, venturi assemblies, choke housing and choke cover for cracks.

Replace the float if the arm needle contact surface is grooved. If the float is serviceable, polish the needle contact surface of the arm with crocus cloth or an equivalent material. Replace float shaft if worn. Replace all damaged screws and nuts and all distorted or broken springs. Inspect all gasket mating surfaces for nicks or burrs. Replace any parts that have damaged gasket surfaces.

Assembly

NOTE: *Ensure all holes in the replacement gaskets have been correctly punched and that no foreign material has adhered to the gaskets.*

(1) If removed, install idle mixture screws and springs in body. Turn screws lightly against their seats, then back off number of turns recorded during disassembly. Install dowel pins in throttle body.

(2) Invert main body, place throttle body on main body, and align. Install screws and tighten securely.

(3) Install accelerator pump discharge check valve ball 5/32-inch (3.96 mm) diameter in discharge passage.

(4) Test operation of accelerator pump. Pour clean no-lead fuel into carburetor bowl 1/2 inch (12.7 mm) deep. Insert pump piston into pump cylinder, move piston up and down gently to expel air from pump passage. With suitable clean brass rod, hold discharge check valve ball firmly against its seat. Raise piston and press down. No fuel should be emitted from either intake or discharge passages (fig. 1J-106).

(10) Place vacuum piston spring in vacuum piston bore. Position replacement gasket on main body and install air horn. Install solenoid. Tighten retaining screws alternately one turn at a time to compress gasket evenly.

(11) Measure vacuum piston gap. Refer to Service Adjustment Procedures and figure 1J-107. Carefully install step-up piston and metering rod assembly into its bore in air horn. Ensure metering rods are in main metering jets. Ensure metering rod springs are installed properly (fig. 1J-107).

(12) Position two lifting tangs of plastic rod lifter under piston yoke. Slide shaft of accelerator pump lever through rod lifter and pump arm. Install locks and adjusting screws, but do not tighten.

(13) Install fast idle cam and linkage. Tighten retaining screw securely.

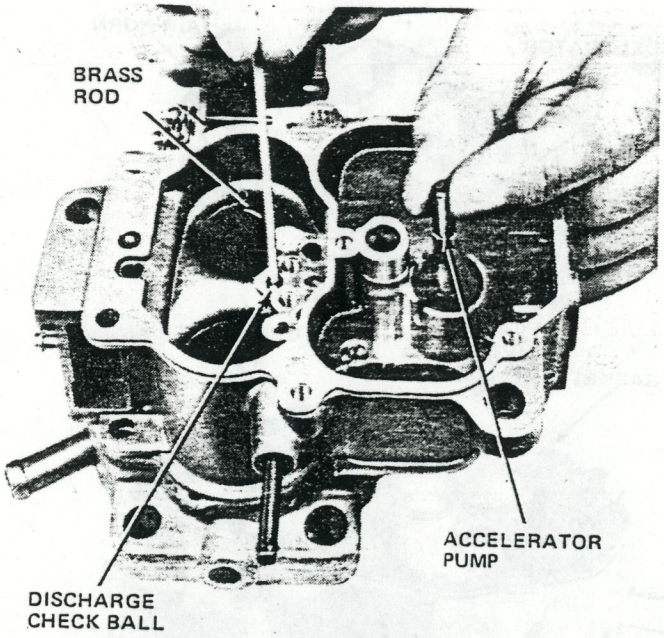


Fig. 1J-106 Accelerator Pump Test

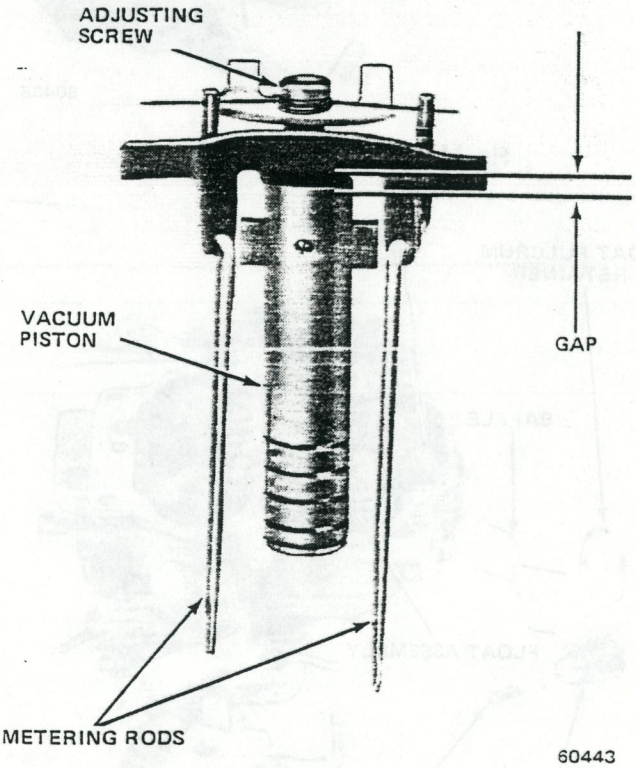


Fig. 1J-107 Vacuum Piston and Metering Rod Assembly

(14) Connect accelerator pump linkage to pump lever and throttle lever. Install retaining clip.

(15) Adjust vacuum piston and accelerator pump. Refer to Service Adjustment Procedures.

(16) Install dust cover, using replacement gasket.

(17) Install diaphragm assembly and secure with attaching screws. Do not connect vacuum hose to diaphragm fitting until initial choke valve clearance has been adjusted. Refer to Service Adjustment Procedures.

(18) Engage diaphragm link with slot in choke lever. Install choke lever and screw on choke shaft.

(19) Install choke housing on throttle body.

(20) Install baffle, gasket and cover on housing. Turn cover 1/4 turn rich (clockwise) and retain in position with one straight-slot screw.

(21) Install link and retainer between choke lever and choke housing lever.

(22) Connect link and retainer to fast idle cam and choke lever.

(23) Adjust initial choke valve clearance. Refer to Service Adjustment Procedures.

(24) Adjust fast idle cam clearance. Refer to Service Adjustment Procedures.

(25) Adjust choke unloader clearance. Refer to Service Adjustment Procedures.

(26) Remove straight-slot screw that is retaining choke cover and adjust cover index to specified notch (refer to Specifications).

(27) Install replacement torque-head (break off) screws to retain cover.

NOTE: *Heads of screws will break off when tightened beyond the calibrated torque.*

(28) Install stepper motor (if equipped) with replacement gasket.

SERVICE ADJUSTMENT PROCEDURES

Float Level Adjustment

(1) Remove air horn.

(2) Raise float **gently** against needle and hold (fig. 1J-108).

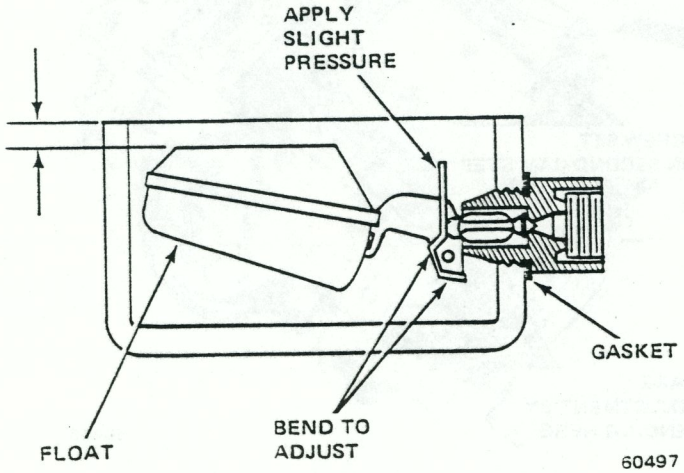


Fig. 1J-108 Float Level Adjustment

(3) Place straightedge across float bowl to measure float level. Refer to Specifications.

CAUTION: *Never bend float lever while it is resting against needle. Pressure may damage synthetic tip and cause a misadjustment.*

(4) If adjustment is necessary, release float and bend float lever.

(5) Install air horn.

Vacuum Piston Gap Adjustment

The vacuum piston gap is a critical adjustment (fig. 1J-109). Turning the adjusting screw clockwise richens the air/fuel mixture. Turning the adjusting screw counterclockwise leans the air/fuel mixture. Turn adjusting screw to adjust gap. Refer to Specifications.

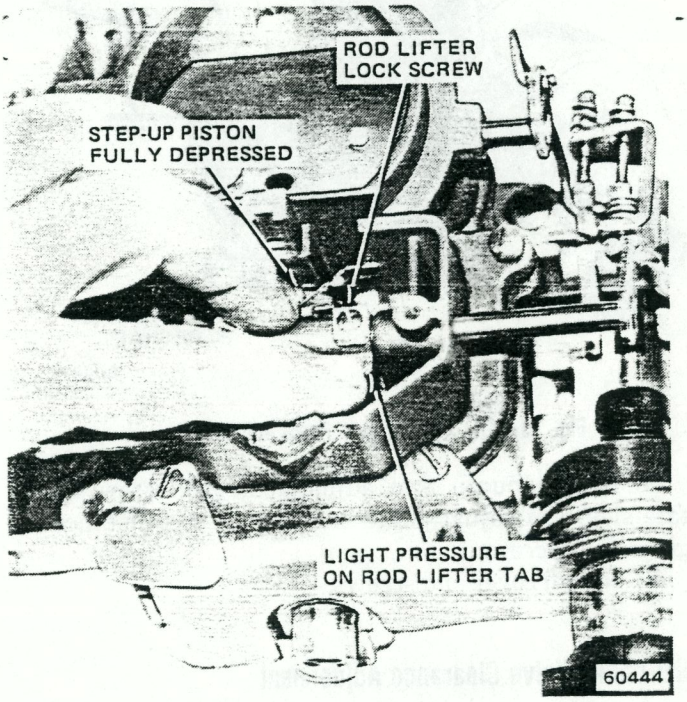


Fig. 1J-109 Vacuum Piston Adjustment

Vacuum Piston Adjustment

(1) Adjust gap in vacuum piston to specification.

(2) Back off idle speed adjustment screw until throttle valves are completely closed. Count number of turns and note so that screw can be returned to original position. Turn idle speed adjustment screw until it barely contacts stop, then turn one full turn further.

(3) Fully depress vacuum piston while holding moderate pressure on rod lifter tab. While in this position, tighten rod lifter lock screw (fig. 1J-109).

(4) Release piston and rod lifter.

(5) Adjust accelerator pump as outlined below.

(6) Return idle speed adjustment screw to its original position.

(7) Install dust cover.

Accelerator Pump Adjustment

(1) Remove dust cover.

(2) Back off idle speed adjustment screw to completely close throttle valves. Open choke valve so that fast idle cam allows throttle valves to seat in bores.

(3) Turn idle speed adjustment screw in until it barely contacts stop. Then continue two complete turns.

(4) Measure distance between surface of air horn and top of accelerator pump shaft (fig. 1J-110). Refer to Specifications for correct dimension.

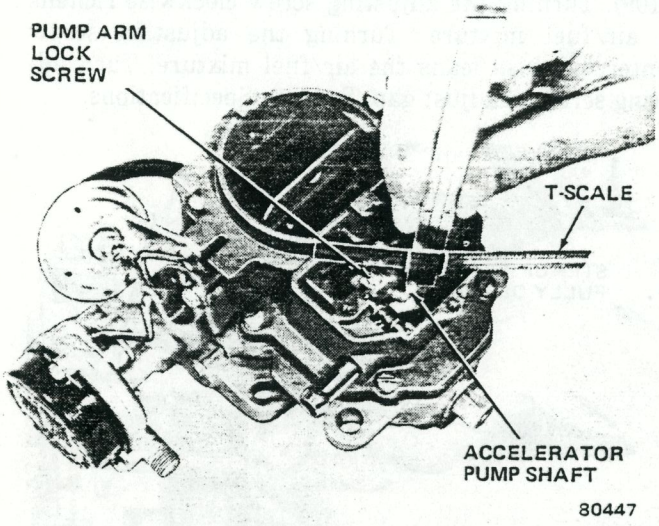


Fig. 1J-110 Accelerator Pump Adjustment

(5) Loosen pump arm adjustment lock screw and rotate sleeve to adjust pump travel to correct distance. Tighten lock screw.

(6) Install cover and screws.

Initial Choke Valve Clearance Adjustment

NOTE: *The choke should not normally require readjustment from the original factory assembly adjustment except after a major overhaul.*

(1) Grind off torque-head screw heads and remove remaining portions of screws by turning counterclockwise with locking pliers. Turn choke cover 1/4 turn rich. Retain in position with one straight-slot screw.

(2) Open throttle valve slightly to place fast idle screw on high step of cam.

(3) Use Tool J-23738 or any vacuum source that holds at least 19 inches of mercury (19 in. Hg/64 kPa) to pull in diaphragm against stop.

(4) Measure clearance between choke plate and air horn wall. Refer to Specifications.

(5) Adjust clearance by bending diaphragm connector link (fig. 1J-111).

(6) Remove straight-slot screw and adjust cover index to specified notch. Install replacement torque-head (break off) screws.

NOTE: *Head of screws will break off when tightened beyond the calibrated torque.*

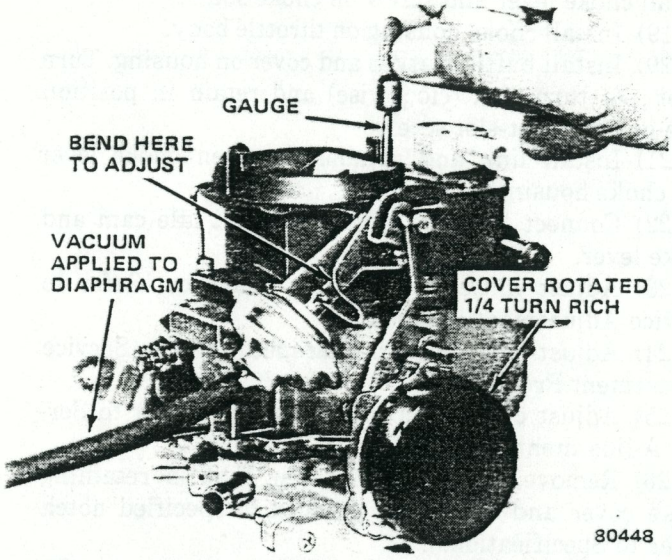


Fig. 1J-111 Initial Choke Valve Clearance

Fast Idle Cam Position Adjustment

(1) Remove torque-head screws and position choke cover 1/4 turn rich. Retain with one straight-slot screw.

(2) Open throttle slightly and place fast idle screw on second step of cam.

(3) Measure distance between choke plate and air horn wall (fig. 1J-112). Refer to Specifications for correct dimension.

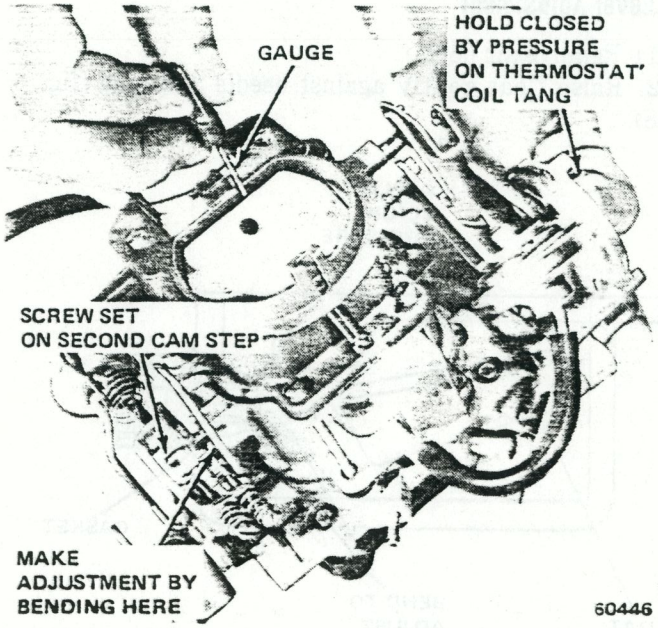


Fig. 1J-112 Fast Idle Cam Adjustment

(4) Adjust by bending fast idle cam link down to increase distance or up to decrease distance.

(5) Remove choke cover screw and adjust index to specified notch. Install replacement torque-head screws.

Choke Unloader Adjustment

(1) Hold throttle wide open (fig. 1J-113).

(2) Apply light pressure to choke plate and hold in closed position.

(3) Measure distance between choke plate and air horn wall. Refer to Specifications.

(4) Adjust by bending unloader tang. Do not bend tang so that it binds or interferes with any other part.

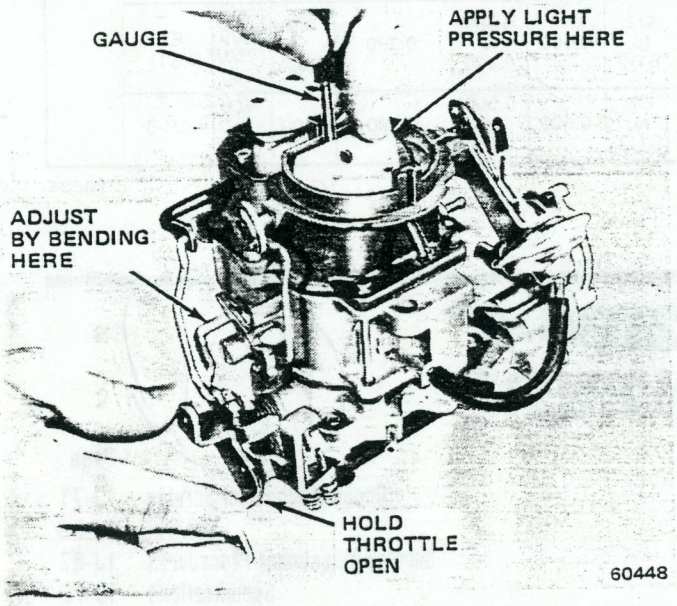


Fig. 1J-113 Choke Unloader Adjustment

Automatic Choke Adjustment (On or Off Vehicle)

The automatic choke adjustment is made by loosening the housing cover retaining screws and rotating cover in the required direction. Rich and lean are indicated by the arrow on the face of the cover. Refer to Specifications for the correct position. The specified position will be satisfactory for most driving conditions.

Idle Speed and Mixture Adjustment

Refer to idle speed adjustment procedure outlined in Chapter 1A—General Service and Diagnosis.

Idle Mixture Adjustment

(1) Install carburetor, fuel pipe, vacuum hoses, etc.

(2) Connect tachometer, start engine and warm to operating temperature.

(3) Position gear selector: manual—Neutral, automatic—Drive. Set parking brake firmly.

(4) Adjust idle speed.

(5) Adjust mixture screw(s) leaner (clockwise) until perceptible loss of rpm is noted.

(6) Turn mixture screw(s) richer (counterclockwise) until highest rpm indication is obtained. Do not turn screw(s) any further than point at which highest rpm is first obtained. This is referred to as lean best idle.

NOTE: *Engine speed will increase above curb idle speed an amount that corresponds approximately to the lean drop specification to be obtained in step (7).*

(7) As final adjustment, turn mixture screws clockwise (leaner) to obtain 50 rpm drop in engine speed. Turn both idle mixture screws in small, equal amounts until specified drop is achieved.

NOTE: *If the final rpm differs more than ± 30 rpm from the original curb idle rpm, adjust curb idle speed to specification and repeat steps (6) and (7) above.*

(8) Install dowel pins after performing idle mixture adjustment. Use care to prevent disturbing mixture adjustments.

Fast Idle Speed Adjustment

Adjust the fast idle speed with the engine at normal operating temperature and with the EGR valve disconnected. Position fast idle adjustment screw in contact with the second step and against the shoulder of the top step of fast idle cam. Refer to Specifications for the correct rpm. Adjust by turning the fast idle adjustment screw.

SPECIFICATIONS

Model BBD Carburetor Calibrations (Inches)

	8302	8303	8311	8312	8306	8307
Throttle Bore Size	1.44	1.44	1.44	1.44	1.44	1.44
Main Venturi Size	1.0625	1.0625	1.19	1.19	1.0625	1.0625
Fuel Inlet Diameter	0.101	0.101	0.101	0.101	0.101	0.101
Low Speed Jet (Tube)	0.0295	0.0295	0.0295	0.0295	0.0295	0.0295
Economizer	0.059	0.059	0.055	0.055	0.059	0.059
Idle Air Bleed	0.070	0.070	0.067	0.063	0.070	0.070
Main Jet Size	0.092	0.092	0.089	0.089	0.092	0.092
Accelerator Pump Jet	0.033	0.033	0.033	0.033	0.033	0.033
Main Metering Jet Number	120-392	120-392	120-389	120-386	120-392	120-392

80608

Model BBD Carburetor Service Specifications

List Number	Application	Float Level (Inches)		Vacuum Piston Gap (Inches)		Initial Choke Valve Clearance (Inches)		Fast Idle Cam Setting (Inches)		Automatic Choke Cover Setting (Notches Rich)		Accelerator Pump Dimensions (Inches)		Choke Unloader (Inches)	Fast Idle Speed ①		Choke Bimetal ID	Choke
		Set To	OK Range	Set To	OK Range	Set To	OK Range	Set To	OK Range	Set To	OK Range	Set To	OK Range		Set To	OK Range		
8302	258 (Auto) CJ-7 & 8 475, Cal. Alt	0.25	0.218 to 0.282	0.035	0.020 to 0.050	0.140	0.125 to 0.155	0.095	0.030 to 0.110	1 NR	1/2 to 1-1/2	0.520	0.500 to 0.540	0.280	1850	1750 to 1950	ER 3	TR
8303	258 (Man.) CJ-5, 7, 8 California	0.25	0.218 to 0.282	0.035	0.020 to 0.050	0.140	0.125 to 0.155	0.095	0.080 to 0.110	1 NR	1/2 to 1-1/2	0.520	0.500 to 0.540	0.280	1700	1600 to 1800	ER 3	
8311	258 (Man.) CJ-5, 7, 8 Altitude	0.25	0.218 to 0.282	0.035	0.020 to 0.050	0.120	0.105 to 0.135	0.085	0.070 to 0.100	1 NR	1/2 to 1-1/2	0.520	0.500 to 0.540	0.280	1700	1600 to 1800	ER 3	
8306	258 (Man.) Cke,Wag,J-10 California	0.25	0.218 to 0.282	0.035	0.020 to 0.050	0.140	0.125 to 0.155	0.095	0.080 to 0.110	1 NR	1/2 to 1-1/2	0.520	0.500 to 0.540	0.280	1700	1600 to 1800	ER 3	
8312	258 MOT Manual Automatic 49 State	0.25	0.218 to 0.282	0.035	0.020 to 0.050	0.140	0.125 to 0.155	0.095	0.080 to 0.110	1 NR	1/2 to 1-1/2	0.500	0.480 to 0.520	0.280	1700M 1850A	1600/1800 1750/1950	EU (B1)	
8307	258 MOT Manual California	0.25	0.218 to 0.282	0.035	0.020 to 0.050	0.140	0.125 to 0.155	0.095	0.080 to 0.110	1 NR	1/2 to 1-1/2	0.520	0.500 to 0.540	0.280	1700	1600 to 1800	ER 3	

①Hot with EGR disconnected.
TR – Tamper Resistant
MOT – Medium Duty Truck

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CARBURETOR MODEL 2150-2 VENTURI

1981

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GENERAL

The Motorcraft Model 2150 carburetor is a two-venturi carburetor that incorporates two lightweight aluminum assemblies, the air horn and the main body.

The air horn assembly serves as the main body cover and also contains the choke assembly and fuel bowl vents.

The throttle shaft assembly and all components of the fuel metering circuits are contained in the main body assembly. The automatic choke assembly and the solenoid are attached to the main body (fig. 1J-114).

Identification

Each carburetor is identified by a code number and build date that is stamped on an identification tag. Each carburetor build month is coded alphabetically beginning with the letter A for January and ending with the letter M for December (the letter I is not used). The tag is attached to the carburetor and must remain with it to assure proper identification (fig. 1J-115).

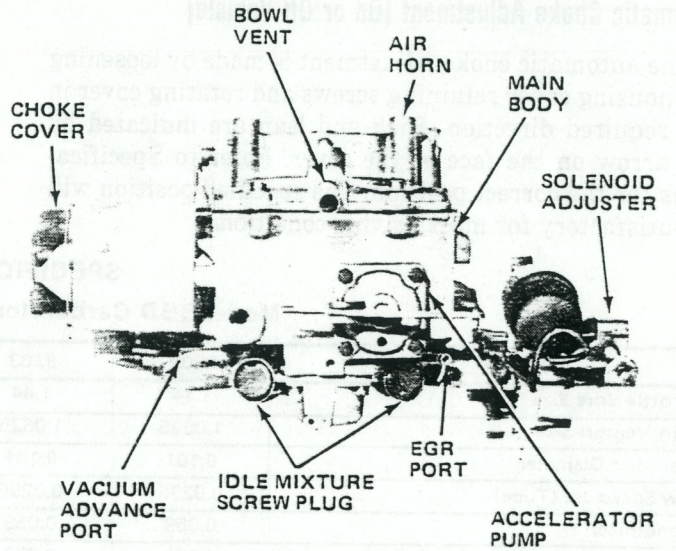

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Fig. 1J-114 Model 2150 Carburetor Assembly

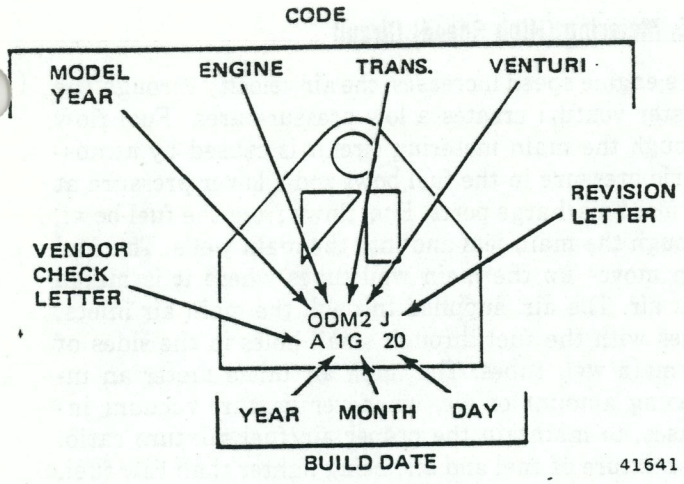

Fig. 1J-115 Identification Tag

CARBURETOR CIRCUITS

The Model 2150 carburetor utilizes five conventional circuits: Float (Fuel Inlet), Idle Metering (Low Speed), Main Metering (High Speed), Pump, and Choke.

Float (Fuel Inlet) Circuit

Pressurized fuel enters the fuel bowl through the fuel inlet fitting in the main body. The Viton-tipped fuel inlet needle is controlled by the float and lever assembly, which is hinged on the float shaft. A wire retainer is hooked over grooves on opposite ends of the float shaft and into a groove behind the fuel inlet needle seat. The retainer holds the float shaft firmly in the fuel bowl guides and also centers the float assembly in the fuel bowl. An integral retaining clip is hooked over the end of the float lever and attached to the fuel inlet needle. This assures reaction of the fuel inlet needle during downward movement of the float (fig. 1J-116).

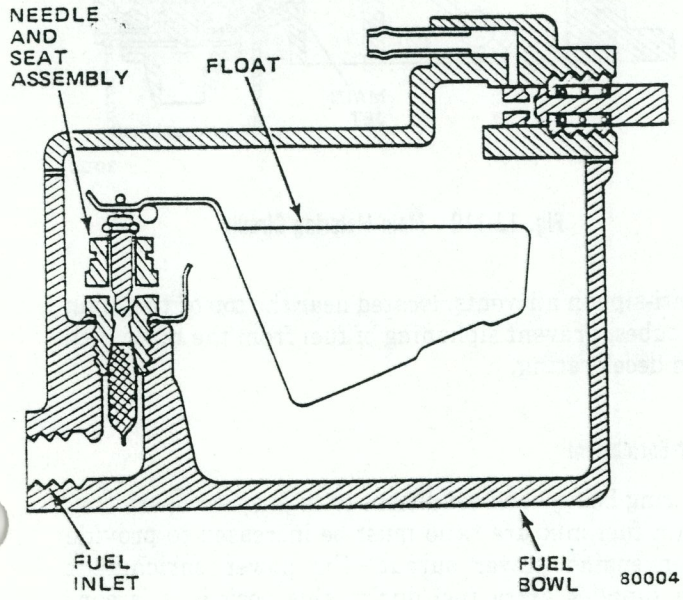

Fig. 1J-116 Float Circuit

The float circuit maintains the correct fuel level in the bowl. This enables the fuel metering circuits to deliver the proper air/fuel mixture to the combustion chambers. The amount of fuel entering the bowl is regulated by the distance the fuel inlet needle is raised off its seat. The float drops as the fuel level drops and allows the fuel inlet needle to move off its seat. This permits additional fuel to enter the bowl. When the fuel reaches the preset level, the fuel inlet needle is lowered and admits only enough fuel to replace that being used.

Bowl Vent

Two bowl vents are required. The internal vent is used to balance air pressure in the fuel bowl when the engine is operating. The external vent provides a method of controlling fuel vapor in the bowl when the engine is not operating.

The external fuel bowl vent permits vapor to move from the carburetor to the fuel vapor storage canister. A bell crank attached to the accelerator pump housing actuates the bowl vent (fig. 1J-117). At idle or solenoid Off position (if equipped), the vent opens, permitting vapor to pass. At any throttle position above idle, the vent is mechanically closed.

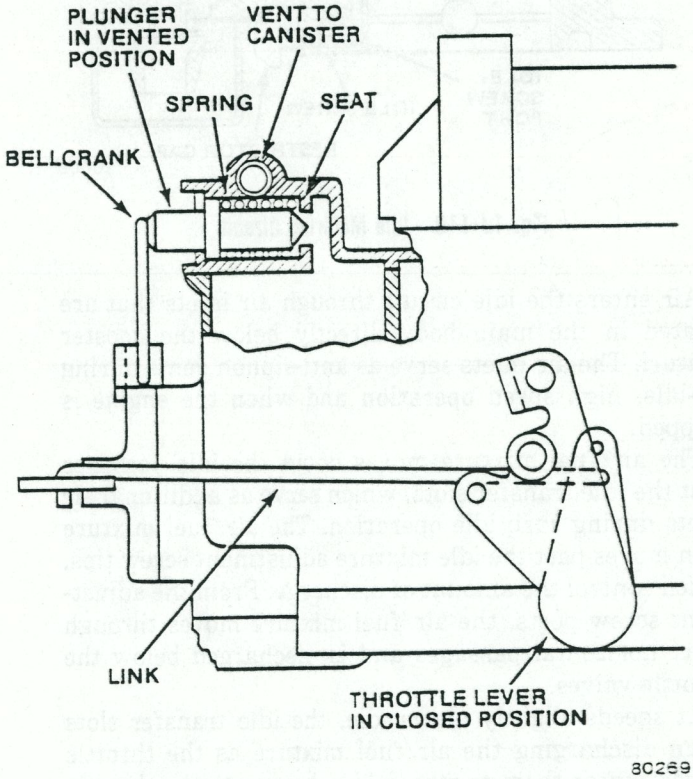

Fig. 1J-117 External Bowl Vent

Idle Metering (Low Speed) Circuit

Fuel for idle and low speed operation flows from the fuel bowl through the main jets into the main wells. From the main wells, the fuel is metered as it passes

through calibrated restrictions at the lower end of the idle tubes. After flowing through the idle tubes, the fuel enters diagonal passages above the tubes. The fuel is metered again as it flows downward through restrictions at the lower end of the diagonal passages and then enters the idle passages in the main body (fig. 1J-118).

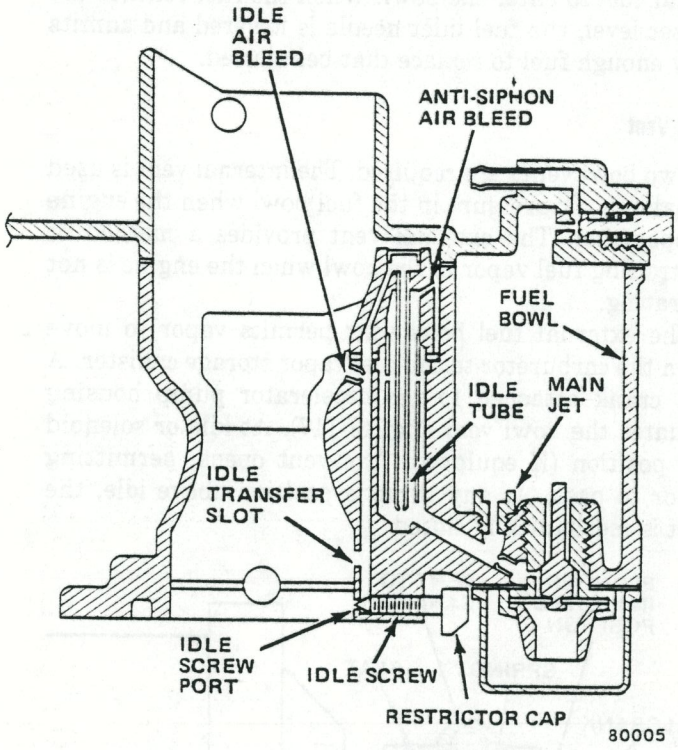

Fig. 1J-118 Idle Metering Circuit

Air enters the idle circuit through air inlets that are located in the main body directly below the booster venturi. The air inlets serve as anti-siphon vents during off-idle, high speed operation and when the engine is stopped.

The air/fuel mixture moves down the idle passages past the idle transfer slots, which serve as additional air inlets during curb idle operation. The air/fuel mixture then moves past the idle mixture adjustment screw tips, which control the amount of discharge. From the adjustment screw ports, the air/fuel mixture moves through short horizontal passages and is discharged below the throttle valves.

At speeds slightly above idle, the idle transfer slots begin discharging the air/fuel mixture as the throttle valves expose them to manifold vacuum. As the throttle valves continue opening and engine speed increases, the airflow through the carburetor increases proportionately. This increased airflow creates a vacuum in the venturi and the main metering circuit begins discharging the air/fuel mixture. The discharge from the idle circuit tapers off as the main metering circuit begins discharging.

Main Metering (High Speed) Circuit

As engine speed increases, the air velocity through the booster venturi creates a low pressure area. Fuel flow through the main metering circuit is caused by atmospheric pressure in the fuel bowl and a lower pressure at the main discharge ports. Fuel flows from the fuel bowl, through the main jets and into the main wells. The fuel then moves up the main well tubes where it is mixed with air. The air, supplied through the main air inlets, mixes with the fuel through small holes in the sides of the main well tubes. The main air inlets meter an increasing amount of air, whenever venturi vacuum increases, to maintain the proper air/fuel mixture ratio. The mixture of fuel and air, being lighter than raw fuel, responds quickly to changes in venturi vacuum. It also atomizes more readily than raw fuel.

The air/fuel mixture moves from the main well tubes to the discharge ports and is discharged into the booster venturi (fig. 1J-119).

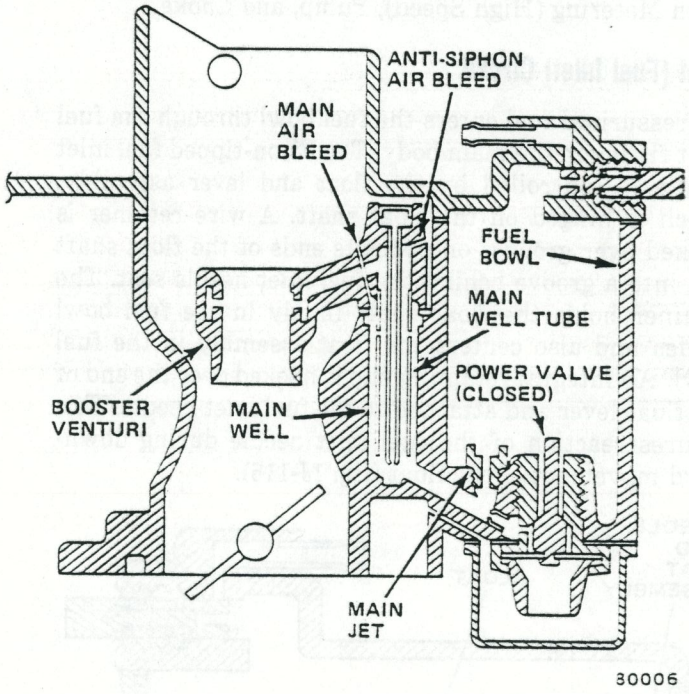

Fig. 1J-119 Main Metering Circuit

Anti-siphon air vents, located near the top of the main well tubes, prevent siphoning of fuel from the main well when decelerating.

Power Enrichment

During heavy load conditions or high speed operation, the air/fuel mixture ratio must be increased to provide higher engine power output. The power enrichment valve supplies extra fuel during this period. It is controlled by intake manifold vacuum (fig. 1J-120).

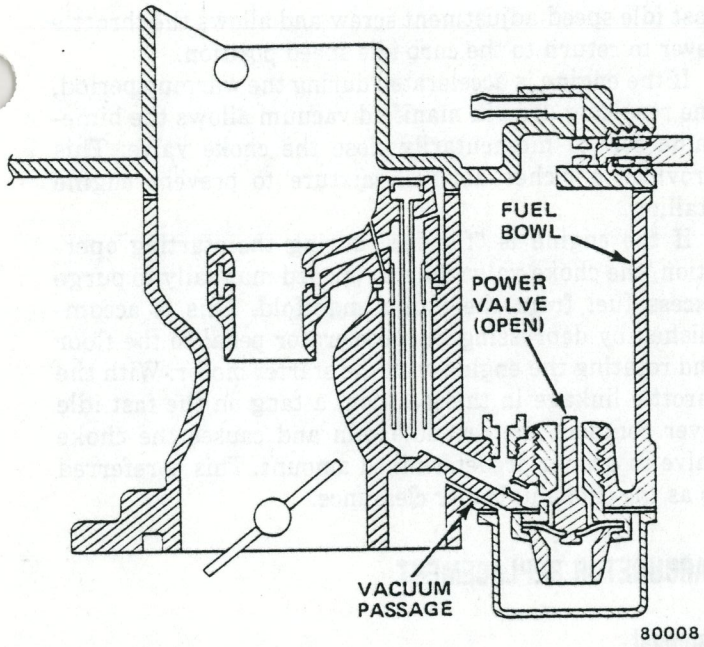

Fig. 1J-120 Power Enrichment Valve

Manifold vacuum is applied to the power valve diaphragm from an opening in the base of the main body, through a passage in the main body and power valve chamber to the power valve diaphragm. During engine idle and cruise speed conditions, manifold vacuum is high enough to overcome the power valve spring tension and holds the valve closed. When higher engine power output is required, the increased load on the engine results in decreased manifold vacuum. The power valve spring opens the first stage of the power valve when manifold vacuum drops below a predetermined value and a small amount of fuel flows through the valve. When manifold vacuum drops to a lower value, the power valve spring opens the second stage of the power valve and allows a greater amount of fuel to flow through the valve. The fuel that flows through the power valve is added to the fuel in the main metering circuit to enrich the mixture. As engine load requirements decrease, manifold vacuum increases and overcomes the tension of the power valve spring, closing the power valve.

Pump Circuit

When the throttle valves are opened quickly, the airflow through the carburetor responds almost immediately. Because fuel is heavier than air, there is a brief lag in time before the fuel flow can gain sufficient velocity to maintain the proper air/fuel mixture ratio. During this lag, the pump circuit supplies the required fuel until the proper air/fuel mixture ratio can be maintained by the other metering circuits (fig. 1J-121).

The pump is charged when the throttle valves are closed. The diaphragm return spring exerts force against the diaphragm and pushes it against the cover.

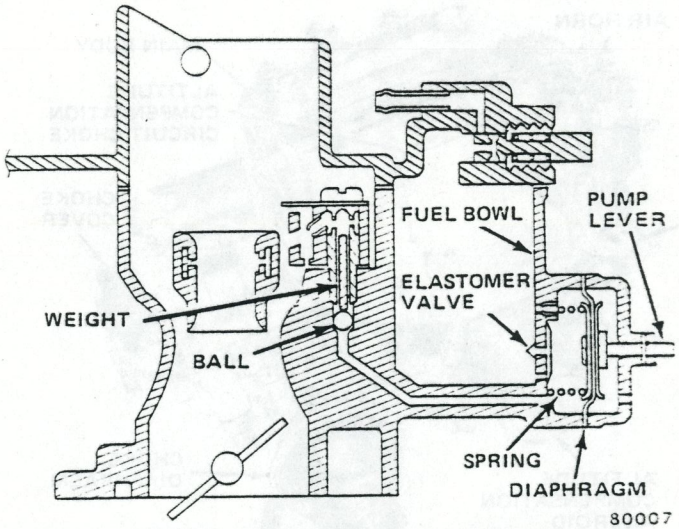

Fig. 1J-121 Pump Circuit

Fuel is drawn through the inlet, past the elastomer valve, and into the pump chamber. A discharge check ball and weight prevents air from being drawn into the pump chamber.

When the throttle valves are opened, the diaphragm rod is pushed inward forcing fuel from the pump chamber into the discharge passages. The elastomer valve seals the inlet hole during pump discharge preventing fuel from returning to the fuel bowl. Fuel under pressure unseats the discharge check ball and weight and is forced through the pump discharge screw. The fuel is then sprayed into the main venturi through discharge ports.

A vent is provided in the pump chamber to prevent vapor accumulation and pressure buildup.

Choke Circuit

The choke valve, located in the air horn assembly, provides a high vacuum above as well as below the throttle valves when closed. During cranking, vacuum above the throttle valves causes fuel to flow from the main and idle metering circuits. This provides the richer air/fuel mixture required for cold engine starting.

The choke shaft is connected by linkage to a bimetallic coil that winds up (contracts) when cold and unwinds (expands) when warm.

The position of the choke valve is controlled by the action of a vacuum modulator that exerts force against the tension of the bimetallic coil (fig. 1J-122).

When the engine is cold, tension of the bimetallic coil holds the choke valve closed. When the engine is started, manifold vacuum is channeled through an opening at the base of the carburetor through a passage on the bottom side of the modulator diaphragm assembly, to move the diaphragm downward against the setscrew. At the same time, the modulator arm contacts a tang on the choke shaft. The downward movement of the diaphragm assembly compresses the piston spring and exerts a

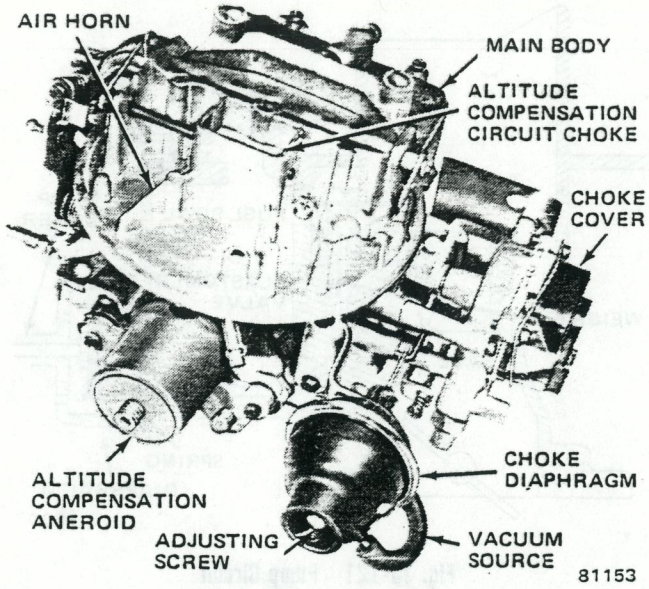

Fig. 1J-122 Choke Circuit

pulling force on the modulator arm, causing the choke valve to open slightly. This opening is referred to as initial choke valve clearance.

The bimetallic coil is warmed by electric heater element and, as the engine begins to warm up, heated air routed from the exhaust crossover through a heat tube to the choke housing. A thermostatically controlled bypass valve, which is an integral part of the choke heat tube, helps prevent premature choke valve opening during the early part of the engine warmup period. The valve regulates the temperature of the hot airflow to the choke housing by allowing outside unheated air to enter the heat tube. A thermostatic disc is incorporated in the valve. It is calibrated to close the valve at 75°F (24°C) and open it at 55°F (13°C).

The electric heater element and heated air entering the choke housing cause the bimetallic coil to begin unwinding and decrease the closing tension exerted against the choke valve. The coil gradually loses its tension and allows the choke valve to open.

When the engine reaches normal operating temperature, the bimetallic coil continues unwinding and exerts pressure against the choke linkage, forcing the choke valve fully open. A continual flow of heated air passes through the choke housing and is exhausted into the intake manifold. The bimetallic coil remains heated and the choke valve remains fully open until the engine is stopped and allowed to cool.

Air flowing through the choke housing must be filtered to minimize contamination of the choke coil and associated parts. The filtered air is supplied through a tube that originates inside the air cleaner.

A fast speed idle is required to prevent engine stalling during the warmup period. The fast idle cam, actuated by the choke rod, contacts the fast idle speed adjustment screw and increases engine speed in proportion to the choke valve opening. When the choke valve reaches the fully open position, the fast idle cam rotates free of the fast idle speed adjustment screw and allows the throttle lever to return to the curb idle speed position.

If the engine is accelerated during the warmup period, the resulting drop in manifold vacuum allows the bimetallic coil to momentarily close the choke valve. This provides a richer air/fuel mixture to prevent engine stalling.

If the engine is "flooded" during the starting operation, the choke valve may be opened manually to purge excess fuel from the intake manifold. This is accomplished by depressing the accelerator pedal to the floor and rotating the engine with the starter motor. With the throttle linkage in this position, a tang on the fast idle lever contacts the fast idle cam and causes the choke valve to open a predetermined amount. This is referred to as the choke unloader clearance.

CARBURETOR REPLACEMENT

Removal

(1) Remove air cleaner.

(2) Remove throttle cable from throttle lever. Disconnect vacuum hoses, pullback spring, choke filtered air tube, choke heater element wire connector, solenoid wire connector, PCV valve hose, inline fuel filter and choke heated air tube at carburetor.

(3) Remove carburetor retaining nuts. Remove carburetor and gasket from intake manifold.

Installation

(1) Clean gasket mounting surfaces of spacer and carburetor. Position gasket on intake manifold. Position carburetor on spacer and gasket and install nuts. To prevent leakage, distortion or damage to carburetor body flange, alternately tighten nuts in crisscross pattern.

(2) Connect in-line fuel filter, throttle cable, choke heated air tube, PCV valve hose, pullback spring, choke heater element wire connector, solenoid wire connector, choke filtered air tube and vacuum hoses.

(3) Adjust engine idle speed. Refer to Chapter 1A—General Service and Diagnosis for procedures.

CARBURETOR OVERHAUL

The following procedure applies to a complete overhaul with the carburetor removed from the engine.

A complete disassembly is not necessary when performing routine service adjustments. In most instances, service adjustments of individual circuits may be accomplished without removing the carburetor from the engine. Refer to Service Adjustment Procedures.

A complete carburetor overhaul includes disassembly, thorough cleaning, inspection, and replacement of all gaskets and worn or damaged parts. Refer to figure 1J-123 for parts identification.

1. MODULATOR COVER (IF EQUIPPED)
2. MODULATOR RETAINING SCREW (3) (IF EQUIPPED)
3. PIVOT PIN
4. MODULATOR ARM
5. CHOKE VALVE RETAINING SCREW (2)
6. CHOKE VALVE
7. CHOKE SHAFT
8. AIR HORN
9. AIR HORN RETAINING SCREW (4)
10. AIR HORN GASKET
11. FLOAT AND LEVER ASSEMBLY
12. FLOAT SHAFT RETAINER
13. FLOAT SHAFT
14. NEEDLE RETAINING CLIP
15. CURB IDLE ADJUSTING SCREW
16. CURB IDLE ADJUSTING SCREW SPRING
17. THROTTLE SHAFT AND LEVER ASSEMBLY
18. DASHPOT
19. DASHPOT LOCKNUT
20. DASHPOT BRACKET
21. DASHPOT BRACKET RETAINING SCREW
22. ADJUSTING SCREW
23. CARRIAGE
24. ELECTRIC SOLENOID
25. MOUNTING BRACKET
26. THROTTLE VALVE RETAINING SCREW (4)
27. THROTTLE VALVE (2)
28. NEEDLE AND SEAT ASSEMBLY
29. NEEDLE SEAT GASKET
30. MAIN JET (2)
31. MAIN BODY
32. ELASTOMER VALVE
33. PUMP RETURN SPRING
34. PUMP DIAPHRAGM
35. PUMP LEVER PIN
36. PUMP COVER
37. PUMP ROD
38. PUMP ROD RETAINER
39. PUMP LEVER
40. BOWL VENT BELLCRANK
41. FUEL INLET FITTING
42. POWER VALVE GASKET
43. POWER VALVE
44. POWER VALVE COVER GASKET
45. POWER VALVE COVER
46. POWER VALVE COVER RETAINING SCREW (4)
47. IDLE LIMITER CAP (2)
48. IDLE MIXTURE SCREW (2)
49. IDLE MIXTURE SCREW SPRING (2)
50. RETAINER
52. FAST IDLE LEVER RETAINING NUT
53. FAST IDLE LEVER PIN
54. RETAINER
55. LEVER AND SHAFT
56. FAST IDLE CAM ROD
57. CHOKE SHIELD
58. CHOKE SHIELD RETAINING SCREW (2)
59. PISTON PASSAGE PLUG
60. HEAT PASSAGE PLUG
61. CHOKE COVER RETAINING CLAMP
62. CHOKE COVER RETAINING SCREW (3)
63. CHOKE COVER AND COIL
64. CHOKE COVER GASKET
65. COIL LEVER RETAINING SCREW
66. COIL LEVER
67. CHOKE HOUSING RETAINING SCREW (3)
68. CHOKE HOUSING
69. CHOKE SHAFT BUSHING
70. FAST IDLE SPEED ADJUSTING SCREW
71. FAST IDLE LEVER
72. FAST IDLE CAM
73. CHOKE HOUSING GASKET
74. PUMP DISCHARGE CHECK BALL
75. PUMP DISCHARGE WEIGHT
76. BOOSTER VENTURI GASKET
77. BOOSTER VENTURI ASSEMBLY
78. AIR DISTRIBUTION PLATE
79. PUMP DISCHARGE SCREW
80. RETAINER
81. CHOKE ROD
82. CHOKE LEVER RETAINING SCREW
83. CHOKE PLATE LEVER
84. CHOKE ROD SEAL
85. STOP SCREW
86. MODULATOR RETURN SPRING (IF EQUIPPED)
87. MODULATOR DIAPHRAGM ASSEMBLY (IF EQUIPPED)

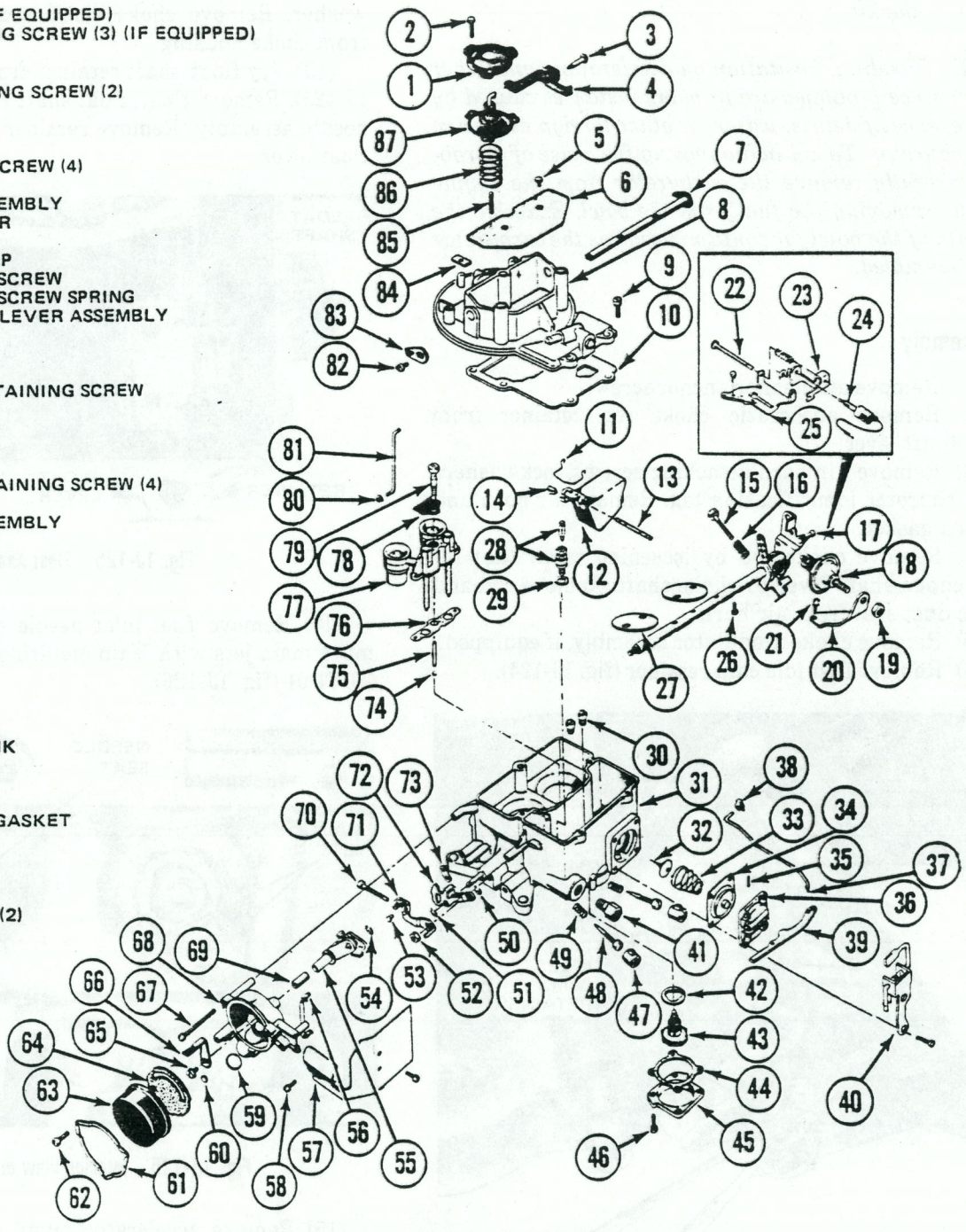

Fig. 1J-123 Parts Identification—Motorcraft Model 2150 Carburetor

NOTE: *When using an overhaul kit, use all parts included in the kit.*

NOTE: *Flooding, hesitation on acceleration, and other performance problems are in many instances caused by the presence of debris, water, or other foreign matter in the carburetor. To aid in diagnosing the cause of a problem, carefully remove the carburetor from the engine without removing the fuel from the bowl. Examine the contents of the bowl for contamination as the carburetor is disassembled.*

Disassembly

(1) Remove air cleaner anchor screw.

(2) Remove automatic choke rod retainer from choke shaft lever.

(3) Remove air horn attaching screws, lockwashers and carburetor identification tag. Remove air horn and air horn gasket.

(4) Remove choke rod by loosening screw that secures choke shaft lever to choke shaft. Remove rod and plastic dust seal from air horn.

(5) Remove choke modulator assembly, if equipped.

(6) Remove fast idle cam retainer (fig. 1J-124).

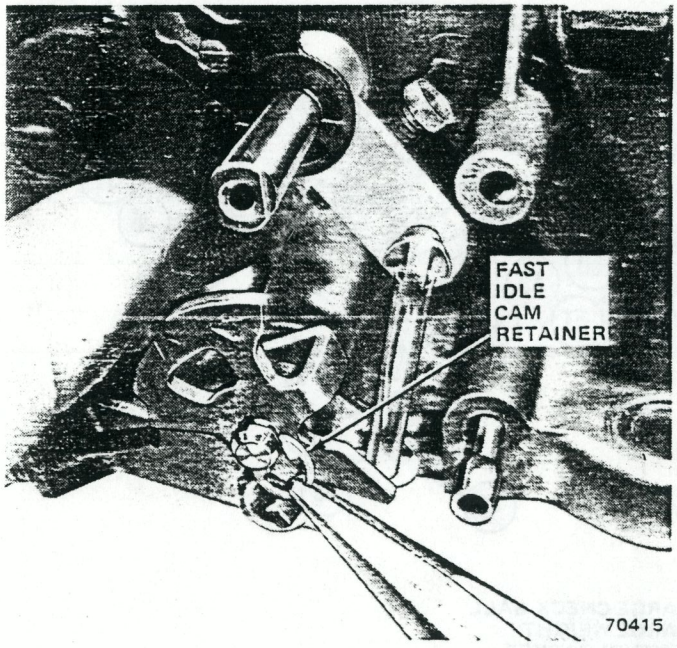

Fig. 1J-124 Fast Idle Cam Retainer

(7) Remove choke shield.

(8) Remove choke housing cover retaining screws and clamp, cover with coil and gasket.

(9) Remove fast idle cam rod from fast idle cam lever.

(10) Remove choke housing assembly retaining screws, housing assembly and gasket.

(11) Remove fast idle cam.

(12) Remove thermostat lever retaining screw and washer. Remove choke shaft and fast idle cam lever from choke housing.

(13) Pry float shaft retainer from fuel inlet seat (fig. 1J-125). Remove float, float shaft retainer and fuel inlet needle assembly. Remove retainer and float shaft from float lever.

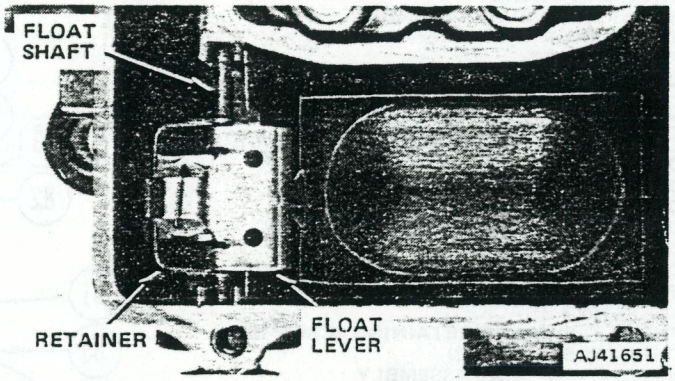

Fig. 1J-125 Float Assembly

(14) Remove fuel inlet needle seat and gasket. Remove main jets with Main Metering Jet Removal Tool J-10174-01 (fig. 1J-126).

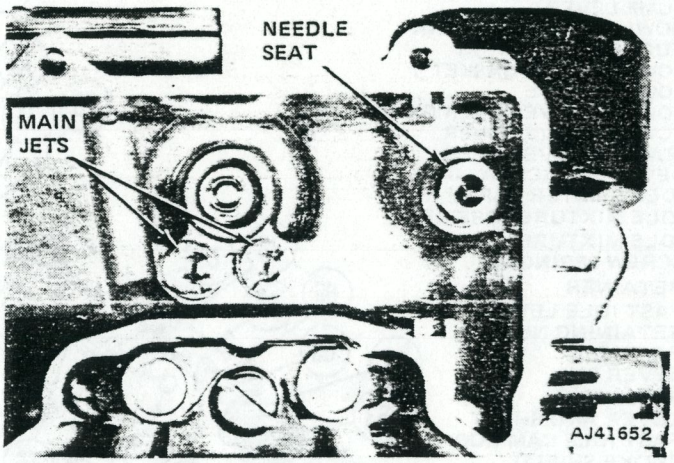

Fig. 1J-126 Interior View of Fuel Bowl

(15) Remove accelerator pump discharge screw, air distribution plate, booster venturi and gasket (fig. 1J-127). Do not attempt to remove tubes from venturi assembly. Invert main body and catch accelerator pump discharge weight and ball.

(16) Disconnect accelerator pump operating rod from overtravel lever. Remove rod and retainer.

(17) Remove accelerator pump cover attaching screws. Remove bowl vent bell crank and bracket assembly, accelerator pump cover, diaphragm assembly and spring (fig. 1J-128).

(18) Remove elastomer valve by grasping firmly and pulling out.

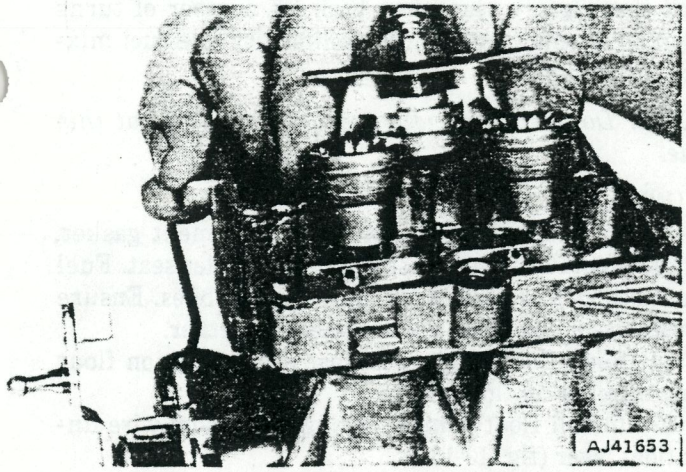

Fig. 1J-127 Booster Venturi Assembly

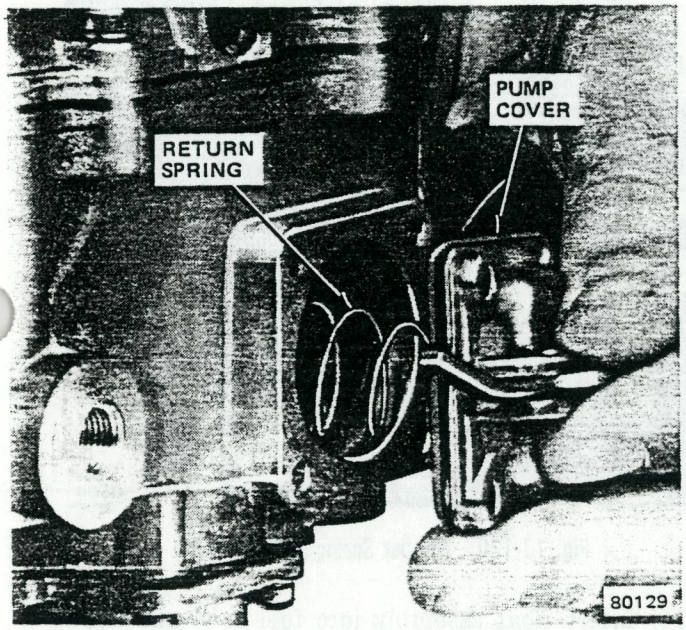

Fig. 1J-128 Accelerator Pump Assembly

NOTE: *If the elastomer valve tip breaks off during removal, ensure the tip is removed from the fuel bowl. The elastomer valve must be replaced whenever it has been removed from the carburetor.*

(19) Invert main body and remove power valve cover, gasket and screws. Remove power valve (fig. 1J-129). Remove and discard power valve gasket.

NOTE: *If it is necessary to remove the idle mixture screws because air pressure and soaking did not completely clean the air passages, remove caps concealing screws. Count and record number of turns necessary to lightly seat mixture screws for assembly reference. Remove idle mixture screws.*

(20) Remove solenoid.

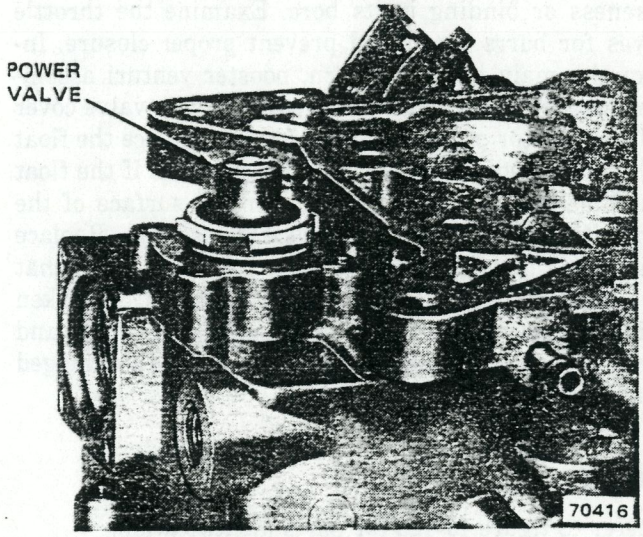

Fig. 1J-129 Power Valve

Cleaning and Inspection

Debris, gum, water and carbon contamination in the carburetor or on the exterior moving parts of the carburetor are often responsible for unsatisfactory engine performance. Efficient carburetion depends upon careful cleaning and inspection.

The cleaning and inspection procedure listed below does not involve the replacement parts included in the carburetor overhaul/repair kit. Install all gaskets and parts included in the repair kit when the carburetor is assembled. Discard the original gaskets and replaced parts.

CAUTION: *Do not use a wire brush to clean any parts. Do not use a drill or wire to clean any openings or passages in the carburetor. A drill or wire may enlarge the hole or passage and change the calibration of the carburetor.*

Wash all the carburetor parts except accelerator pump diaphragm, power valve, vacuum modulator diaphragm, and dashpot assembly in clean commercial carburetor cleaning solvent. If a commercial solvent is not available, use lacquer thinner or denatured alcohol. If a commercial cleaner is used, rinse the parts in hot water to remove all traces of the cleaning solvent, then dry them with compressed air. Wipe all parts that cannot be immersed in solvent with a clean, soft, dry cloth. Ensure all sediment, gum, carbon and other foreign matter is removed from all parts. Force compressed air through all passages of the carburetor.

Examine the choke shaft for wear and excessive looseness or a binding condition. Inspect the choke shaft and polish with fine crocus cloth or equivalent material. Inspect the choke valve for nicked edges and for ease of operation and repair if necessary. Ensure all carbon and foreign residue has been removed from the automatic choke housing. Examine the throttle shaft for excessive

looseness or binding in its bore. Examine the throttle valves for burrs that could prevent proper closure. Inspect the main body, air horn, booster venturi assemblies, choke housing and choke cover, power valve cover and accelerator pump cover for cracks. Replace the float if the arm needle contact surface is grooved. If the float is serviceable, polish the needle contact surface of the arm with crocus cloth or equivalent material. Replace float shaft if worn. Replace all screws and nuts that have stripped threads. Replace all distorted or broken springs. Inspect all gasket mating surfaces for nicks and burrs. Repair or replace any parts that have a damaged gasket surface.

Assembly

Refer to figure 1J-123 for parts identification.

NOTE: *Ensure all holes in the replacement gaskets have been properly punched and that no foreign material has adhered to the gaskets. Inspect vacuum diaphragms for tears or cuts.*

(1) Install fast idle speed adjustment screw and spring on fast idle lever.

(2) Install solenoid.

(3) Place fast idle lever assembly on throttle shaft and install retaining washer and nut.

(4) Lubricate tip of replacement elastomer valve and insert tip into accelerator pump cavity center hole.

(a) Using needlenose pliers, grasp valve tip from inside fuel bowl.

(b) Pull valve in until it seats in pump cavity wall. Cut off tip forward of retaining shoulder.

(c) Remove tip from bowl.

(5) Install accelerator pump diaphragm return spring in chamber depression. Insert diaphragm assembly in cover, place cover and diaphragm assembly into position on main body and install two right-side cover screws.

(6) Position bowl vent bell crank and bracket assembly over accelerator pump cover left-side holes. Ensure vent lever is positioned behing pump lever. Install retaining screws.

(7) Insert accelerator pump operating rod into inboard hole of accelerator pump actuating lever.

(8) Position accelerator pump operating rod retainer over hole 3 in overtravel lever.

(9) Invert main body and install power valve and replacement gasket. Tighten valve securely.

(10) Install power valve cover and replacement gasket.

NOTE: *Install the power valve cover with the extensions adjacent to the main body to provide entry for the slots on the idle mixture adjustment screw caps.*

(11) If removed, install idle mixture adjustment screws and springs. Turn screws in gently with fingers until they lightly seat, then back off number of turns recorded during removal for preliminary idle fuel mixture adjustment.

NOTE: *Do not install idle mixture screw caps at this time.*

(12) Install main jets.

(13) Install fuel inlet seat and replacement gasket. Install fuel inlet needle assembly in fuel inlet seat. Fuel inlet needles and seats are matched assemblies. Ensure correct needle and seat are assembled together.

(14) Slide float shaft into float lever. Position float shaft retainer on float shaft.

(15) Install float damper spring with short wire under float lever (fig. 1J-130).

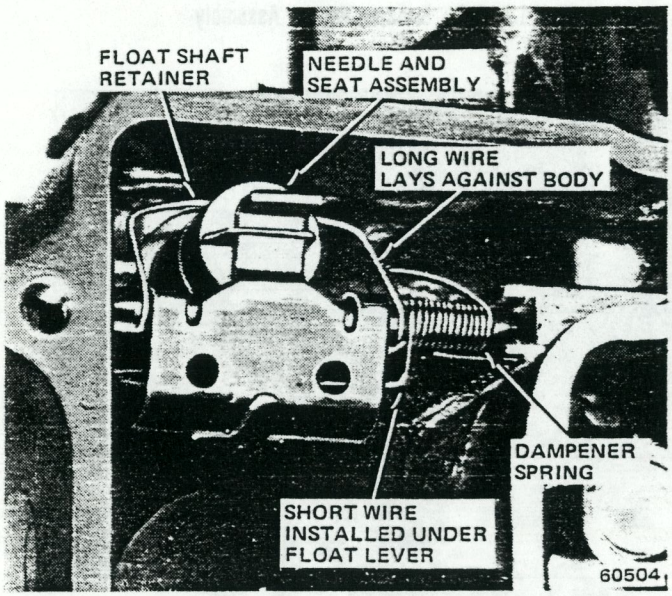

Fig. 1J-130 Damper Spring Installation

(16) Insert float assembly into fuel bowl and hook float lever tab under fuel inlet needle assembly. Insert float shaft into its guides at sides of fuel bowl.

(17) Press float shaft retainer into groove on fuel inlet needle seat and adjust float level. Refer to Service Adjustment Procedures.

(18) Drop accelerator pump discharge ball into passage in main body.

(19) Position replacement booster venturi gasket and booster venturi in main body.

(20) Drop accelerator pump discharge weight into booster on top of discharge ball.

(21) Install air distribution plate and accelerator pump discharge screw and tighten screw.

(22) Position fast idle cam lever on choke shaft. Install retainer.

NOTE: *The bottom of the fast idle cam lever adjustment screw must rest against the tang on the choke shaft.*

(23) Insert choke shaft into the rear of choke housing. Position choke shaft so that hole in shaft is on left side of choke housing.

(24) Install fast idle cam rod on fast idle cam lever.

(25) Install fast idle cam and retainer to hub on main body.

(26) Place choke housing vacuum pickup port-to-main body gasket on choke housing flange.

(27) Wipe choke shaft bushing clean (small piece of plastic material), and install in choke shaft bore in choke housing.

(28) Position choke housing on main body and install choke housing attaching screws.

(29) Install retainer to fast idle cam rod at fast idle cam.

(30) Install coil lever.

(31) Install choke housing cover, gasket, retainer and screws. Turn choke cover 1/4 turn rich and tighten one retaining screw.

(32) Install choke shield.

(33) Insert choke rod into choke valve lever. Lower end of rod must protrude through air horn.

(34) Install choke valve lever on choke shaft and tighten screw.

(35) Install plastic dust shield on choke rod.

(36) Position main body gasket on main body.

(37) Position air horn on main body and gasket so that choke valve rod fits through opening in main body. Ensure plastic shield is free to slide.

(38) Insert end of choke valve rod into choke valve lever.

(39) Install air horn attaching screws and carburetor identification tag. Tighten attaching screws.

(40) Attach choke valve rod and retainer on choke shaft lever.

(41) Install air cleaner anchor screw.

(42) If equipped, install modulator diaphragm return spring in recess of air horn. Position modulator cover over diaphragm assembly and engage piston rod with keyed slot of modulator arm. Place diaphragm and cover over return spring and install cover retaining screws.

(43) Adjust initial choke valve clearance. Refer to Service Adjustment Procedures.

(44) Adjust fast idle cam linkage. Refer to Service Adjustment Procedures.

(45) Adjust choke unloader clearance. Refer to Service Adjustment Procedures.

(46) Loosen choke housing cover screw and align cover index with specified notch. Refer to Specifications. Tighten all cover screws.

SERVICE ADJUSTMENT PROCEDURES

Float Level Adjustment—Dry

(1) Remove air horn assembly and gasket. Raise float by pressing down on float tab until fuel inlet needle is lightly seated.

(2) Use T-scale to measure distance from fuel bowl machined top surface to flat surface on either corner of float at free end. Refer to Specifications for correct dimension.

(3) Bend float tab to adjust. Hold fuel inlet needle off its seat while adjusting to prevent damage to Viton-tipped needle (fig. 1J-131).

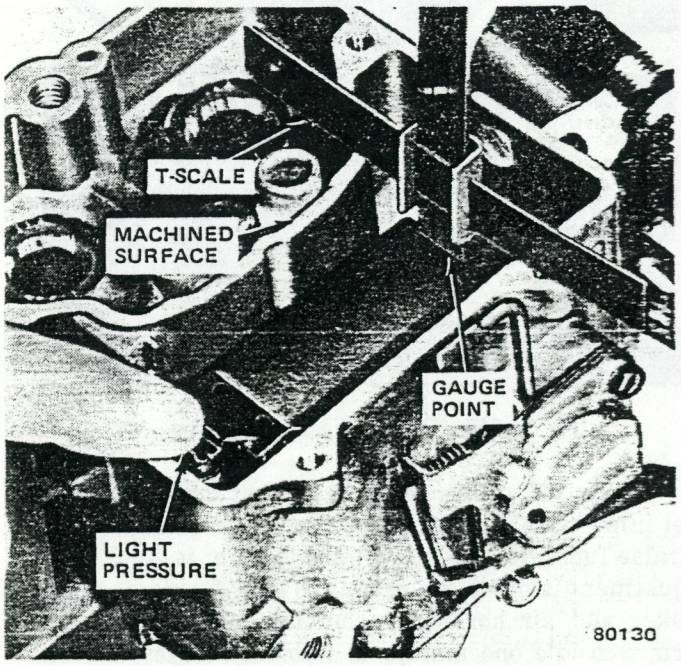

Fig. 1J-131 Float Level Adjustment—Dry

Float Level Adjustment—Wet

WARNING: *Exercise extreme caution when performing this procedure. Fuel vapor is present when carburetor air horn is removed. Extinguish cigarettes and other smoking materials.*

(1) Position vehicle on flat, level surface and warm engine to normal operating temperature. Turn engine off. Remove carburetor air cleaner assembly and anchor screw.

(2) Remove air horn attaching screws and carburetor identification tag. Temporarily place air horn and gasket in position on carburetor main body and start engine. Let engine idle one minute, then turn engine off and move air horn aside. Remove air horn gasket to provide access to float assembly.

(3) Use T-scale to measure vertical distance from top machined surface of carburetor main body to level of fuel in fuel bowl (fig. 1J-132). Measure at least 1/4 inch away from vertical surface to assure accurate indication because top surface of fuel is concave (higher at edges than in center). Measure fuel level at exact point of contact between scale and fuel. Refer to Specifications for correct fuel level (wet) dimension.

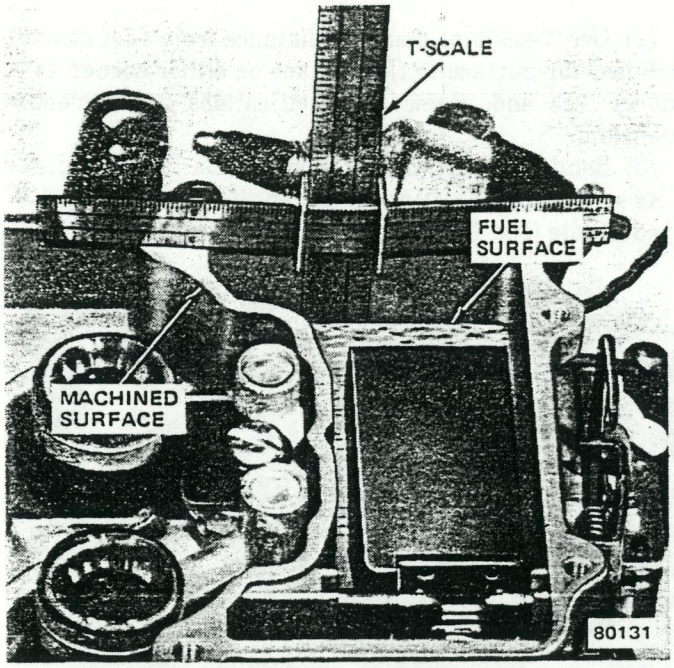

Fig. 1J-132 Float Level Adjustment—Wet

(4) To adjust fuel level, bend float tab (contacting fuel inlet valve) upward in relation to original position to raise fuel level, and downward to lower it. Each time adjustment is made to float tab to alter fuel level, place gasket and air horn on carburetor, start engine and permit to idle one minute to stabilize fuel level. Turn engine off and measure fuel level after each adjustment until specified level is obtained.

(5) Install replacement air horn gasket, air horn assembly, carburetor identification tag and attaching screws. Ensure plastic dust seal on choke operating rod is positioned correctly and does not cause rod to bind. Tighten screws. Install air cleaner anchor screw and tighten.

(6) Adjust idle speed. Refer to Chapter 1A—General Service and Diagnosis.

(7) Install air cleaner.

Initial Choke Valve Clearance and Fast Idle Cam Linkage Adjustments

(1) Loosen choke cover retaining screws.

(2) Open throttle and rotate choke cover until choke valve is held closed. Tighten one retaining screw.

(3) Close throttle with fast idle speed adjustment screw on top step of cam.

(4) Apply vacuum to hold choke diaphragm against setscrew. Do not press on links.

NOTE: *If vacuum is applied to the choke diaphragm with a hand pump, an air leak may be noticed. This is normal.*

(5) Measure clearance between lower edge of choke valve and air horn (fig. 1J-133).

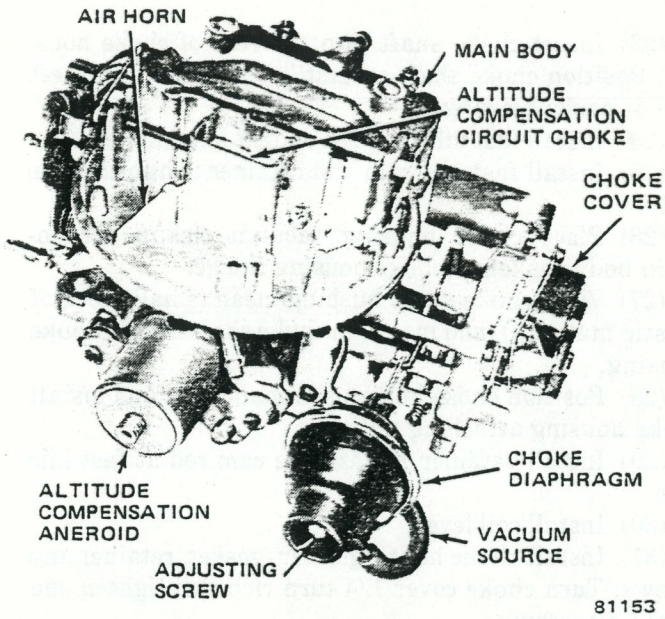

Fig. 1J-133 Initial Choke Valve Clearance Adjustment

(6) Adjust clearance by turning screw located at rear of diaphragm housing.

(7) Push down on fast idle cam lever until fast idle speed adjustment screw is in contact with second step (index) and against shoulder of high step.

(8) Measure clearance between upper edge of choke valve and air horn wall. Refer to Specifications for correct dimension.

(9) Adjust by turning fast idle cam lever screw (fig. 1J-134).

(10) Loosen choke cover retaining screw and adjust choke by turning cover until index is aligned with correct notch on housing. Refer to Specifications.

(11) Position choke cover shield and install retaining screws.

Choke Unloader Adjustment

(1) Hold throttle fully open and apply pressure on choke valve toward closed position.

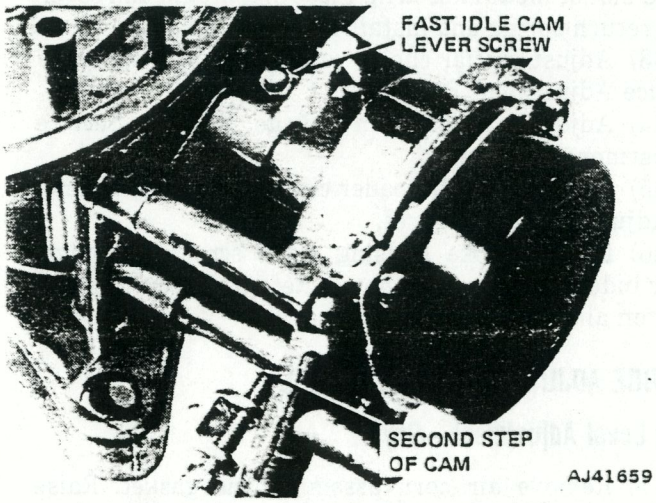

Fig. 1J-134 Fast Idle Cam Linkage Adjustment

(2) Measure clearance between lower edge of choke valve and air horn wall. Refer to Specifications for correct dimension.

CAUTION: *Do not bend the unloader tang downward from a horizontal plane.*

(3) Adjust by bending unloader tang that contacts fast idle cam (fig. 1J-135). Bend toward cam to increase clearance and away from cam to decrease clearance.

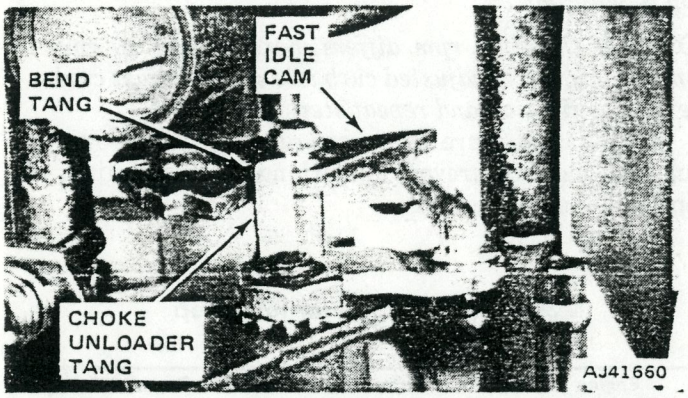

Fig. 1J-135 Choke Unloader Adjustment

(4) After completing adjustment, open throttle until unloader tang is directly below fast idle cam pivot. There must be exactly 0.070-inch (1.8 mm) clearance between unloader tang and edge of fast idle cam (fig. 1J-136).

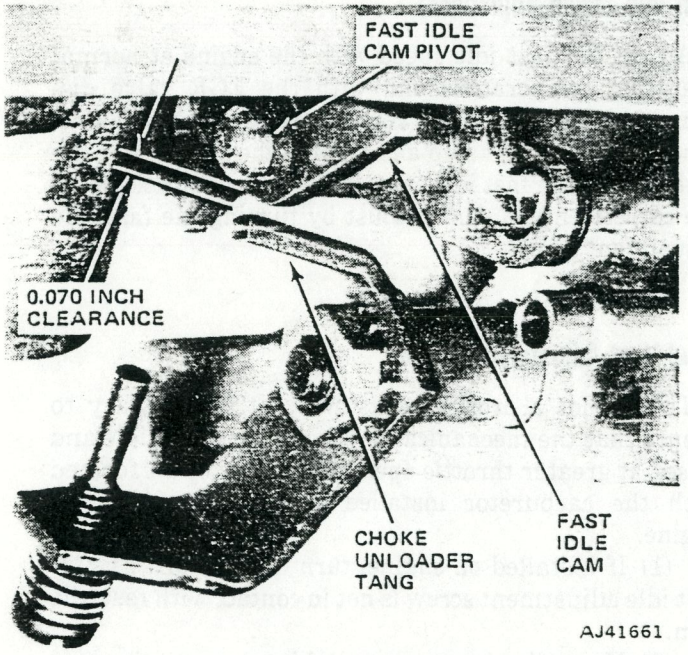

Fig. 1J-136 Unloader—Fast Idle Cam Clearance

(5) Operate throttle and inspect unloader tang to ensure it does not bind, contact or stick on any part of carburetor casting or linkage. After carburetor installation, inspect for full throttle opening when throttle is operated from inside vehicle. If full throttle opening is not obtainable, it may be necessary to remove excess padding under floormat or reposition throttle cable bracket located on engine.

Automatic Choke Adjustment

Loosen choke housing cover retaining screws and rotate cover in the desired direction as indicated by the arrow on the face of the cover. Refer to Specifications for the correct position (notch). The specified position will be satisfactory for most driving conditions.

NOTE: *The richer the choke setting the longer the coil tension exerts force against the linkage and holds the choke in a closed position. As heated incoming air and the electric heater warm the coil, the tension is reduced and fast idle cam weight gradually moves the choke linkage in the opposite direction.*

Accelerator Pump Stroke Adjustment

The specified accelerator pump stroke has been selected to help maintain the exhaust emission level of the engine within regulations. The unused adjustment holes permit adjusting the stroke for a specific engine application and ambient location. The primary throttle shaft lever (overtravel lever) has four holes and the accelerator pump link has two holes (fig. 1J-137).

For normal operating conditions, the accelerator pump operating rod should be in the third hole (away from the lever pivot) of the overtravel lever and the inboard hole (closest to the pump plunger) in the accelerator pump lever. In extremely hot climate regions, the

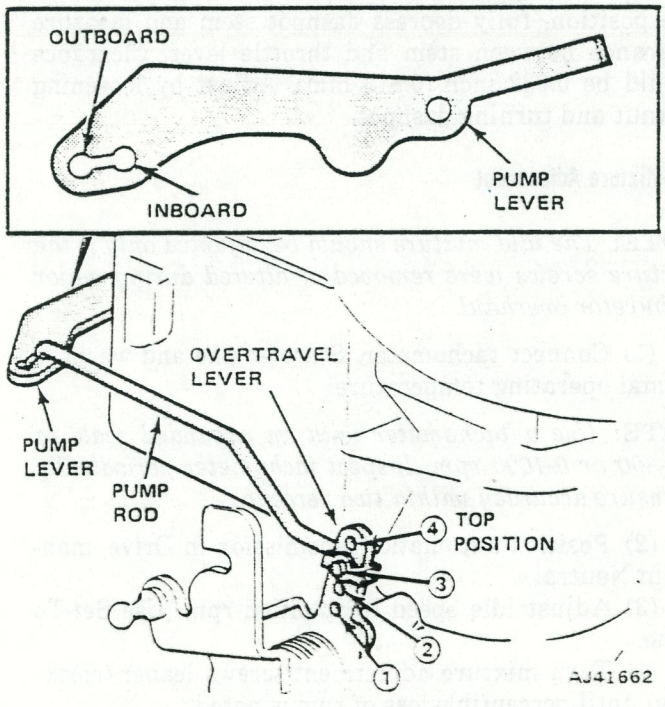

Fig. 1J-137 Accelerator Pump Stroke Adjustment

pump stroke may be shortened to provide smoother acceleration by placing the pump rod in the second hole of the overtravel lever. In extremely cold climate regions, the pump stroke may be increased to provide smoother acceleration by placing the pump rod in the fourth hole of the overtravel lever.

(1) Remove retaining clip from operating rod.

(2) Position clip over specified hole in overtravel lever. Insert operating rod end through clip and overtravel lever. Snap release clip over rod end.

Idle Speed and Mixture Adjustments

Idle Speed Adjustment

NOTE: *When adjusting idle speed, put manual transmission in Neutral. Put automatic transmission in Drive.*

WARNING: *Set parking brake firmly. Do not accelerate engine.*

(1) Connect tachometer, start engine and warm to normal operating temperature. Choke must be off.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(2) Turn hex-head screw on solenoid carriage to obtain 600 rpm.

(3) Disconnect solenoid wire connector and adjust curb idle screw to obtain 500 rpm curb idle speed.

(4) Connect solenoid wire connector.

(5) If equipped with dashpot: with throttle at curb idle position, fully depress dashpot stem and measure clearance between stem and throttle lever. Clearance should be 0.032 inch (0.813 mm). Adjust by loosening locknut and turning dashpot.

Idle Mixture Adjustment

NOTE: *The idle mixture should be adjusted only if the mixture screws were removed or altered during major carburetor overhaul.*

(1) Connect tachometer. Start engine and warm to normal operating temperature.

NOTE: *Use a tachometer with an expanded scale of 400-800 or 0-1000 rpm. Inspect tachometer periodically to ensure accuracy within two percent.*

(2) Position automatic transmission in Drive, manual in Neutral.

(3) Adjust idle speed to specified rpm. Use Set-To value.

(4) Turn mixture adjustment screws leaner (clockwise) until perceptible loss of rpm is noted.

(5) Turn mixture screws richer (counterclockwise) until highest rpm is obtained. Do not turn screws any further than position where highest rpm is first obtained. This is referred to as lean best idle.

NOTE: *Engine speed will increase above curb idle speed an amount that corresponds approximately to the lean drop specification.*

(6) As final adjustment, turn both idle mixture screws clockwise in small, equal amounts until specified drop is achieved.

NOTE: *If the final rpm differs more than ± 30 rpm from the originally adjusted curb idle speed, adjust curb idle to specification and repeat steps (5) and (6).*

(7) Install mixture screw caps removed during overhaul. Use care to prevent disturbing mixture adjustment while installing caps.

Model 2150 Carburetor Idle Drop

Engine	Transmission	Idle Drop RPM
304 2V	Manual Automatic	50 20
360 2V	Manual Automatic	50 20

81154

Fast Idle Speed Adjustment

Adjust the fast idle speed with the engine at normal operating temperature and with the EGR valve disconnected. Position the fast idle adjustment screw in contact with second step and against the shoulder of the high step of the fast idle cam. Refer to Specifications for the correct engine rpm. Adjust by turning the fast idle adjustment screw.

Bowl Vent Adjustment

This is not a precise adjustment. It is necessary to ensure that the mechanical bowl vent is open at idle and closed at greater throttle openings. It may be performed with the carburetor installed or removed from the engine.

(1) If installed on engine, turn ignition off. Ensure fast idle adjustment screw is not in contact with fast idle cam.

(2) Manually depress stem of bowl vent valve and insert gauge between valve stem and flat on end of bell crank. Refer to Specifications for clearance dimension.

(3) If clearance is not correct, bend bell crank as required. Do not bend lever on accelerator pump.

CHOKE MECHANISM SERVICE

The choke mechanism may be serviced without removing the carburetor from the engine. If the choke or linkage binds, sticks, or does not operate smoothly, perform the following.

(1) Disconnect heater wire connector and remove choke cover.

(2) Remove choke lever screw and lever.

(3) Remove choke housing. Slide out choke shaft. Remove thin plastic bushing.

(4) Polish shaft with crocus cloth. Wipe bushing clean and insert into housing.

(5) Wipe fast idle cam clean.

(6) Install choke housing over choke shaft and install housing screws.

(7) Install choke lever and screw.

(8) Install choke cover, connect heater connector wire and adjust to specification.

ALTITUDE COMPENSATED MODEL 2150 CARBURETOR

The Model 2150 carburetor with altitude compensation is installed on eight-cylinder engines for vehicles sold for use at elevations of 4,000 (1 250 m) feet and above.

This carburetor features a compensation circuit that mixes a metered amount of additional air into the air/fuel mixture to prevent an over-rich condition at higher altitudes. An automatic device (aneriod) reacts to atmospheric pressure and overrides the compensation feature at lower altitudes (fig. 1J-138).

NOTE: *With extremely low barometric pressure conditions, the aneroid may open the vent valve at sea level. This is normal and does not indicate a faulty component.*

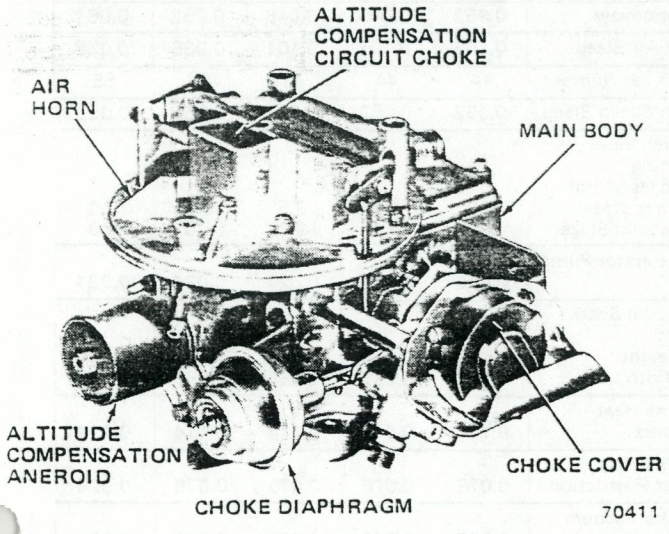

Fig. 1J-138 Model 2150 Carburetor with Altitude Compensation

The Model 2150 carburetor with altitude compensation uses an additional choke valve to aid cold weather engine start up.

The Model 2150 carburetor with altitude compensation operates and is serviced the same as the standard Model 2150 except for the altitude compensation device and the additional choke valve.

Altitude Compensation Circuit

The altitude compensation circuit supplies the extra air necessary to lean out the air/fuel mixture at high altitudes. The compensation circuit parallels the main carburetor intake circuit (fig. 1J-139). At the top, a small choke valve controls the airflow when the main choke is closed. Air flows down through a passage in the main body into a plenum chamber located adjacent to the two main venturi bores. A spring-loaded valve regulates the amount of air passed from the plenum into the compensator body. Air flows from the compensator body through two air passages bored into the main venturi tubes.

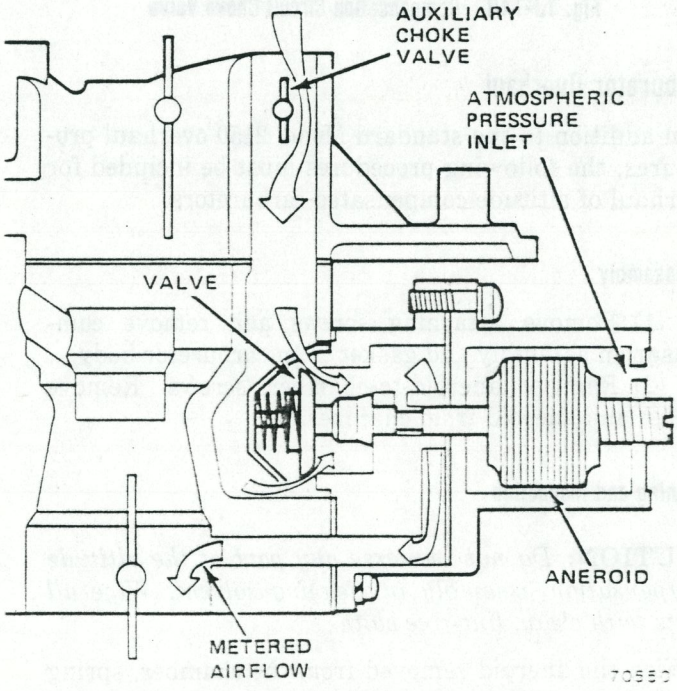

Fig. 1J-139 Altitude Compensation Circuit

The opening and closing of the valve in the compensator body is controlled by an aneroid that reacts to the atmospheric pressure. At the lower atmospheric pressure of higher altitudes, the aneroid pushes on the end of the compensator valve stem, opening the valve. At lower altitudes, the aneroid relaxes, automatically closing the valve.

The aneroid is calibrated during factory assembly and is not adjustable. Do not tamper with the hex-head plug on the aneroid.

Choke Circuit

The compensation circuit is provided with a separate choke valve linked directly to the main choke valve (fig. 1J-140). It is not adjustable.

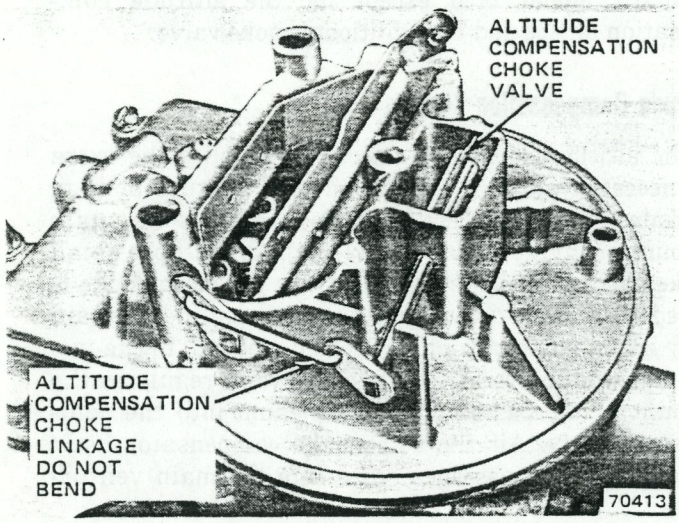

Fig. 1J-140 Compensation Circuit Choke Valve

Carburetor Overhaul

In addition to the standard Model 2150 overhaul procedures, the following procedures must be included for overhaul of altitude compensated carburetors.

Disassembly

(1) Remove attaching screws and remove compensation assembly and gasket from carburetor body.

(2) Remove aneroid-to-chamber screws. Remove gasket and aneroid from chamber.

Cleaning and Inspection

CAUTION: *Do not immerse any part of the altitude compensation assembly in cleaning solvent. Wipe all parts with clean, lint-free cloths.*

With the aneroid removed from the chamber, spring tension should fully close the air valve. Examine the position of the spring in the retainer and ensure it is properly seated (fig. 1J-141). Inspect the rubber seal on the valve stem. Examine the aneroid assembly and ensure that the atmospheric pressure inlet hole is free of debris.

Assembly

(1) Position aneroid on chamber with replacement gasket. Install screws.

(2) Position assembly on carburetor body with replacement gasket. Install screws.

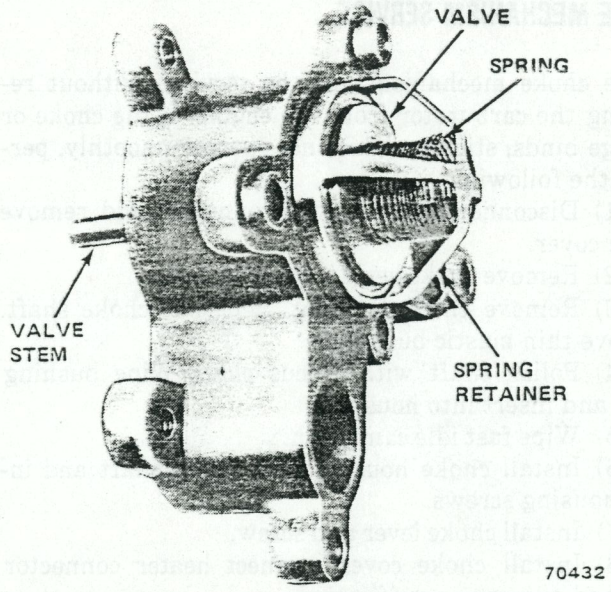

Fig. 1J-141 Altitude Compensator

There are no adjustments for the altitude compensator assembly. **Do not** attempt to turn the fitting on the aneroid. It is adjusted and sealed during factory assembly.

SPECIFICATIONS

Model 2150 Carburetor Calibrations (Inches)

	DM2J	DA2J	DM2A	RHM2	RHA2
Throttle Bore Size	1.562	1.562	1.562	1.562	1.562
Main Venturi Size	1.080	1.080	1.080	1.21	1.21
Fuel Inlet Diameter	0.101	0.101	0.101	0.101	0.101
Low Speed Jet (Tube)	0.031	0.032	0.033	0.033	0.036
Economizer	0.052	0.046	0.046	0.052	0.061
Idle Air Bleed	0.106	0.101	0.101	0.086	0.086
Main Jet Number	44	44	43	55	55
High Speed Bleed	0.052	0.052	0.052	0.055	0.055
Power Valve Timing (inches of Hg)					
—First Stage	9.0	9.0	7.5	9.0	9.0
—Second Stage	5.0	5.0	2.0	5.0	5.0
Accelerator Pump Jet	0.032	0.024	0.024	0.024	0.024
Vacuum Spark Port					
—Height	0.050	0.050	0.050	0.050	0.050
—Width	0.085	0.085	0.085	0.085	0.085
Choke Heat Bypass	0.114	0.114	0.114	0.114	0.114
Choke Heat Inlet Restriction	0.076	0.076	0.076	0.076	0.076
Choke Vacuum Restriction	0.082	0.089	0.089	0.089	0.089

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Model 2150 Carburetor Specifications

List Number	Application	Float Level (Wet) (Inches)		Float Level (Dry)	Initial Choke Valve Clearance (Inches)		Fast Idle Cam Setting (Inches)		Automatic Choke Cover Setting (Notches Rich)		Choke Unloader (Inches)	Fast Idle Speed ①		Bowl Vent Clearance	Choke Bimetel ID
		Set To	OK Range		Set To	OK Range	Set To	OK Range	Set To	OK Range		Set To	OK Range		
DMJ2	304 Manual 49 State	0.93	0.868 to 0.992	Measure from machined surface to a point on float 1/8-inch from tip. Needle Seated.	0.125	0.102 to 0.148	0.113	0.098 to 0.128	2	1-1/2 to 2-1/2	0.300 min.	1500	1400 to 1600	0.120	EKL
DA2J	304 Automatic 49 State	0.93	0.868 to 0.992	Set to 0.375 OK Range 0.300 to 0.450	0.128	0.105 to 0.151	0.113	0.098 to 0.128	1	1-1/2 to 1-1/2	0.300 min.	1600	1500 to 1700	0.120	EKL
DM2A	304 Manual Hilly Terrain	0.93	0.868 to 0.092		0.128	0.113 to 0.143	0.113	0.098 to 0.128	1	1/2 to 1-1/2	0.360 min.	1500	1400 to 1600	0.120	EKL
RHM2	360 Manual 49 State	0.93	0.868 to 0.992	Measure from machined surface to a point on float 1/8-inch from tip. Needle Seated.	0.104	0.091 to 0.127	0.081	0.066 to 0.096	2	1-1/2 to 2-1/2	0.348 min.	1500	1400 to 1600	0.120	EKL
RHA2	360 Automatic 49 State	0.93	0.868 to 0.992	Set to 0.575 OK Range 0.300 to 0.450	0.113	0.090 to 0.136	0.086	0.071 to 0.101	2	1-1/2 to 2-1/2	0.350 min.	1600	1500 to 1700	0.120	EKL

① Hot with EGR valve disconnected.

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EXHAUST GAS RECIRCULATION (EGR) SYSTEM

	Page		Page
EGR CTO Valve	1J-76	EGR Valve	1J-74
EGR Delay Valves	1J-78	General	1J-73
EGR Vacuum Dump Valve	1J-77	Thermal Vacuum Switch (TVS)	1J-77

GENERAL

The EGR system used on all Jeep vehicles reduces the production of oxides of nitrogen (NOx) by introducing a metered amount of exhaust gas into the combustion chambers. Exhaust gas is inert (will not burn), therefore combustion temperature is lowered and less NOx is produced at the lower combustion temperature.

EGR action does not occur until the engine coolant temperature has reached a calibrated level and the engine load is sufficient to permit proper EGR operation (figs. 1J-142, 143 and 144).

The EGR coolant temperature override (CTO) valve prevents EGR action until engine coolant temperature reaches a calibrated level, and the back-pressure sensor permits EGR action only at increased engine loads, improving driveability.

Depending on model applications, the following components may be used either seperately or together. The Thermal Vacuum Switch (TVS) is located in the air cleaner and is controlled by air cleaner air temperature. The TVS controls the vacuum passage between the EGR CTO valve and the EGR valve. At air temperatures below the calibrated value, the TVS limits the effects of

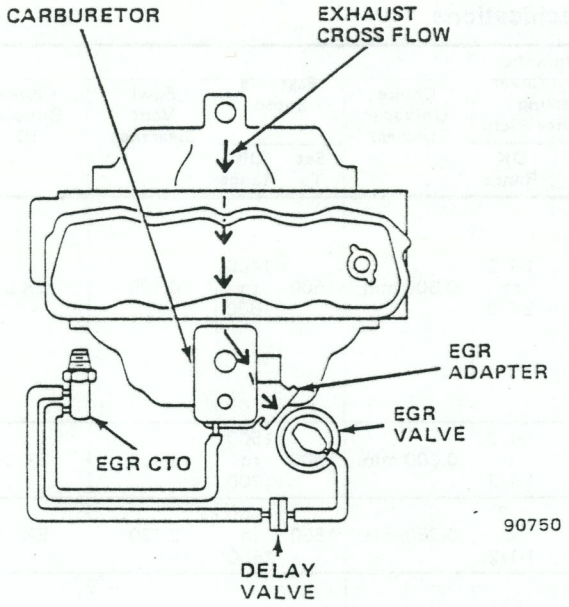

Fig. 1J-142 EGR System—Four-Cylinder Engine—Typical

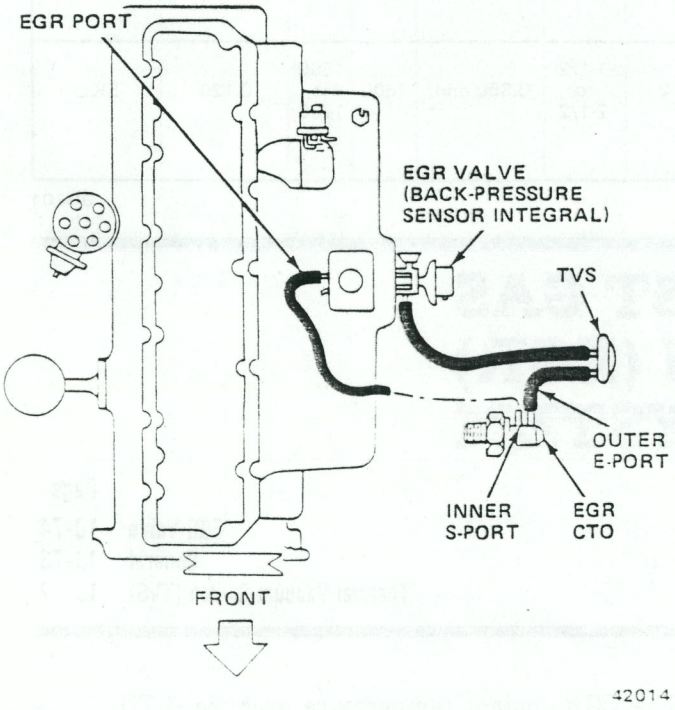

Fig. 1J-143 EGR System—Six-Cylinder Engine—Typical

vacuum on the EGR valve. This prohibits EGR valve operation and improves cold engine driveability. The EGR Vacuum Dump Valve is connected between the EGR vacuum source and the EGR valve. At the calibrated vacuum level, the vacuum to the EGR valve is interrupted, thereby preventing EGR operation. This valve is used to eliminate the EGR function at relatively low intake manifold vacuum levels.

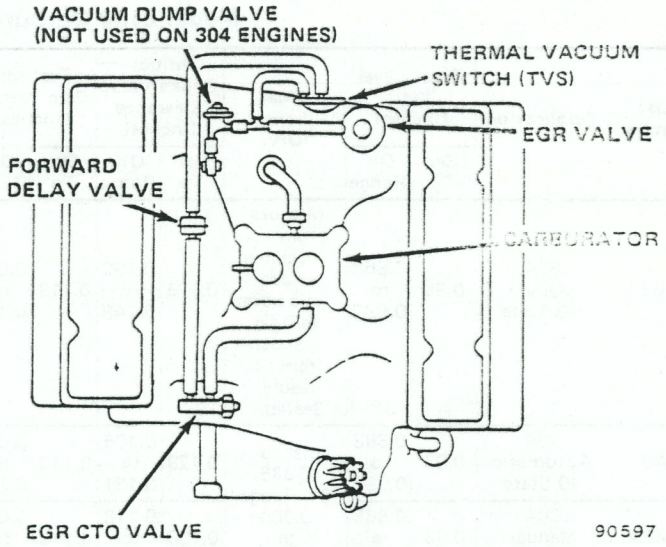

Fig. 1J-144 EGR System—Eight-Cylinder Engine—Typical

EGR VALVE

The EGR valve mounts on a spacer plate located beneath the carburetor for four-cylinder engines, on the side of the intake manifold for six-cylinder engines and on a machined surface at the rear of the intake manifold on eight-cylinder engines. Exhaust gas enters the intake manifold via the cross flow cast into the cylinder head on four-cylinder engines, is drawn from the center of the exhaust manifold via a flexible tube on six-cylinder engines and from the exhaust crossover passage on eight-cylinder engines.

An integral back-pressure sensor is incorporated in the EGR valve for all engines. Calibration is accomplished by the selective use of different diaphragm spring loads and flow control orifices. The unit combines the functions of the EGR valve and back-pressure sensor.

The flow (recirculation) of exhaust gas is controlled by a movable pintle within the valve (fig. 1J-145). In the relaxed position, spring pressure holds the pintle against its seat, confining exhaust gases to the exhaust manifold. Carburetor ported vacuum is available at the power diaphragm to force the pintle from its seat, but this cannot occur while the air inlet valve in the power diaphragm is open.

Exhaust gas exerts pressure (back-pressure) inside the exhaust manifold whenever the engine is operating. This pressure is conducted through the hollow pintle stem into the control diaphragm chamber. If this pressure is great enough to overcome control spring pressure, the control diaphragm is moved against the air inlet valve. Full vacuum is now applied to the power diaphragm and the pintle moves off its seat. EGR action now begins. If the back-pressure drops sufficiently, the control diaphragm moves away from the air inlet valve, the power diaphragm again relaxes and EGR action stops.

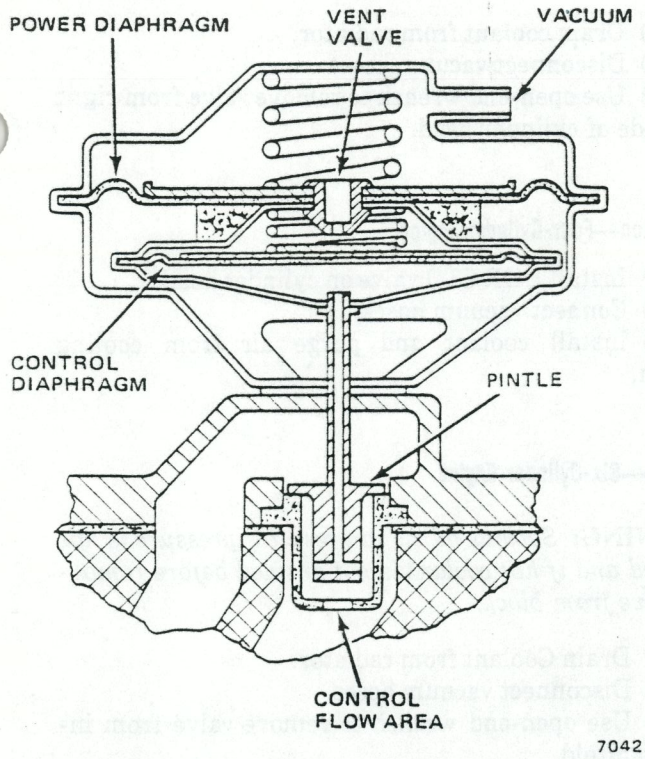

Fig. 1J-145 EGR Valve with Back-Pressure Sensor

When system vacuum remains constant, within the range of the unit, recirculation is primarily a function of the exhaust manifold back-pressure level. EGR operation is then dependent on exhaust back-pressure and exhaust gas is a fixed percentage of the incoming charge.

EGR Valve Functional Tests

The mechanical condition of the exhaust system may affect the operation of an EGR valve with a back-pressure sensor. Excessive back-pressure from exhaust system restrictions may create driveability problems. Refer to Chapter 1K—Exhaust Systems for Restricted Exhaust System Diagnosis. Leaks from the exhaust system may decrease back-pressure enough to prevent proper EGR operation. This will increase undesirable exhaust emissions. Visually inspect the exhaust system if leaks are suspected.

Valve Opening Test

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

With the engine at normal operating temperature and at curb idle speed , rapidly open and close the throttle. The throttle should be opened sufficiently for the engine speed to attain 1500 rpm. A definite movement should be observed in the EGR valve diaphragm. If the diaphragm does not move, the probable causes are: faulty vacuum hose to the EGR valve, defective EGR valve diaphragm or defective back-pressure sensor diaphragm. Inspect vacuum hoses for air leaks.

Valve Closing Test

With the engine at normal operating temperature and at curb idle speed, manually depress the EGR valve diaphragm. This should cause an immediate decrease in engine speed, indicating that the EGR valve had been properly preventing the flow of exhaust gas during idle. If there is no change in engine rpm and the engine is idling properly, exhaust gases are not entering the combustion chamber. The probable cause is a plugged passage between the EGR valve and the intake manifold.

If the engine idles improperly and the rpm is not noticeably affected by compressing the EGR diaphragm, the EGR valve is not preventing the flow of exhaust gas during idle. There is either a defect in the vacuum hoses, hose routings or the valve itself.

EGR Valve Replacement

Removal

(1) For four- and eight-cylinder engines, remove air cleaner assembly.

(2) Disconnect vacuum hoses.

(3) Remove two retaining screws/nuts from manifold.

(4) Remove EGR valve and gasket.

(5) Clean EGR pintle if necessary. Refer to EGR Valve Maintenance.

(6) Discard gasket and clean all gasket mating surfaces.

Installation

(1) Install gasket and EGR valve.

(2) Install retaining screws/nuts and tighten.

(3) Connect vacuum hoses and install air cleaner assembly, if removed.

NOTE: *For correct vacuum hose routings, refer to figures 1J-142, 1J-143 and 1J-144.*

EGR Valve Maintenance

Remove all carbon deposits from the stainless steel metering pintle of the valve with a wire brush. After cleaning, depress the diaphragm, cap the vacuum inlet and repeatedly open the EGR valve manually by pressing down on the diaphragm and releasing. Pintle should remain retracted. If it does not, diaphragm has a leak and valve must be replaced.

On six-cylinder engines, carbon deposits will collect more rapidly in the exhaust gas discharge passage (upper hole). If the deposits cannot be removed with a spiral-type wire brush, a 9/16-inch (14 mm) drill bit may be used. Coat the tip of the drill bit with heavy grease

and use locking pliers to rotate it in the discharge passage.

EGR CTO VALVE

The EGR CTO valve is located in the coolant passage at the right rear of the cylinder head for four-cylinder engines, on the intake manifold for six-cylinder engines and either on the intake manifold adjacent to the oil filler tube or at the right rear corner of the engine adjacent to the EGR valve for eight-cylinder engines. The inner port(s) connects by hose to the EGR port at the carburetor (ported vacuum), the outer port (E) connects to the EGR valve (or to the TVS for four-cylinder engines, fig. 1J-142).

When the coolant temperature is below the calibrated switching temperature of the CTO valve there is no vacuum applied to the EGR valve. The EGR CTO valve opens at 100°F (38°C) for four-cylinder engines and at 115°F (46°C) for six- and eight-cylinder engines, and can be identified by its black body or a black paint dab.

EGR CTO Valve Functional Test

NOTE: *Engine coolant temperature must be 10°F (5.6°C) below the calibrated opening temperature.*

(1) Inspect vacuum hoses for air leaks and correct routings (figs. 1J-142, 143 and 144).

(2) Disconnect vacuum hose at EGR valve. Connect hose to vacuum gauge.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(3) Operate engine at 1500 rpm. No vacuum should be indicated on gauge. If vacuum is indicated, replace EGR CTO valve.

(4) Idle engine until coolant temperature exceeds 100°F (38°C) for four-cylinder engines and 115°F (46°C) for six- and eight-cylinder engines.

NOTE: *The coolant temperature gauge pointer will be approximately midway between the cold mark and the beginning of the normal operating temperature band when the engine coolant temperature is 115°F (46°C).*

(5) Accelerate engine to 1500 rpm. Carburetor ported vacuum should be indicated on vacuum gauge. If not, replace EGR CTO valve.

EGR CTO Valve Replacement

Removal—Four-Cylinder Engine

WARNING: *Serious burns can result if pressure is not released and if hot coolant is not drained before removing valve.*

(1) Drain coolant from radiator.
(2) Disconnect vacuum hoses.
(3) Use open-end wrench to remove valve from right rear side of cylinder head.

Installation—Four-Cylinder Engine

(1) Install EGR CTO valve on cylinder head.
(2) Connect vacuum hoses.
(3) Install coolant and purge air from cooling system.

Removal—Six-Cylinder Engine

WARNING: *Serious burns can result if pressure is not released and if hot coolant is not drained before removing valve from block.*

(1) Drain Coolant from radiator.
(2) Disconnect vacuum hoses.
(3) Use open-end wrench to remove valve from intake manifold.

Installation—Six-Cylinder Engine

(1) Install EGR CTO valve on intake manifold.
(2) Connect vacuum hoses.
(3) Install coolant and purge air from cooling system.

Removal—Eight-Cylinder Engine

WARNING: *Serious burns can result if pressure is not released and if hot coolant is not drained before removing valve from intake manifold.*

(1) Drain coolant from radiator.
(2) Remove air cleaner assembly.
(3) If necessary, remove ignition coil bracket attaching screw and tip coil away from EGR CTO valve.
(4) Disconnect vacuum hoses from CTO valve.
(5) Using open-end wrench, remove valve from intake manifold or engine, as applicable.

Installation—Eight-Cylinder Engine

(1) Install EGR CTO valve in intake manifold or engine, as applicable.
(2) If removed, install ignition coil and bracket with attaching screw.
(3) Connect vacuum hoses to valve.
(4) Install air cleaner assembly.
(5) Install coolant and purge cooling system of air.

THERMAL VACUUM SWITCH (TVS)

The Thermal Vacuum Switch (TVS) is located in the air cleaner and functions as an **On-Off** switch controlled by air cleaner air temperature (fig. 1J-146). The TVS controls the vacuum passage between the EGR CTO Valve and the EGR Valve. At air temperatures below 40° to 50°F (4.4° to 10°C), the TVS limits the vacuum applied to the EGR valve and, by doing so, prevents EGR operation. This improves cold engine driveability.

NOTE: *A TVS is also used with other systems whose operation is dependent on air cleaner air temperture.*

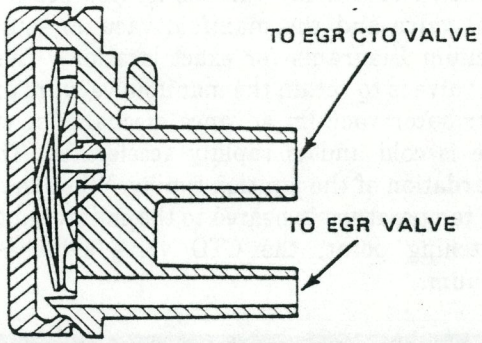

Fig. 1J-146 Thermal Vacuum Switch (TVS)

TVS Functional Test

(1) Cool air cleaner air below TVS operational temperture limits: 40° to 50°F (4.4° to 10°C).

(2) Disconnect vacuum hoses from TVS and connect external vacuum source to one nipple and vacuum gauge to other nipple (fig. 1J-146).

(3) Apply vacuum to TVS. Vacuum should not be indicated on gauge through TVS when air temperature is below 40° to 50°F (4.4° to 10°C). If vacuum is indicated through TVS, replace it.

(4) Start engine and warm air cleaner air above 50°F (10°C). Vacuum should be indicated on gauge through TVS when air temperature exceeds 50°F (10°C). If vacuum is not indicated on gauge through TVS, replace it.

TVS Replacement

Removal

(1) Remove air cleaner.

(2) Remove filter element.

(3) Remove retaining clip(s) attaching TVS to air cleaner.

(4) Remove vacuum hoses.

Installation

(1) Position TVS in air cleaner.

(2) Install retaining clip(s).

(3) Install vacuum hoses.

(4) Install filter element.

(5) Install air cleaner.

EGR VACUUM DUMP VALVE

The EGR Vacuum Dump Valve is connected in parallel with the EGR vacuum source and the EGR valve for eight-cylinder engines. It functions to stop EGR operation when intake manifold vacuum drops to a level of 3 to 5 in. Hg (10 to 17 kPa), thereby effectively "dumping" the vacuum controlling EGR operation.

Vacuum Dump Valve Functional Test

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing*

(1) Start engine and warm to normal operating temperature.

(2) Remove vacuum dump valve vacuum hose from connection at intake manifold and plug/cap manifold connection.

(3) Accelerate engine to 2000 rpm. Vacuum should be present at exhaust ports on bottom of valve. If not, replace valve.

(4) Connect vacuum dump valve vacuum hose to manifold. With engine speed at 2000 rpm, no vacuum should be present at exhaust ports on bottom of valve. If present, replace valve.

Vacuum Dump Valve Replacement

Removal

(1) Remove vacuum hoses from vacuum dump valve.

(2) Remove valve.

Installation

(1) Connect manifold vacuum hose to port "A" (fig. 1J-147).

(2) Connect EGR valve vacuum hose to port "B" (fig. 1J-147).

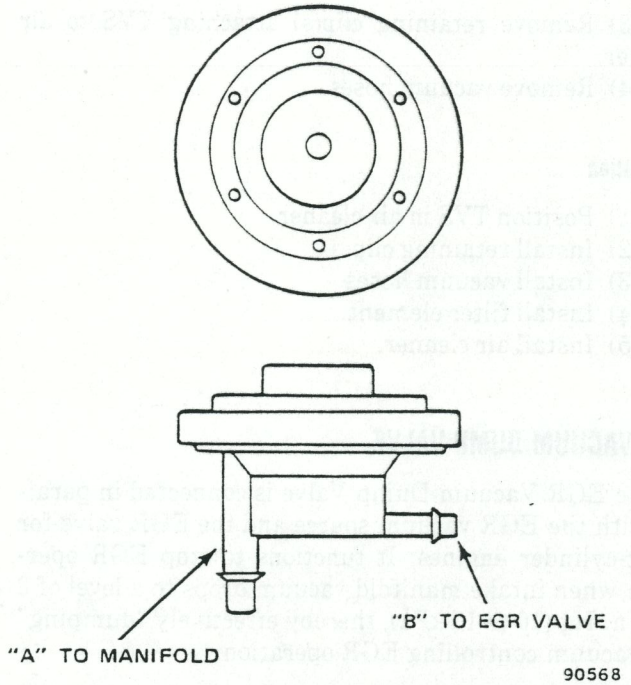

Fig. 1J-147 EGR Vacuum Dump Valve

EGR DELAY VALVES

Forward Delay Valve

The forward delay valve is located between the EGR CTO valve and the EGR valve (refer to Vacuum Diagrams for exact location). Its purpose is to modify the initial vacuum applied to the EGR valve by delaying the full effects of the vacuum. With gradual vacuum applied to the EGR valve, a harsh, sudden activation of the EGR system is avoided.

The black side of the valve is installed toward the EGR vacuum source.

Reverse Delay Valve

The reverse delay valve is located between the EGR CTO valve and the manifold vacuum source (refer to Vacuum Diagrams for exact location). The purpose of the valve is to retain the manifold vacuum applied to the distributor vacuum advance mechanisim when the engine is cold and is rapidly accelerated. This prevents retardation of the ignition timing. When the engine coolant temperature is heated to the calibrated temperature switching point, the CTO valve switches to ported vacuum.

POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM

	Page		Page
Components	1J-78	PCV Valve Air Inlet Filter Maintenance	1J-80
General	1J-78	PCV Valve Functional Test	1J-79
Operation—PCV System	1J-79		

GENERAL

The PCV system functions to prevent crankcase vapor from entering the atmosphere. Filtered air is routed into the crankcase and vapor forced into the intake manifold and burned during the engine combustion process.

In addition to controlling crankcase vapor, the system also constantly ventilates the crankcase, which helps to prevent the formation of sludge.

COMPONENTS

The PCV system is comprised of an air inlet filter, a flow-control (PCV) valve and associated hoses (figs. 1J-148, 149 and 150). The air inlet filter is located inside the air cleaner housing on four- and six-cylinder engines. It is located in the oil filler cap on eight-cylinder engines.

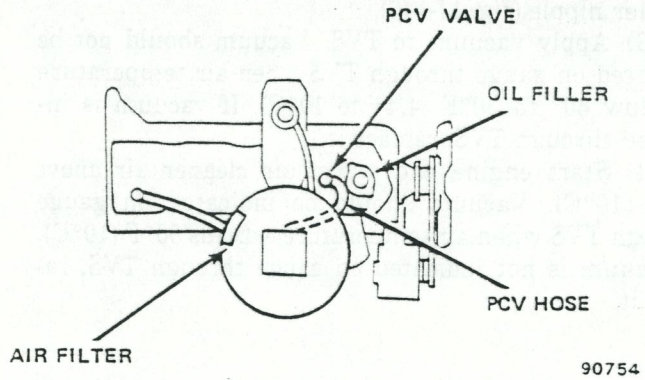

Fig. 1J-148 PCV System—Four-Cylinder Engine

Positive Crankcase Ventilation (PCV) Valve

Three PCV valves with different flow rates are used. Flow rate is measured in cubic feet per minute (cfm) or

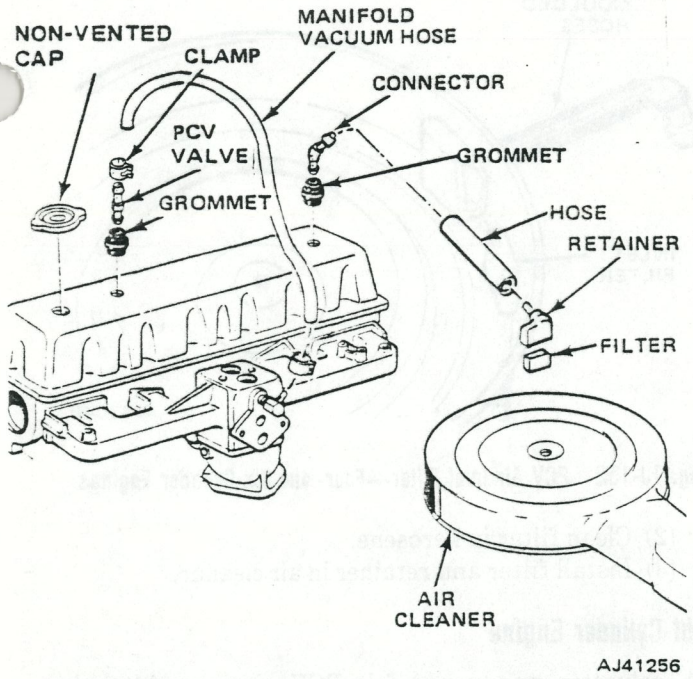

Fig. 1J-149 PCV System—Six-Cylinder Engine

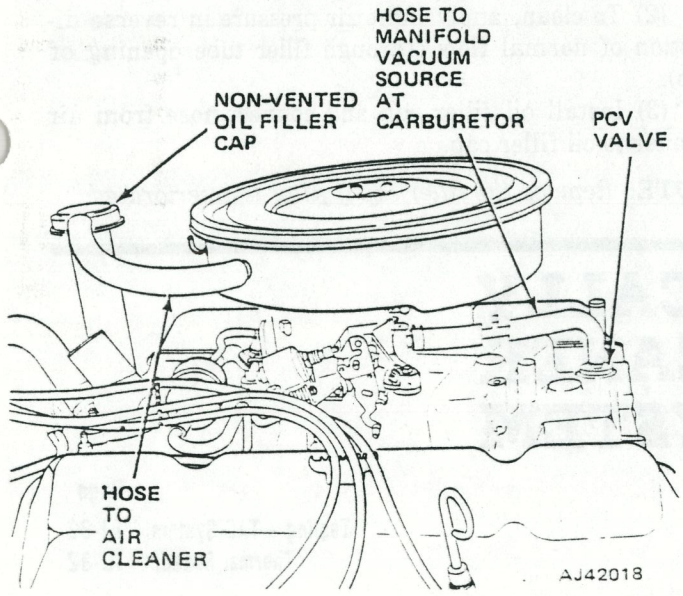

Fig. 1J-150 PCV System—Eight-Cylinder Engine

liters per second (l/s). Refer to the Jeep Parts Catalog for the correct PCV valve when replacing.

Replace the PCV valve at the intervals specified in the Maintenance Schedule. Inspect all hoses in the PCV system at the same time for leaks or restrictions and clean or replace as required. PCV valve replacement may be required more often under adverse operating conditions.

OPERATION—PCV SYSTEM

Airflow through the PCV system is controlled primarily by manifold vacuum. There are two basic operating modes. When manifold vacuum is relatively high, as at idle or at cruising speed, fresh air is drawn through the air intake filter into the crankcase. After circulating through the crankcase, the vapor-filled air is forced through the PCV valve into the intake manifold. The vapor mixes with the air/fuel mixture and is burned in the combustion chambers. The PCV valve is calibrated to control airflow at a rate acceptable to the intake system.

If crankcase vapor pressure (blowby) exceeds the flow capacity of the PCV valve, airflow in the system reverses. Crankcase vapor is forced through the air cleaner element and carburetor and burned along with the air/fuel mixture.

PCV VALVE FUNCTIONAL TEST

Test the valve at idle speed for correct flow rate (cfm or l/s) providing the engine manifold vacuum is at least 14 in. Hg (45 kPa). When testing the vacuum, connect the gauge to a fitting that is as centrally located as possible on the intake manifold.

(1) Remove valve from grommet in cylinder head cover (four- and six-cylinder engines) or manifold vacuum source hose (eight-cylinder engine). Connect plastic hose of PCV Valve Tester J-23111 to valve (fig. 1J-151).

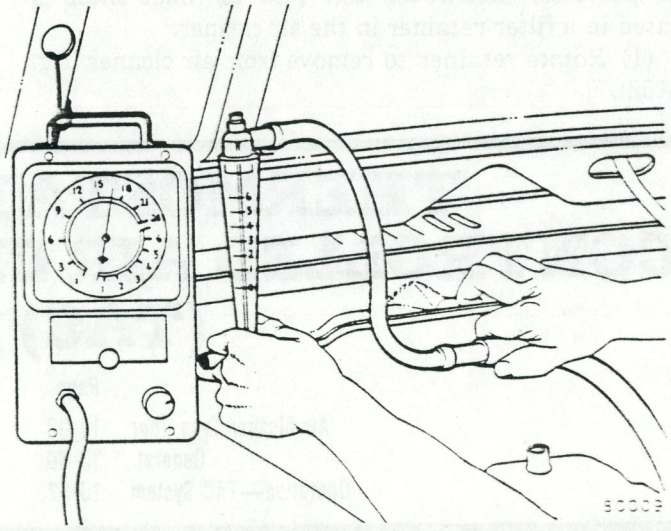

Fig. 1J-151 PCV Valve Test

NOTE: *The PCV valve must be held in a horizontal position and tapped lightly during the test. Hold the tester in a vertical position.*

(2) Start engine and operate at idle speed. Observe flow rate (cfm or l/s). Refer to PCV Valve Flow Chart. With low vacuum, it may be necessary to load engine while testing flow rate.

(3) Replace valve having flow rate above or below specification. Ensure correct PCV valve is used for replacement.

PCV Valve Flow Rate Chart

Engine Manifold Vacuum (in. Hg.)	Air Flow CFM (liters/second)		
	Black Four-Cylinder	Yellow Six-Cylinder	Black Eight-Cylinder
15	0.5-1.0 (.236-.472)		
16			1.34-1.63 (.003-.004)
13		1.30-1.90 (.003-.005)	
6	1.05-1.85 (.496-.873)		
7			2.70-3.79 (.007-.010)
5		1.21-2.26 (.003-.006)	
3	1.5-2.5 (.708-1.18)		3.30-4.39 (.009-.012)
2		1.28-2.56 (.003-.007)	

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PCV VALVE AIR INLET FILTER MAINTENANCE

Perform PVC valve air inlet filter maintenance at the intervals specified in the Maintenance Schedule listed in Chapter B.

Four- and Six-Cylinder Engines

A polyester non-woven felt PCV air inlet filter is located in a filter retainer in the air cleaner.

(1) Rotate retainer to remove from air cleaner (fig. 1J-152).

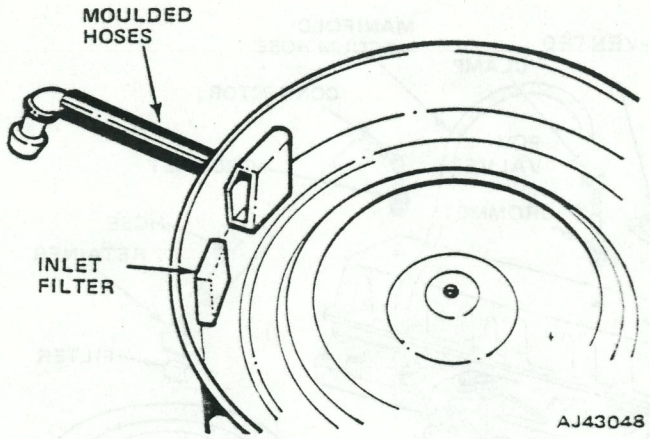

Fig. 1J-152 PCV Air Inlet Filter—Four- and Six-Cylinder Engines

(2) Clean filter in kerosene.

(3) Install filter and retainer in air cleaner.

Eight-Cylinder Engine

A polyester non-woven felt PCV air inlet filter is located in the sealed oil filler cap.

(1) Remove oil filler cap from engine.

(2) To clean, apply light air pressure in reverse direction of normal flow (through filler tube opening of cap).

(3) Install oil filler cap and connect hose from air cleaner to oil filler cap.

NOTE: *Replace the filler cap if filter is deteriorated.*

THERMOSTATICALLY CONTROLLED AIR CLEANER (TAC) SYSTEM

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GENERAL

The Thermostatically Controlled Air Cleaner (TAC) System provides heated air for the carburetor during engine warm-up when the outside (ambient) air temperature is low. Warm intake air permits the carburetor to have a leaner air/fuel mixture, reducing hydrocarbon emissions. It also improves engine performance during warm-up and minimizes carburetor icing.

All 1981 Jeep vehicles are equipped with a vacuum-operated TAC system. In addition, vehicles with six-cylinder engines have air cleaners with trap doors that close off the air cleaner air intake duct when the engine is turned off. This prevents fuel vapor, etc., from escaping to the atmosphere during the time the engine is inoperative.

The TAC system is comprised of a heat stove that is either fully encloses the exhaust manifold (four-cylinder engines) or partially encloses the exhaust manifold (six- and eight-cylinder engines), a heated air tube, an air cleaner assembly equipped with a thermal sensor, and a vacuum motor and air valve assembly (figs. 1J-153 and 154). The air cleaner duct is attached by a flexible duct to the ambient air inlet at the front of the engine compartment.

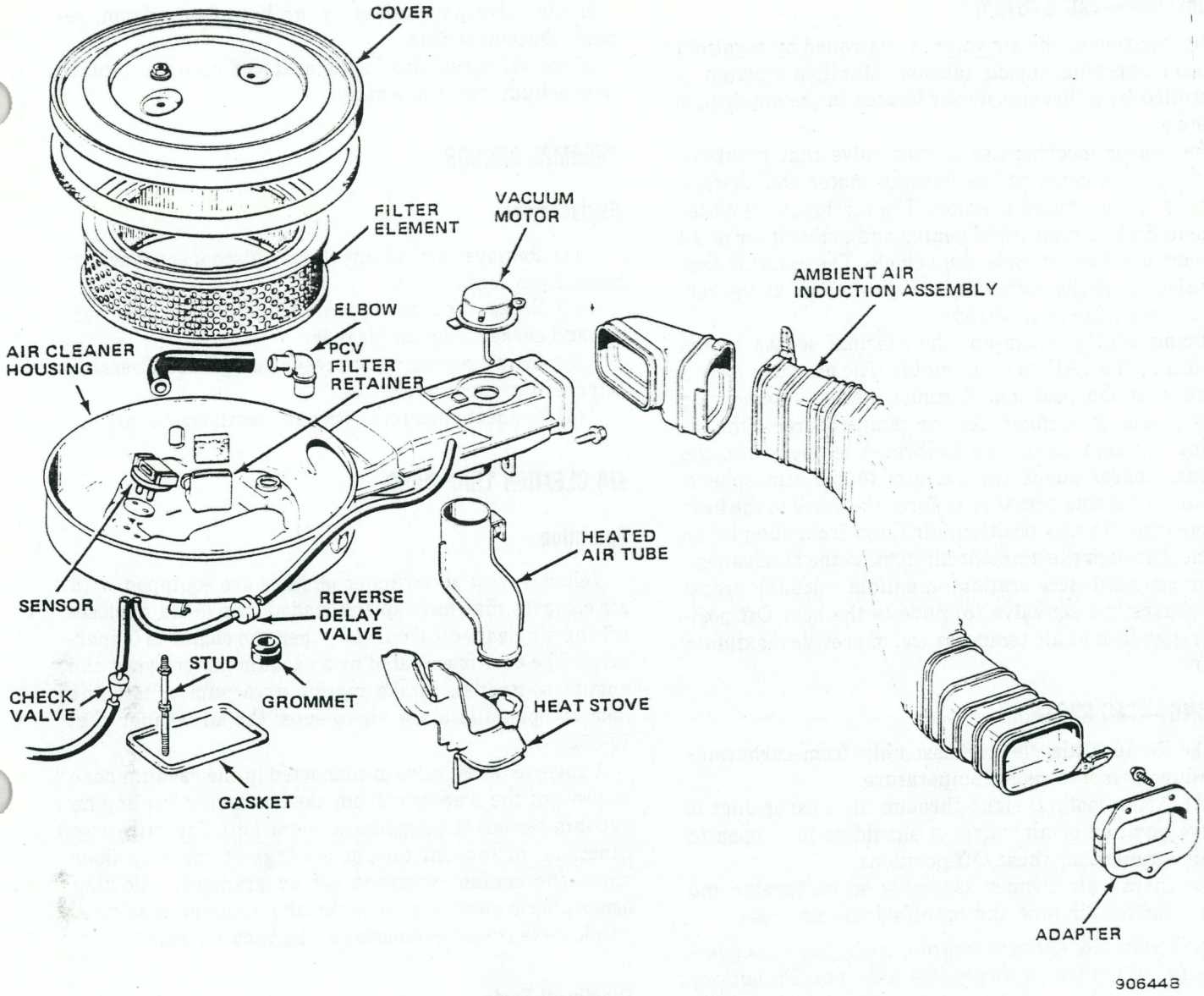

Fig. 1J-153 TAC System—Four-Cylinder Engine

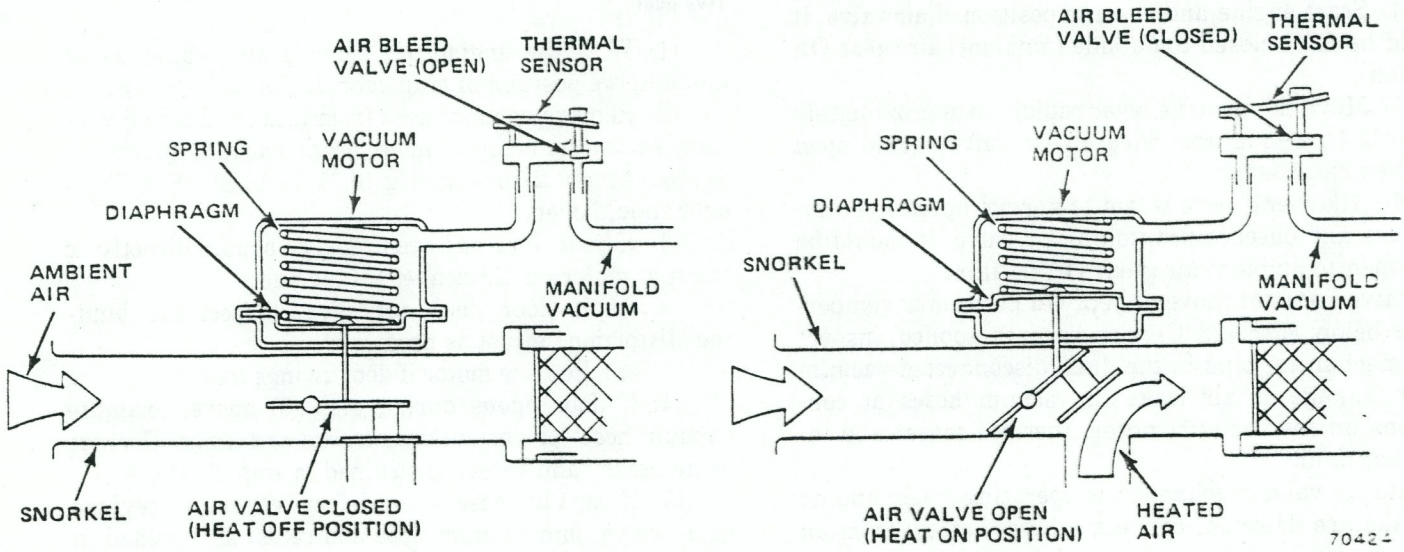

Fig. 1J-154 TAC System—Typical—Six- and Eight-Cylinder Engines

OPERATION—TAC SYSTEM

The position of the air valve is controlled by manifold vacuum opposing spring tension. Manifold vacuum is controlled by a thermal sensor located in the air cleaner housing.

The sensor incorporates a vent valve that regulates the vacuum applied to the vacuum motor and thereby controls the air valve position. The air supply is either all heated air, a mixture of heated and ambient air or all ambient air from outside the vehicle. The result is that the inlet air to the carburetor is maintained at the correct temperature (fig. 1J-155).

During engine warm-up, the thermal sensor passes vacuum to the TAC vacuum motor. The air valve is held in the heat **On** position. Exhaust manifold-heated air flows to the air cleaner. As the temperature of the incoming air approaches the calibrated temperature, the thermal sensor opens the vacuum to the atmosphere. This allows spring pressure to force the valve to the heat **Off** position. In this position, air flows from outside the vehicle, through the ambient air duct, to the air cleaner.

During hard acceleration, manifold vacuum drops. This causes the air valve to move to the heat **Off** position, regardless of air temperature, to provide maximum airflow.

TESTING—TAC SYSTEM

(1) Remove air cleaner assembly from carburetor and allow to cool to room temperature.

(2) After cooling, sight through air cleaner duct to observe position of air valve. It should be fully open to outside ambient air (heat **Off** position).

(3) Install air cleaner assembly on carburetor and connect heated air tube and manifold vacuum hose.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(4) Start engine and observe position of air valve. It should be fully closed to outside (ambient) air (heat **On** position).

(5) Move the throttle lever rapidly to approximately 1/2 to 3/4 opening and release. Air valve should open and then close again.

(6) Allow engine to warm to normal operating temperature and observe position of air valve. It should be fully open to ambient air (heat **Off** position).

If valve does not move to heat **On** position at temperatures below 83°F (28°C) with vacuum applied, inspect for a mechanical bind in the duct, disconnected vacuum motor linkage or air leaks in vacuum hoses at connections on the vacuum motor, thermal sensor and intake manifold.

If the air valve mechanism is operating freely and no air leaks are detected, connect a hose directly from an intake manifold vacuum source to the vacuum motor.

If the valve now moves to the heat **On** position, replace thermal sensor.

If the valve remains in the heat **Off** position, replace the vacuum motor assembly.

THERMAL SENSOR

Replacement

(1) Remove air cleaner and disconnect vacuum hoses from sensor.

(2) Break vacuum nipples off sensor. Remove sensor and gasket from air cleaner.

(3) Install replacement sensor and gasket. Press retainers over vacuum nipples.

(4) Connect vacuum hoses and install air cleaner.

AIR CLEANER TRAP DOOR

Operation

Vehicles with six-cylinder engines are equipped with air cleaners that have spring-loaded trap doors to close-off the air cleaner/carburetor when the engine is inoperative. The door is actuated by a vacuum motor; when the engine is started, intake manifold vacuum causes the door to open and allow air to enter the air cleaner (fig. 1J-155).

A reverse delay valve is connected in the vacuum hose to prevent the trap door from closing during low engine vacuum periods (i.e., engine acceleration). The valve also functions to prevent abrupt closings of the trap door when the engine is turned off by gradually allowing atmospheric pressure to enter the vacuum motor. A check valve is also connected in the vacuum hose.

Functional Tests

Trap Door

(1) With the engine off, remove air cleaner cover and observe position of trap door. It should be closed.

(2) Remove vacuum hose from intake manifold vacuum source and apply an external vacuum source of approximately 2 to 4 in. Hg (6.75 to 13.50 kPa). Trap door should open.

(3) If door does not open, apply vacuum directly to vacuum motor on air cleaner intake duct.

(a) If door does not open, inspect for binding/distortion, adjust as necessary.

(b) Replace motor if door swings freely.

(4) If door opens during step (3) above, examine vacuum hose for obstruction, cracks and kinks. Correct as necessary and retest as outlined in step (2) above.

(5) If vacuum hose is not defective, remove reverse delay valve, join vacuum hose and retest as outlined in step (2) above. If door opens, replace reverse delay valve.

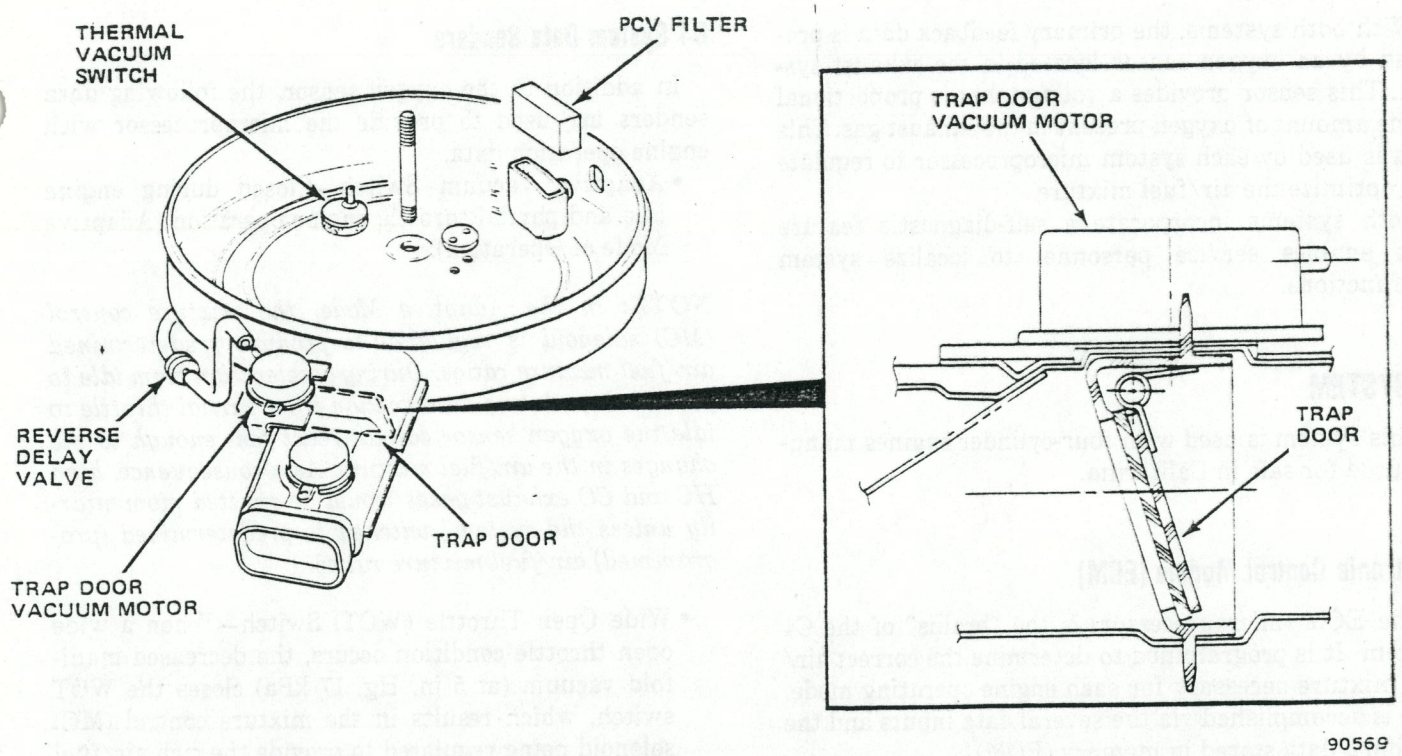

Fig. 1J-155 Air Cleaner with Trap Door

Reverse Delay Valve

The reverse delay valve provides approximately 9 seconds delay before allowing the trap door to completely close. Test valve according to the following procedure.

(1) Remove vacuum hose from red end of valve and apply an external vacuum source of approximately 2 to 4 in. Hg (6.75 to 13.50 kPa).

(2) With elapsed time indicator available in view, note time required for atmospheric pressure to pass through valve and eliminate vacuum.

(3) Replace valve if time required to eliminate vacuum is less than 4.5 seconds or more than 13.2 seconds.

NOTE: *Install replacement reverse delay valve with red end toward trap door vacuum motor.*

Replacement—Trap Door Vacuum Motor

Removal

(1) Disconect vacuum hoses, heated and ambient air ducts, and remove air cleaner.

(2) Remove vacuum motor attaching rivet from bracket.

(3) Lift motor away from bracket, rotate to clear door arm and remove.

Installation

(1) Rotate motor to clear door arm and lower into bracket.

(2) Secure motor to bracket with rivet.

(3) Install air cleaner, air ducts and vacuum hoses.

FEEDBACK SYSTEMS

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Diagnostic Procedures For C4 System	1J-89
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GENERAL

Two different feedback systems are used with Jeep vehicles, one for four-cylinder engines and one for six-cylinder engines. Each system is designed to achieve the same objective: reduce undesirable exhaust emissions, in conjunction with a three-way catalytic (TWC) converter, while maintaining fuel economy and good engine performance.

With both systems, the primary feedback data is provided by an oxygen sensor located in the exhaust system. This sensor provides a voltage that is proportional to the amount of oxygen present in the exhaust gas. This data is used by each system microprocessor to regulate and optimize the air/fuel mixture.

Both systems incorporate a self-diagnostic feature that enables service personnel to localize system malfunctions.

C4 SYSTEM

This system is used with four-cylinder engines manufactured for sale in California.

Electronic Control Module (ECM)

The ECM (microprocessor) is the "brains" of the C4 System. It is programmed to determine the correct air/fuel mixture necessary for each engine operating mode. This is accomplished via the several data inputs and the standard data stored in memory (ROM).

The ECM also contains a Programmable Read Only Memory (PROM) that has stored data unique to the vehicle.

CAUTION: *To ensure the internal components and connectors do not get wet when the passenger compartment is washed, it is advisable not spray water directly on the ECM housing because it is not completely waterproof.*

Oxygen Sensor

This component of the system provides a variable voltage (100 to 900 mv) for the microprocessor (ECM) that is actually a voltage analog for the oxygen content in the exhaust gas. As the oxygen content increases (lean mixture), the voltage output from the sensor decreases proportionally and as the oxygen content decreases (rich mixture), the voltage output increases proportionally. The microprocessor uses the voltage data to control the mixture control (MC) solenoid in the model E2SE carburetor and maintain an optimum air/fuel mixture.

NOTE: *The engine must be warmed to a predetermined temperature before the oxygen sensor voltage output is accepted by the microprocessor.*

NOTE: *The oxygen sensor must be replaced after 30,000 miles (48 000 km) of engine operation. The* ***Emission Maintenance*** *lamp will be illuminated to indicate the necessity for replacement. Refer to Chapter 1L—Power Plant Instrumentation for additional information.*

C4 System Data Senders

In addition to the oxygen sensor, the following data senders are used to provide the microprocessor with engine operation data.

- Adaptive Vacuum Switch—Closed during engine idle and partial throttle engine operation (Adaptive Mode of Operation).

NOTE: *In the Adaptive Mode, the mixture control (MC) solenoid is regulated to produce predetermined air/fuel mixture ratios. During acceleration from idle to partial throttle and deceleration from partial throttle to idle the oxygen sensor cannot react fast enough to the changes in the air/fuel mixture. As a consequence, high HC and CO exhaust gases would be emitted momentarily unless the system switched to predetermined (programmed) air/fuel mixture ratios.*

- Wide Open Throttle (WOT) Switch—When a wide open throttle condition occurs, the decreased manifold vacuum (at 5 in. Hg, 17 kPa) closes the WOT switch, which results in the mixture control (MC) solenoid being regulated to provide the rich air/fuel mixture necessary for the increased airflow (WOT Mode of Operation).
- Engine rpm Voltage from Distributor—The mixture control (MC) solenoid is de-energized until the voltage is equivalent to 200 rpm. The result is a rich air/fuel mixture for engine starting (Inhibit or Starting Mode of Operation).
- Coolant Temperature Sensor—During engine warm-up, below 150°F (66°C), the electrical impedance of the coolant temperature sensor is high. The result is the ECM (microprocessor) does not accept the oxygen sensor voltage output and a fixed air/fuel mixture is maintained (Open Loop Mode of Operation).

In addition to the above data input to the ECM, the ECM also determines the temperature of the oxygen sensor by measuring its electrical impedance. Until the oxygen sensor is heated to a temperature of 600°F (320°C), a fixed air/fuel mixture is maintained (Open Loop Mode of Operation).

Mixture Control (MC) Solenoid

The MC solenoid is an electro-mechanical device integral with the model E2SE carburetor that regulates the air/fuel mixture according to "commands" from the ECM.

One terminal of the MC solenoid is connected to 12v (battery voltage) and the other is connected to the ECM. The ECM functions as a switch that provides either a ground for current flow to energize the MC solenoid or an open circuit to de-energize the MC solenoid. The ECM switches the MC solenoid **ON** and **OFF** ten times a second.

When the MC solenoid is energized the needle is inserted into the jet and the result is a lean air/fuel mixture. When the solenoid is de-energized the needle is withdrawn from the jet and the result is a rich air/fuel mixture.

The average or effective air/fuel mixture is determined by the length of time the solenoid is either energized or de-energized (period of dwell) during each ON—OFF cycle (fig. 1J-131).

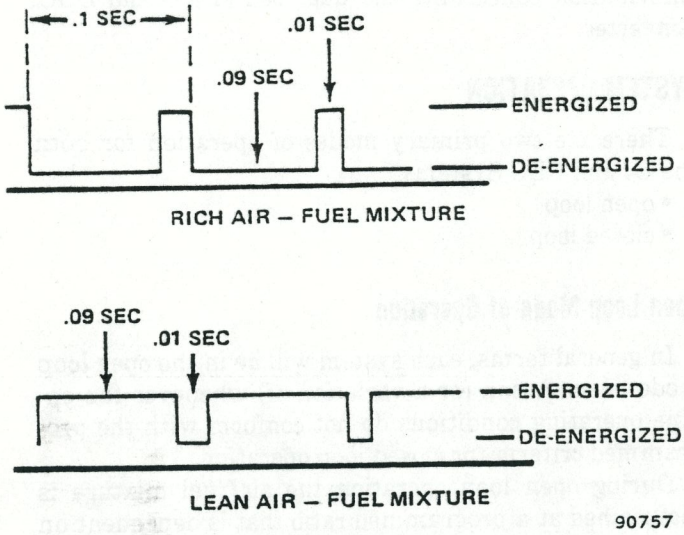

Fig. 1J-156 MC Solenoid ON—OFF Cycle

C4 System Malfunction Test Bulb

The C4 System has provision for connecting a test bulb that will inform a technician of the need for service. If a malfunction exists, the bulb will illuminate. The ECM also incorporates a diagnostic program that will flash a trouble code that identifies the malfunction when this function is activated.

Three-Way Catalytic (TWC) Converter

The TWC converter functions three ways to convert:

- HC to water vapor and carbon dioxide (CO_2).
- CO to carbon dioxide (CO_2) and oxygen.
- NOx and CO to nitrogen (N_2) and carbon dioxide (CO_2).

Refer to Exhaust Systems—Chapter 1K for service information.

COMPUTERIZED EMISSION CONTROL (CEC) SYSTEM

This system is used with six-cylinder engines manufactured for sale in California to control the carburetor air/fuel mixture and the air injection system (i.e., switching air either upstream or downstream).

Micro Computer Unit (MCU)

The MCU is a microprocessor that monitors the oxygen sensor voltage and, based upon the mode of operation, generates an output control signal for the model BBD carburetor stepper motor.

If the system is in the closed loop mode of operation, the air/fuel mixture will vary according to the oxygen content in the exhaust gas and current engine operation.

If the system is in the open loop mode of operation, the air/fuel mixture will be based on a predetermined ratio that is dependent on several engine operating parameters.

Oxygen Sensor

This component of the system provides a variable analog voltage (millivolts) for the microprocessor (MCU) that is proportional to the oxygen content in the exhaust gas.

Data Senders

In addition to the oxygen sensor, the following data senders are used to provide the microprocessor (MCU) with engine operation data.

Three vacuum (ported and manifold) operated electric switches, two mechanically operated electric switches, one engine coolant operated switch and one air temperature operated switch are used to detect and send engine operating data to the MCU. They detect the following engine operating conditions.

- Cold Engine Start-up and operation
- Wide open throttle (WOT)
- Idle (closed throttle)
- Partial and deep throttle

Components

- Thermal Electric Switch (TES)—The TES is attached to the inside of the air cleaner to provide either a ground circuit for the microprocessor to indicate the necessity for a cold weather engine start-up (when the air temperature is below the calibrated value) or an open circuit to indicate normal engine start-up (when the air temperature is above the calibrated temperature).
- Adaptive Vacuum Switch—This switch is controlled by manifold vacuum and, when closed, indicates an engine idle condition.
- Open Loop 1 (OL1) Coolant Temperature Switch—This switch is controlled by the engine coolant temperature and is integral with the intake

manifold heater control switch. When open, the switch indicates the engine is cold (i.e., temperature less than 160°F or 71°C).

- Open Loop 2 (OL2) Switch—This switch is mechanically controlled and has a normally closed (NC) electrical switch. This switch is integral with the WOT switch, which is mounted at the base of the carburetor.
- Open Loop 3 (OL3) Vacuum Switch—This switch is controlled by carburetor ported vacuum and has a normally closed (NC) electrical contact that indicates a closed throttle condition. The switch is opened by 3 ± .5 in. Hg (10 ± 1.7 kPa) vacuum.
- Open Loop 4 (OL4) Vacuum Switch—This switch is controlled by manifold vacuum. When open, the switch indicates a deep throttle condition.
- Wide Open Throttle (WOT) Switch—This mechanically operated electrical switch is controlled by throttle position to indicate a wide open throttle condition.

NOTE: *For the system to operate properly, **all** associated components and related systems must be intact and operational. This includes EGR valves, EGR related componentry, correct spark advance vacuum hose routing, etc.*

Engine RPM Voltage

This voltage is supplied from the tach terminal on the distributor. Until a voltage equivalent to a predetermined rpm is received by the MCU, the system remains in the Open Loop Mode of Operation. The result is a fixed rich air/fuel mixture for engine starting purposes.

Stepper Motor

The Stepper Motor is integral with the model BBD carburetor. It controls the metering pins that vary the size of the idle and main air inlet orifices located in the carburetor body. The motor moves the pins in and out of the orifices in steps according to the control signal generated by the MCU. The motor has a range of 100 steps, but the normal operating area is mid-range.

When the metering pins are stepped in the direction of the orifices, the air/fuel mixture becomes richer; when stepped away from the orifices, the mixture becomes leaner.

Check Engine Display

The Check Engine display will be flashed when the self-diagnostic subsystem has detected a fault. Refer to Chapter 1L—Power Plant Instrumentation for service information. Refer to Diagnostic Procedures for trouble-shooting procedures.

Dual Bed Catalytic Converter

Refer to Exhaust Systems—Chapter 1K for service information concerning the dual bed (TWC and COC) converter.

SYSTEM OPERATION

There are two primary modes of operation for both the C4 and CEC Systems:

- open loop
- closed loop

Open Loop Mode of Operation

In general terms, each system will be in the open loop mode of operation (or a variation of) whenever the engine operating conditions do not conform with the programmed criteria for closed loop operation.

During open loop operation the air/fuel mixture is maintained at a programmed ratio that is dependent on the type of engine operation involved. The oxygen sensor data is not accepted by either system during this mode of operation. The following conditions involve open loop operation (fig. 1J-157).

- Engine Start-Up
- Coolant or Air Temperature Too Low
- Oxygen Sensor Temperature Too Low
- Idle
- Wide Open Throttle (WOT)
- Battery Voltage Too Low

Closed Loop Mode of Operation

When all input data conforms with the programmed criteria for closed loop operation, the oxygen content output voltage from the oxygen sensor is accepted by the microprocessor. This results in an air/fuel mixture that will be optimum for the current engine operating condition and also will correct any pre-existing too lean or too rich mixture condition (fig. 1J-157).

NOTE: *A high oxygen content in the exhaust gas indicates a lean air/fuel mixture. A low oxygen content indicates a rich air/fuel mixture. The optimum air/fuel mixture ratio is 14.7:1.*

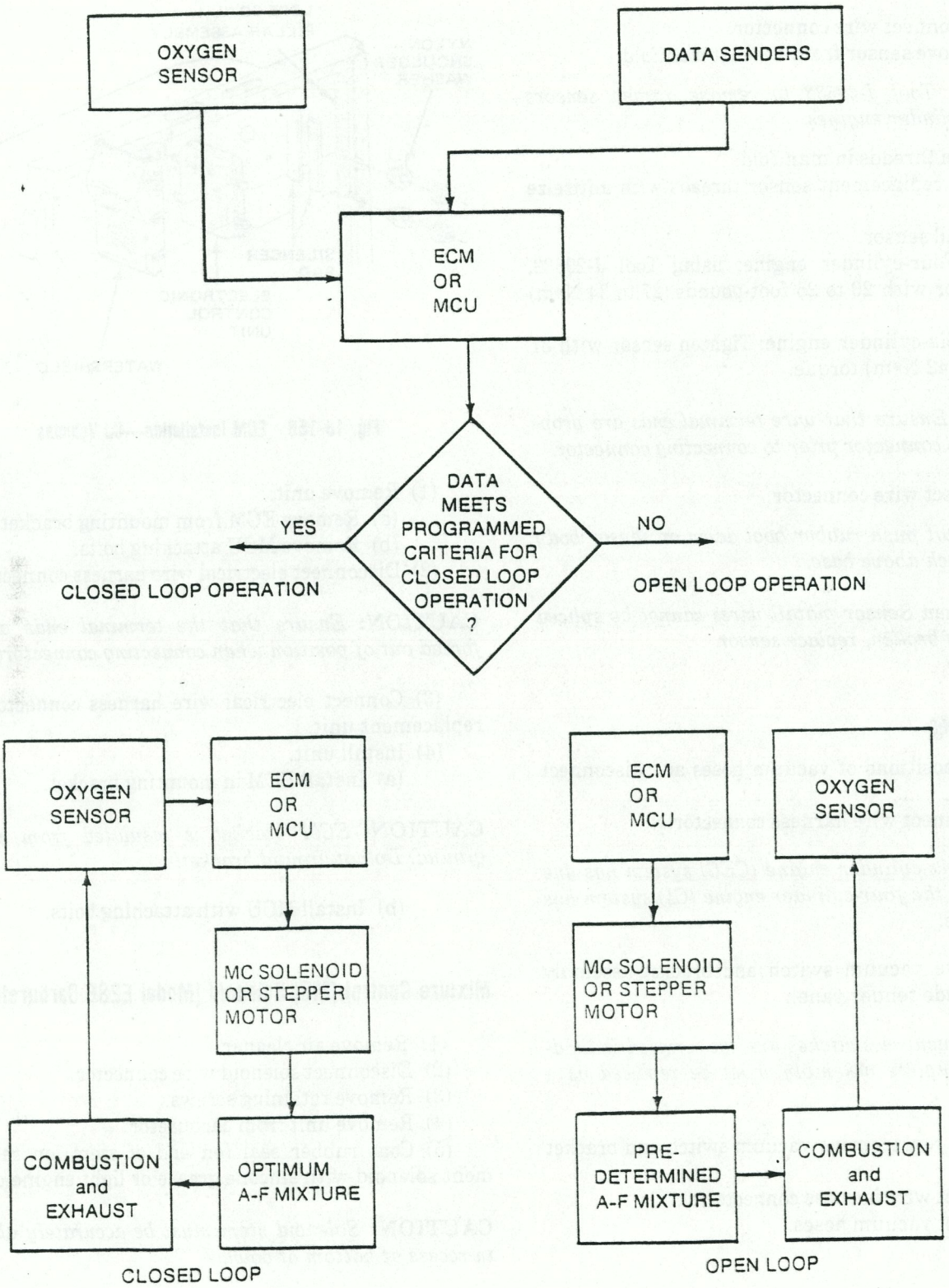

Fig. 1J-157 Open and Closed Loop Modes of Operation

COMPONENT REPLACEMENT

Oxygen Sensor

(1) Disconnect wire connector.
(2) Remove sensor from exhaust manifold.

NOTE: *Use Tool J-29533 to remove oxygen sensors from four-cylinder engines.*

(3) Clean threads in manifold.
(4) Coat replacement sensor threads with antiseize compound.
(5) Install sensor.
(a) Four-cylinder engine: using Tool J-29533, tighten sensor with 20 to 25 foot-pounds (27 to 34 N•m) torque.
(b) Six-cylinder engine: Tighten sensor with 31 foot-pounds (42 N•m) torque.

CAUTION: *Ensure that wire terminal ends are properly seated in connector prior to connecting connector.*

(6) Connect wire connector.

NOTE: *Do not push rubber boot down on sensor body beyond 1/2 inch above base.*

NOTE: *Oxygen Sensor pigtail wires cannot be spliced or soldered. If broken, replace sensor.*

Vacuum Switches

(1) Note positions of vacuum hoses and disconnect from switches.
(2) Disconnect wire harness connector(s).

NOTE: *The six-cylinder engine (CEC) system has one connector and the four-cylinder engine (C4) system has two connectors.*

(3) Remove vacuum switch and bracket assembly from right inside fender panel.

NOTE: *The vacuum switches are not serviced individually. The complete assembly must be replaced as a unit.*

(4) Install replacement vacuum switch and bracket assembly.
(5) Connect wire harness connector(s).
(6) Connect vacuum hoses.

ECM—MCU

The C4 system microprocessor (CJ only) is located in the passenger compartment on the left-hand kick panel (fig. 1J-158). The six-cylinder engine microprocessor is located in the engine compartment on the left-hand inner fender panel.

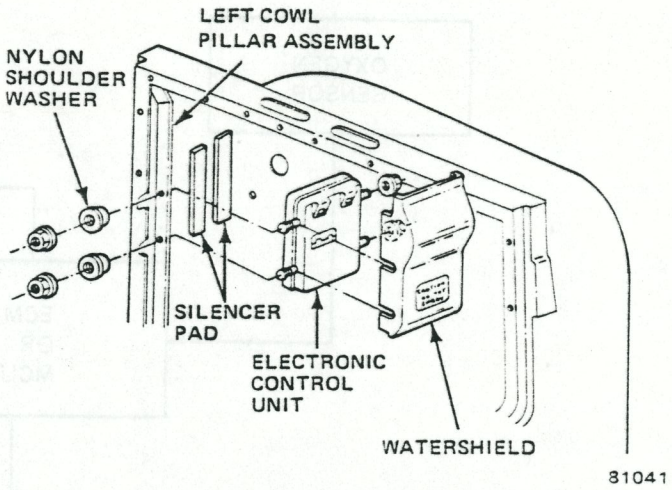

Fig. 1J-158 ECM Installation—CJ Vehicles

(1) Remove unit.
(a) Remove ECM from mounting bracket.
(b) Remove MCU attaching bolts.
(2) Disconnect electrical wire harness connector(s).

CAUTION: *Ensure that the terminal ends are not forced out of position when connecting connector(s).*

(3) Connect electrical wire harness connector(s) to replacement unit.
(4) Install unit.
(a) Install ECM in mounting bracket.

CAUTION: *ECM bracket is insulated from chassis ground. Do not ground bracket!*

(b) Install MCU with attaching bolts.

Mixture Control (MC) Solenoid (Model E2SE Carburetor)

(1) Remove air cleaner.
(2) Disconnect solenoid wire connector.
(3) Remove retaining screws.
(4) Remove unit from carburetor.
(5) Coat rubber seal (on end of stem) on replacement solenoid with silicone grease or light engine oil.

CAUTION: *Solenoid stem must be accurately aligned in recess at bottom of bowl.*

(6) Using new gasket, install replacement solenoid in carburetor.
(7) Connect solenoid wire connector.
(8) Install air cleaner.

Stepper Motor (Model BBD Carburetor)

(1) Remove air cleaner.
(2) Disconnect motor wire connector.

CAUTION: *Avoid dropping metering pins and spring when removing motor.*

(3) Remove retaining screw and unit from carburetor.
(4) Install replacement motor on carburetor with retaining screw. Tighten with 25 inch-pounds (2.8 N•m) torque.
(5) Connect wire connector.
(6) Install air cleaner.

Coolant Temperature Switch (or Sensor)

NOTE: *For six-cylinder engines, the coolant temperature switch is integral with the intake manifold heater coolant temperature control switch.*

(1) Disconnect electrical connector.
(2) Remove switch.
(3) Install replacement switch. Tighten with 72 inch-pounds (7 N•m) torque.
(4) Connect electrical connector.

DIAGNOSTIC PROCEDURES FOR C4 SYSTEM

The C4 System should be considered as a possible source of trouble for engine performance, fuel economy and exhaust emission complaints only after normal tests and inspections that would apply to a vehicle without the C4 system have been performed. An integral self-diagnostic subsystem detects the problems that are most likely to occur.

The diagnostic system will illuminate a test bulb if a fault exists. By grounding the trouble code test lead located under the dash the system will flash a trouble code if a fault has been detected.

As a routine system check, the test bulb will also be illuminated when the ignition switch is first turned **on** and the engine not started. If the test lead is grounded, the system will flash a trouble code 12, which indicates that the diagnostic system is functioning normal (i.e., no rpm voltage to ECM). This consists of **one flash** followed by a pause and then **two flashes.** After a longer pause, the code will be repeated two more times. The cycle will repeat itself until the engine is either started or the ignition switch turned **off.** When the engine is started, the bulb will remain illuminated for a few seconds.

If the test lead is grounded with the engine operating and a fault has been detected by the system, the trouble code will be flashed three times. If more than one fault has been detected, the second trouble code will be flashed three times after the first code is flashed. The series of code flashes will then be repeated.

A trouble code indicates a problem within a specific circuit, for example, code 14 indicates a problem in the coolant temperature sensor circuit. This includes the coolant temperature sensor, wire harness, and electronic control module (ECM). The procedure for determining which of the three is at fault is located in the Trouble Code 14 chart. For other trouble codes, refer to the applicable charts.

Because the self-diagnostic subsystem does not detect all possible faults, the absence of a flashed code does not always indicate that there is no problem with the system. To determine this, a system operational test is necessary. This test should be performed when the test bulb does not indicate a problem but the C4 System is suspected because no other reason can be found for a specific complaint. In addition to the test bulb, a dwell meter, test lamp, digital volt-ohmmeter, tachometer, vacuum gauge and jumper wires are required to diagnose system problems. A test lamp rather than a voltmeter should be used when so instructed. **Although most dwell meters should be acceptable, if one causes a change in engine operation when it is connected to the mixture control (MC) solenoid dwell lead, it should not be used.** The following models of older Sun tach/dwell units should not be used: G, GA, TDT1, 2, 5, 216 and 216-1.

The dwell meter, set for the six-cylinder engine scale and connected to a lead from the mixture control (MC) solenoid in the carburetor, is used to determine the air/fuel mixture dwell. When the dwell meter is connected, do not allow the terminal to contact ground. This includes hoses because they may be conductive. On a normally operating engine, the dwell at both idle and partial throttle will be between 10 degrees and 50 degrees and will be varying. Varying means the pointer continually moves back and forth across the scale. The amount it varies is not important, only the fact that it does vary. This indicates closed loop operation, meaning the mixture is being varied according to the input voltage to the ECM from the oxygen sensor. With wide open throttle (WOT) or cold engine operation, the mixture will be a fixed value and the pointer will not vary. This is open loop operation, meaning the oxygen sensor output has no effect on the air/fuel mixture. If there is a question whether or not the system is in closed loop operation, richening or leaning the mixture will cause the dwell to vary if the system is in closed loop operation.

NOTE: *Normally, system tests should be performed on a warm engine (upper radiator hose hot).*

Trouble Code Memory

When a fault is detected in the system, the test bulb will be illuminated and a trouble code will be set in the

memory of the ECM. However, if the fault is intermittent, the test bulb will be extinguished when the fault no longer exists, but the trouble code will remain in the ECM memory.

Long Term Memory

The ECM (for CJ vehicles) has long term memory. With this provision, trouble codes are not lost when the ignition switch is turned off. Certain troubles may not appear until the engine has been operated 5 to 18 minutes at partial throttle. For this reason, and for intermittant troubles, a long term memory is desirable. To clear the long term memory, disconnect and connect the battery negative cable.

NOTE: *Long term memory causes approximately a 13 ma battery drain with the ignition switch off.*

Trouble Codes

The test bulb will only be illuminated under the conditions listed below when a malfunction exists. If the malfunction is cleared, the bulb will be extinguished and the code will be reset, except for one fault, code 12. If the bulb is illuminated intermittently, but no code is stored, refer to this symptom within Driver Complaint.

- Trouble Code 12—No rpm voltage to the ECM.
- Trouble Code 13—Oxygen sensor circuit. The engine has to operate for approximately five minutes at partial throttle before this code will be flashed.
- Trouble Code 14—Shorted coolant temperature sensor circuit. The engine has to operate two minutes before this code will be flashed.
- Trouble Code 15—Open coolant temperature sensor circuit. The engine has to operate for approximately five minutes at partial throttle before this code will be flashed.
- Trouble Codes 21 and 22 (at same time)—Grounded WOT switch circuit.
- Trouble Code 22—Grounded adaptive vacuum or WOT switch circuit.
- Trouble Code 23—Open or grounded carburetor MC solenoid circuit.
- Trouble Code 44—Input to ECM from oxygen sensor indicates continuous lean mixture. MC solenoid is regulated to produce continuous rich mixture. The engine has to operate for about five minutes at partial throttle with a load and the C4 System in closed loop before this code will be flashed.
- Trouble Codes 44 and 45 (at same time)—Faulty oxygen sensor.
- Trouble Code 45—Input to ECM from oxygen sensor indicates continuous rich mixture. MC solenoid is regulated to produce continuous lean mixture. The engine has to operate about five minutes at partial throttle with a load and the C4 System in closed loop before this code will be flashed.
- Trouble Code 51—Faulty calibration unit (PROM) or installation.
- Trouble Codes 52 and 53—Test bulb off, intermittent ECM problem. Test bulb on, faulty ECM.
- Trouble Code 54—Faulty MC Solenoid and/or ECM.
- Trouble Code 55—Faulty oxygen sensor circuit or ECM.

When the test bulb is not illuminated with the engine operating, but a trouble code can be obtained, the situation must be evaluated to determine if the fault is intermittent or because of engine operating conditions.

For all troubles, except codes 13, 44, and 45, the test bulb should be illuminated with the engine speed below 800 rpm after five minutes of operation.

If codes other than 13, 44, and 45 can be obtained with the test bulb off, the diagnostic charts cannot be used because the system is operating normally. All that can be performed is a physical inspection of the circuit indicated by the trouble code. It should be inspected for poor wire connections, frayed wires, etc., then the System Operational Test should be performed.

Faults 13, 44, and 45 require engine operation at partial throttle with an engine load for an extended period of time before a code will be flashed. Trouble code 15 requires five minutes of operation before it will be flashed. The diagnostic chart should be used if these codes are obtained even though the test bulb is not illuminated at idle.

Calibration Unit (PROM)

The microprocessor has a calibration unit called a PROM that is programmed with specific instructions pertaining to the engine. It is not a replaceable assembly.

Trouble code 51 indicates the PROM has been installed improperly or is defective. When code 51 is flashed the ECM (microprocessor) should be replaced (fig. 1J-159).

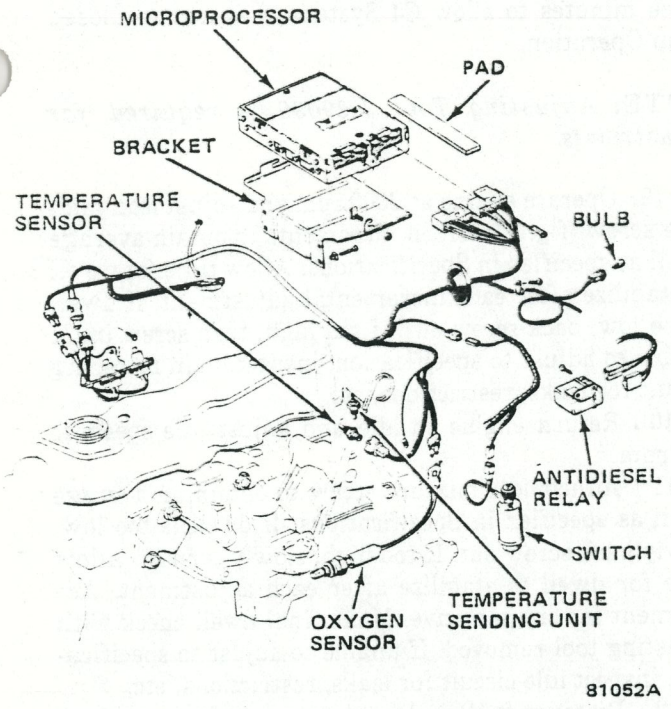

Fig. 1J-159 C4 System

CAUTION: *If trouble code 51 was caused by the PROM (Calibration Unit) being installed backwards, replace ECM with another unit. Whenever the Calibration Unit is installed backwards and the ignition switch is turned on,* ***the unit is destroyed.***

Carburetor Model E2SE Idle Mixture Adjustment

The idle mixture is calibrated during factory assembly and should normally not need adjustment in the field. However, if necessary because of results of C4 System diagnosis, contamination, overhaul, replacement of parts, etc., it can be adjusted according to the procedure outlined below. Because the C4 System is very complex, the procedure must be followed precisely.

The dwell indication from the MC Solenoid is used for the adjustment. During engine idle, it is normal for the dwell to increase and decrease fairly consistently over a relatively narrow range, such as 5 degrees. However, it may occasionally vary by as much as 10 degrees to 15 degrees momentarily because of temporary abrupt mixture changes. The dwell specified in the procedure is the average for the most consistent variation.

The engine must be allowed to stabilize at idle or 300 rpm, as applicable, before the dwell is acceptable as a reference for adjustment.

NOTE: *The mixture control solenoid dwell is an indication of the ratio of "on" to "off" time.*

(1) If idle mixture plug has not been removed:

(a) Remove air cleaner and gasket.

WARNING: *Battery negative cable must be removed to prevent a potential fire hazard when fuel pipe is disconnected.*

(b) Disconnect battery negative cable.

(c) Disconnect fuel pipe and vacuum hoses from carburetor. Identify and tag hoses.

(d) Disconnect throttle linkage and electrical connectors.

(e) Remove carburetor attaching bolts and nuts, and remove carburetor and mounting gasket.

(f) Invert carburetor and drain fuel in container.

(g) Place inverted carburetor on suitable holding fixture manifold side up.

CAUTION: *Use care to avoid damaging linkage, tubes, and parts protruding from air horn.*

(2) Remove idle mixture screw plug as follows:

(a) Using a punch between two locator points in throttle body beneath idle mixture screw plug (manifold side) break out throttle body to gain access to idle mixture screw plug. Drive out hardened steel plug concealing mixture screw.

NOTE: *Hardened plug will shatter rather than remaining intact. It is not necessary to remove plug completely; instead, remove loose pieces to allow use of Idle Mixture Adjusting Tool J-29030.*

(b) Lightly seat screw and back out three turns (automatic transmission) or 2-1/2 turns (manual transmission) for preliminary idle mixture adjustment. Final adjustment must be performed after carburetor is installed.

(c) If plug in air horn covering idle air bleed screw has been removed, turn air bleed screw in until lightly seated, then back out 1-1/4 turns. If plug is in place, removal and adjustment is not required.

(d) Remove vent stack-screen assembly to gain access to lean mixture screw. (Ensure it is installed after adjustment). Turn lean mixture screw in until lightly seated and back out three turns.

(3) Install carburetor on engine. Install battery negative cable. Do not install air cleaner and gasket.

(4) Disconnect bowl vent hose at carburetor.

(5) Disconnect EGR valve and canister purge vacuum hose at carburetor and plug carburetor port.

(6) Connect tachometer to distributor tach output. Connect dwell meter to mixture control solenoid dwell test lead (fig. 1J-160).

(7) Place transmission in Park and set parking brake (manual transmission: Neutral).

WARNING: *Use extreme caution when performing adjustment while engine is operating. The fan, pulleys and belts can cause serious personal injury. Avoid wearing loose clothing. Do not stand in direct line with fan.*

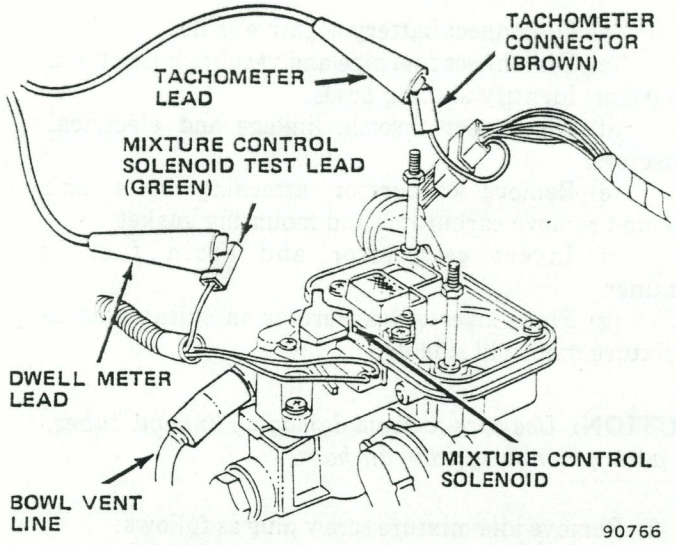

Fig. 1J-160 Idle Mixture Adjustment Preparation

(8) Start engine and operate at fast idle for at least three minutes to allow C4 System to switch to Closed Loop Operation.

NOTE: *Adjusting Tool J-29030 is required for adjustments.*

(9) Operate engine at 3000 rpm and adjust lean mixture screw (fig. 1J-161) in increments to obtain average dwell as specified in Specifications. Allow time for dwell to stabilize after each incremental adjustment. If dwell is too low, back screw out; if too high, turn screw in. If unable to adjust to specification, inspect main metering circuit for leaks, restrictions, etc.

(10) Return engine to idle and adjust idle speed to 700 rpm.

(11) Adjust idle mixture screw to obtain an average dwell as specified in Specifications. If dwell is too low, slowly back screw out. If too high, slowly turn in. Allow time for dwell to stabilize after each adjustment. Adjustment is very sensitive. Make final dwell check with adjusting tool removed. If unable to adjust to specification, inspect idle circuit for leaks, restrictions, etc.

(12) Disconnect MC solenoid wire connector and look for an engine speed change of at least 50 rpm. If speed does not change enough, inspect idle air bleed circuit for restrictions, leaks, etc. Connect MC Solenoid wire connector.

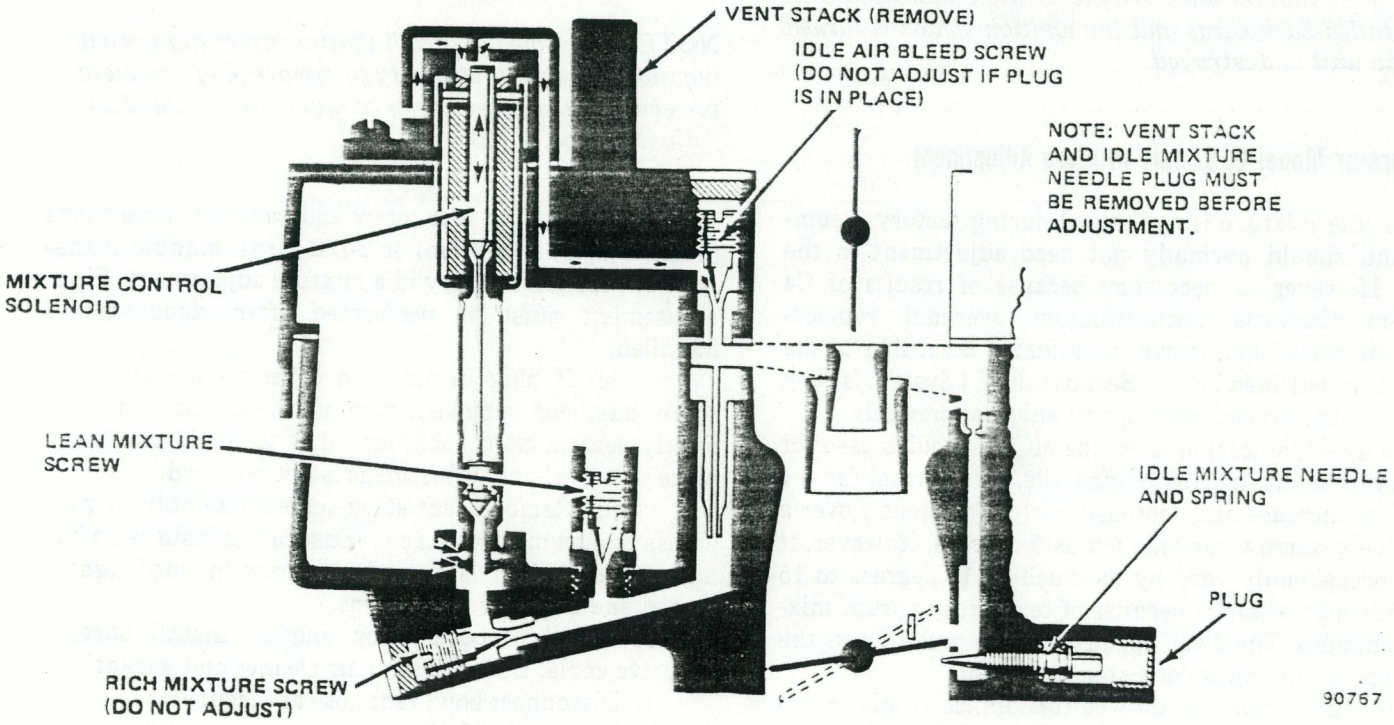

Fig. 1J-161 Model E2SE Carburetor Adjustment Screws

Carburetor Model E2SE Idle Mixture Adjustment Specifications

Transmission	Carburetor Number	Idle Mixture Screw		Idle Air Bleed Screw Preset Turns	Lean Mixture Part Throttle Screw	
		Preset Turns	Dwell		Preset Turns	Dwell
Manual	17081796	2-1/2	25°	1 - 1/4	3	35°
Automatic	17081797	3	25°	1 - 1/4	3	35°

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(13) Increase engine speed to 3000 rpm and note dwell as adjusted in step (9) above. If not correct, readjust lean mixture screw and then idle mixture screw. When correct, reconnect purge and bowl vent hoses, EGR valve, and adjust idle speed according to Emission Control Information label instructions. Remove tachometer and dwell meter.

C4 System Tests and Trouble Code Diagnosis

The self-diagnostic system does not detect all possible faults. The absence of a trouble code does not indicate there is not a malfunction with the system. To determine whether or not a system problem exists, an operational test is necessary.

NOTE: *The System Operational Test should also be performed after all repairs on the C4 System have been completed.*

CAUTION: *The wire leading from the distributor tach terminal to the ECM has an in-series filter. The tachometer must be connected* ***only*** *to the distributor side of the filter.*

Driver Complaints

- Poor Engine Performance or Fuel Economy

If the test bulb is not illuminated, normal tests that would be performed on vehicles without the C4 System should be performed before proceeding to the Operational Test.

- **Alternator Warning Light or Coolant Temperature Hot.**

If the alternator warning lamp is illuminated or coolant temperature is excessively high along with the test bulb being illuminated, diagnose those problems first. Inspect for faulty connections at coolant temperature sensor, alternator, MC solenoid, etc., and defective or loose vacuum hoses and connections. Repair as necessary.

- **Intermittent Test Bulb Display**

If the test bulb illuminates intermittently but a trouble code cannot be obtained, inspect the following items.

NOTE: *If for any reason engine speed drops below 200 rpm, the test bulb will be illuminated until the speed exceeds 200 rpm.*

(1) Poor connection in circuit from distributor tach terminal to ECM terminal A, ignition terminal 1 to ECM, and ECM terminal T to ground.

(2) Tach filter resistance should be 14,000 to 18,000 ohms between distributor and ECM terminals (with one end disconnected) and open circuit to ground.

(3) Low battery voltage (under 9 volts).

(4) Loss of long term memory. Momentarily grounding MC solenoid dwell wire connector with engine idling should cause trouble code 23, which should be retained after engine is stopped and restarted. If voltage is present at long term memory terminal but code was not flashed, ECM is defective.

- Acceleration Stumble

Perform Adaptive Vacuum Switch Circuit Test, Chart 7.

- All Other Complaints

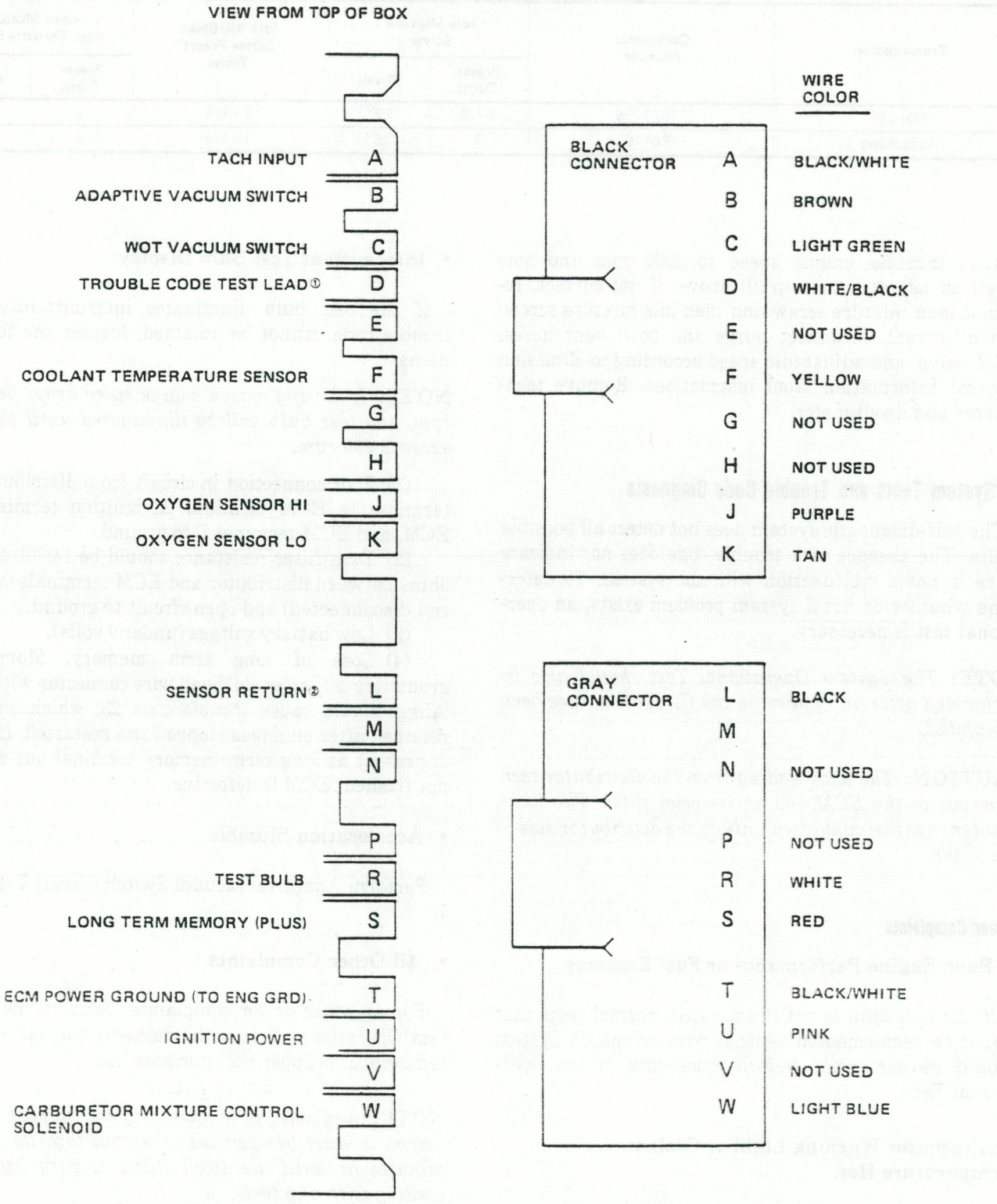
For all other driver complaints, perform the C4 System Operational Test with engine at normal operating temperature (upper radiator hose hot).

NOTE: *Anytime an engine is first started, even if warm, it must be operated at partial throttle for three minutes or until the dwell starts to vary before proceeding with any test.*

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

NOTE: *Install test bulb before performing tests.*

ECM Terminal Connections



(1) GROUND TO OBTAIN MALFUNCTION CODE

(2) COOLANT, WOT AND ADAPTIVE VACUUM SWITCHES

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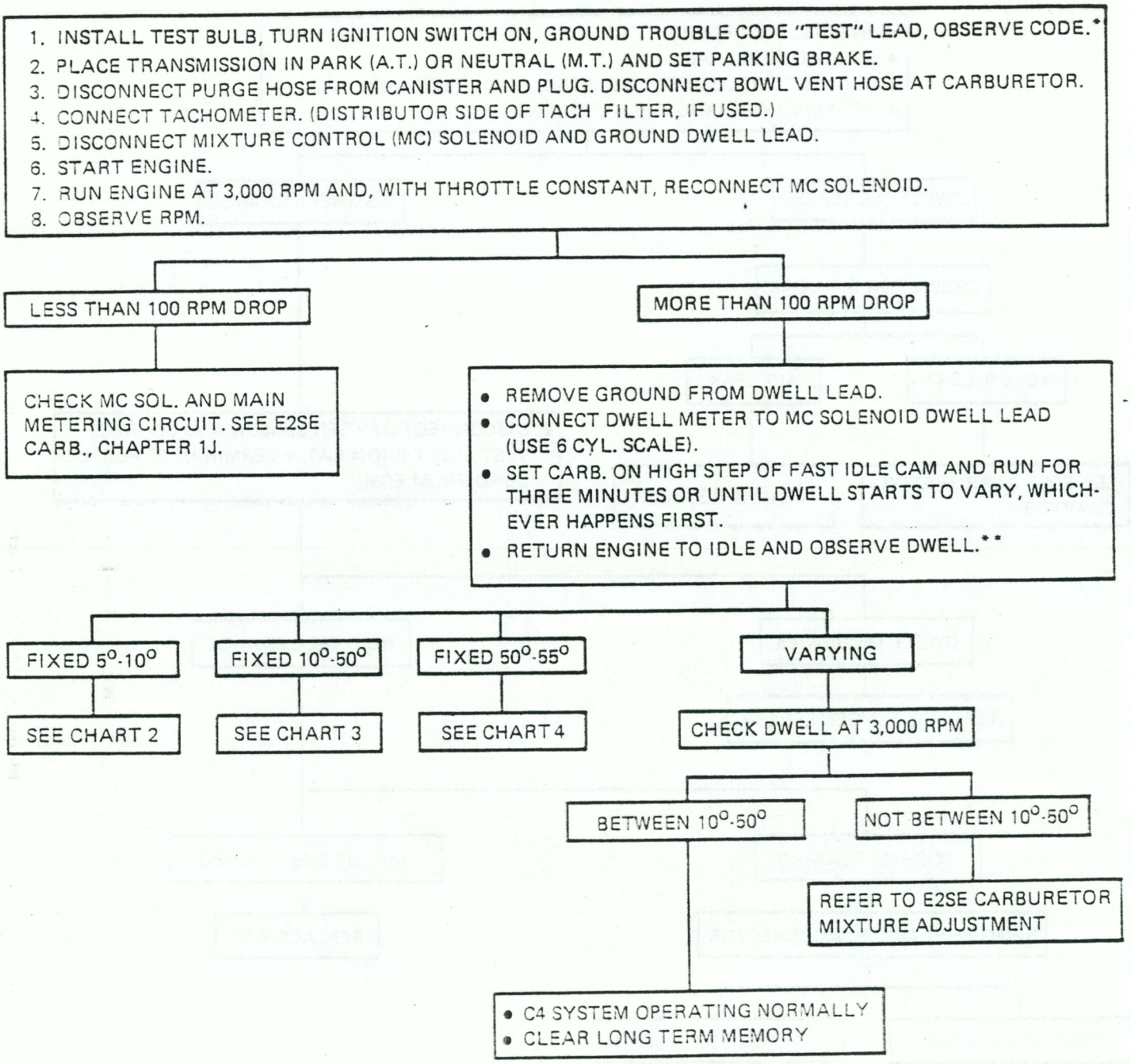
C4 SYSTEM TESTS AND TROUBLE CODE DIAGNOSIS



* IF TEST BULB IS NOT ILLUMINATED, SEE CHART 6.

** OXYGEN SENSOR TEMPERATURE MAY COOL AT IDLE CAUSING THE DWELL TO CHANGE FROM VARYING TO A FIXED INDICATION BETWEEN 10°-50°. IF THIS HAPPENS, RUN THE ENGINE AT FAST IDLE TO HEAT THE SENSOR.

Chart 2—Dwell Fixed Between 5 Degrees and 10 Degrees

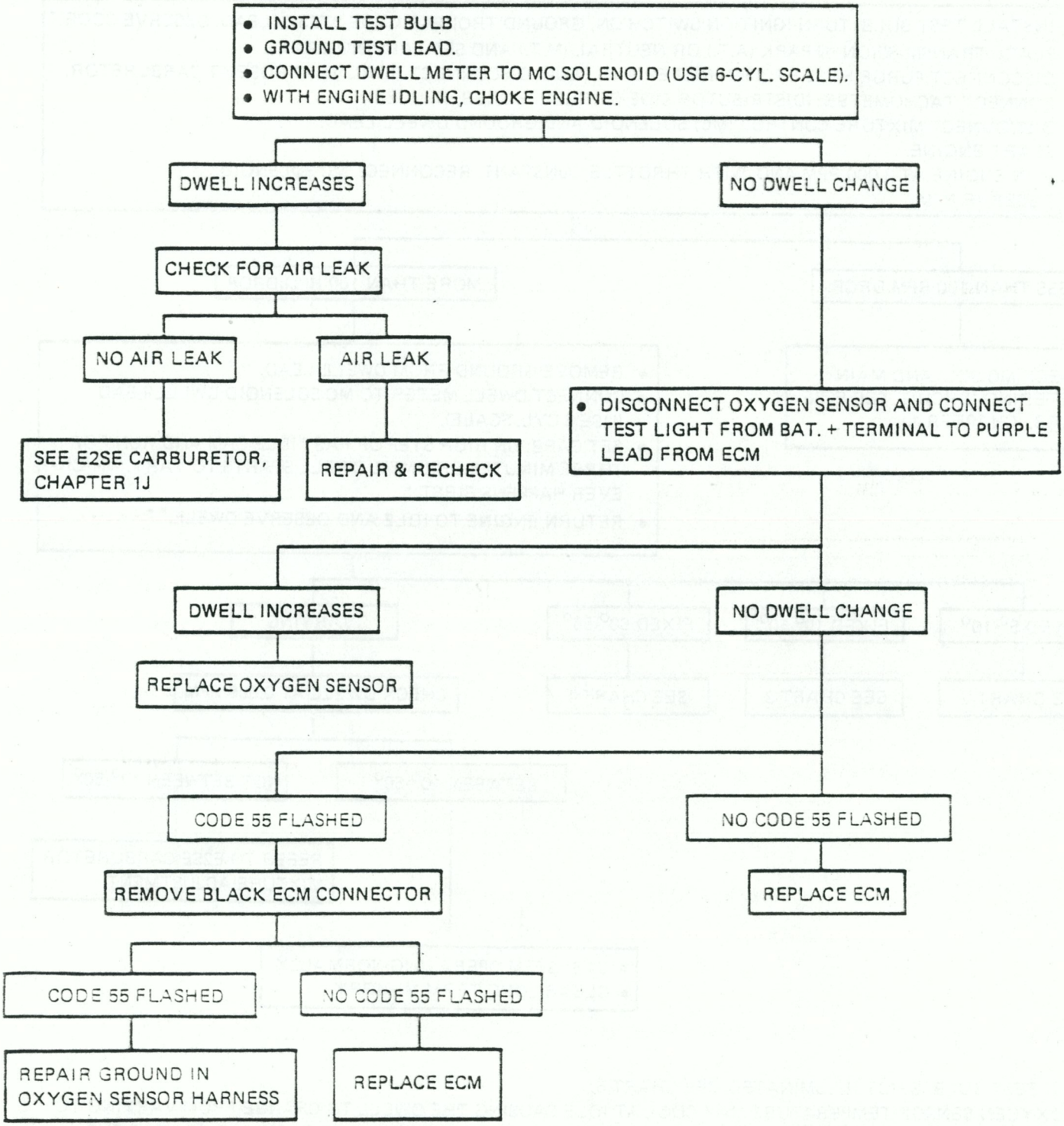


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Chart 3—Dwell Fixed Between 10 Degrees and 50 Degrees

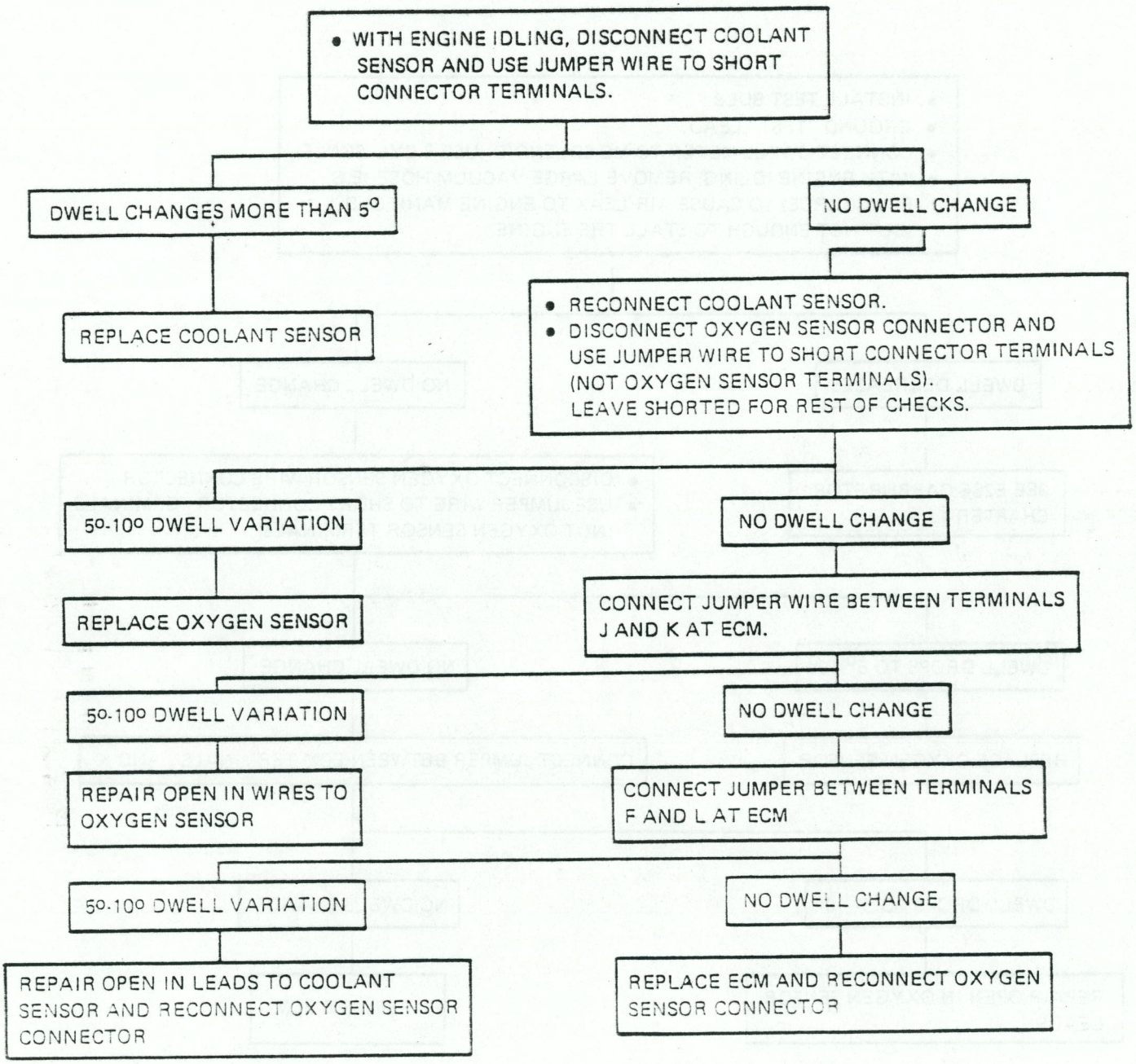

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Chart 4—Dwell Fixed Between 50 Degrees and 55 Degrees

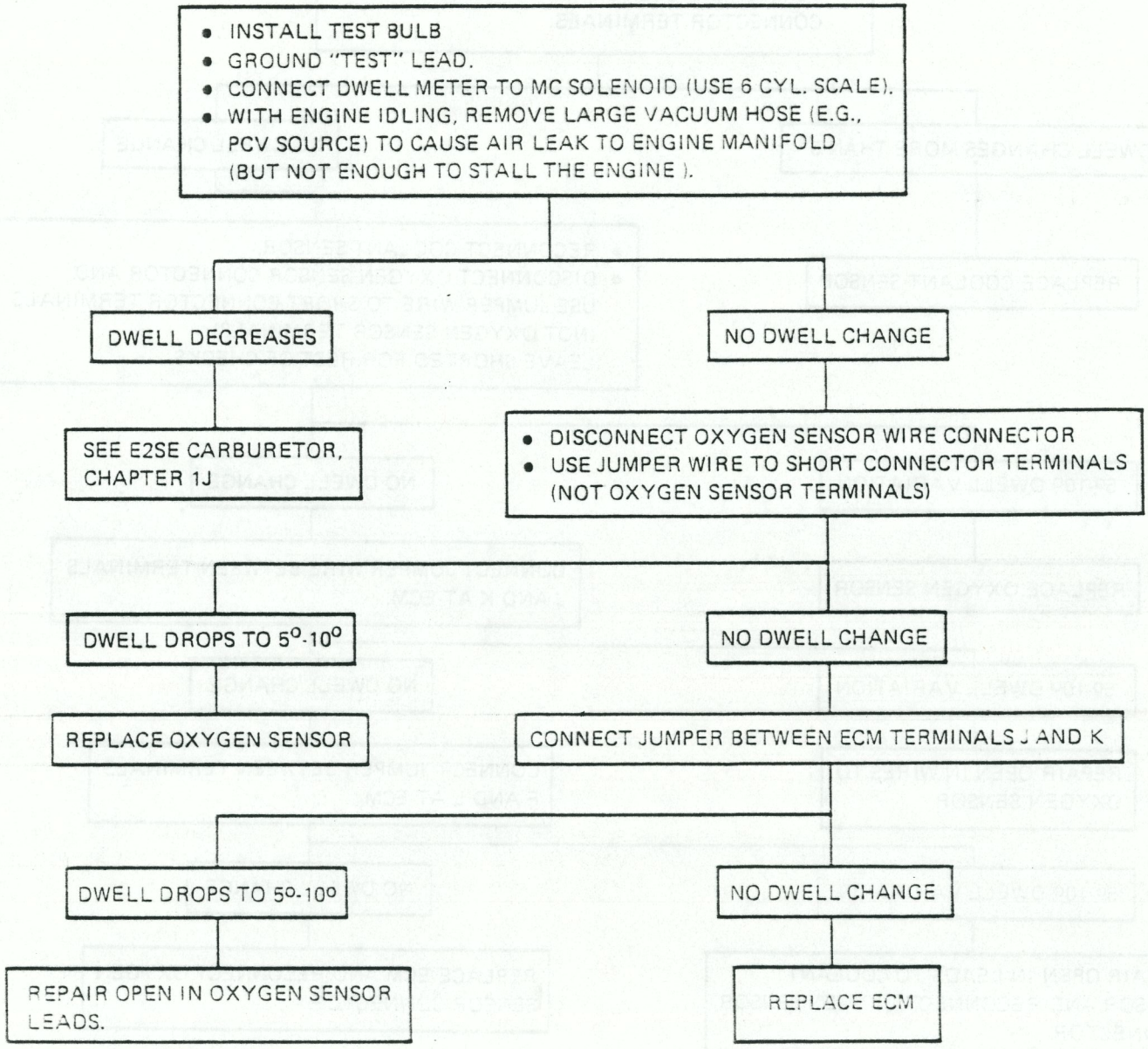

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Chart 5—Self-Diagnostic Circuit Test

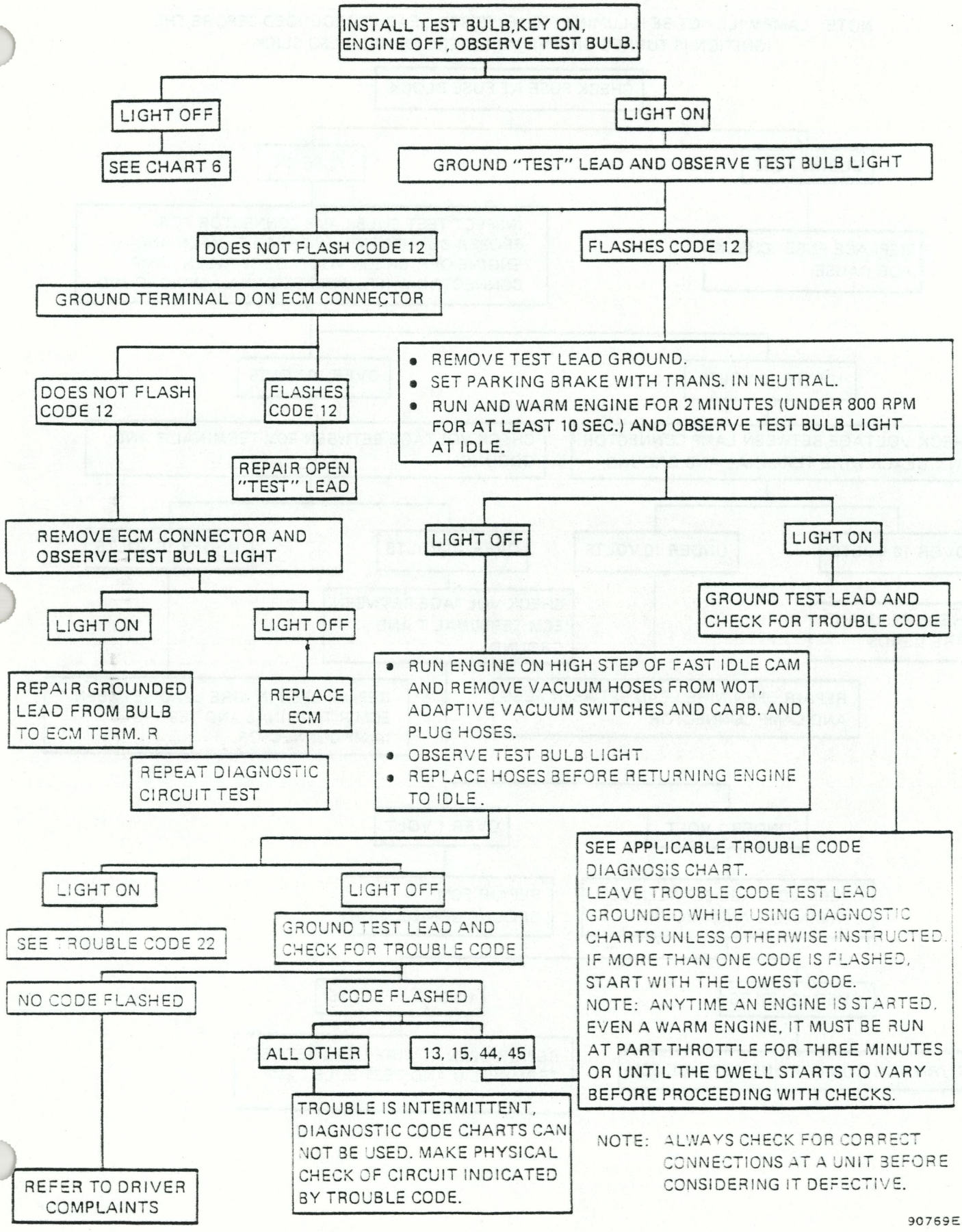

Chart 6—Test Bulb Circuit Inoperative

NOTE: LAMP WILL NOT BE ILLUMINATED IF "TEST" LEAD IS GROUNDED BEFORE THE IGNITION IS TURNED ON. THE MC SOLENOID WILL ALSO CLICK.

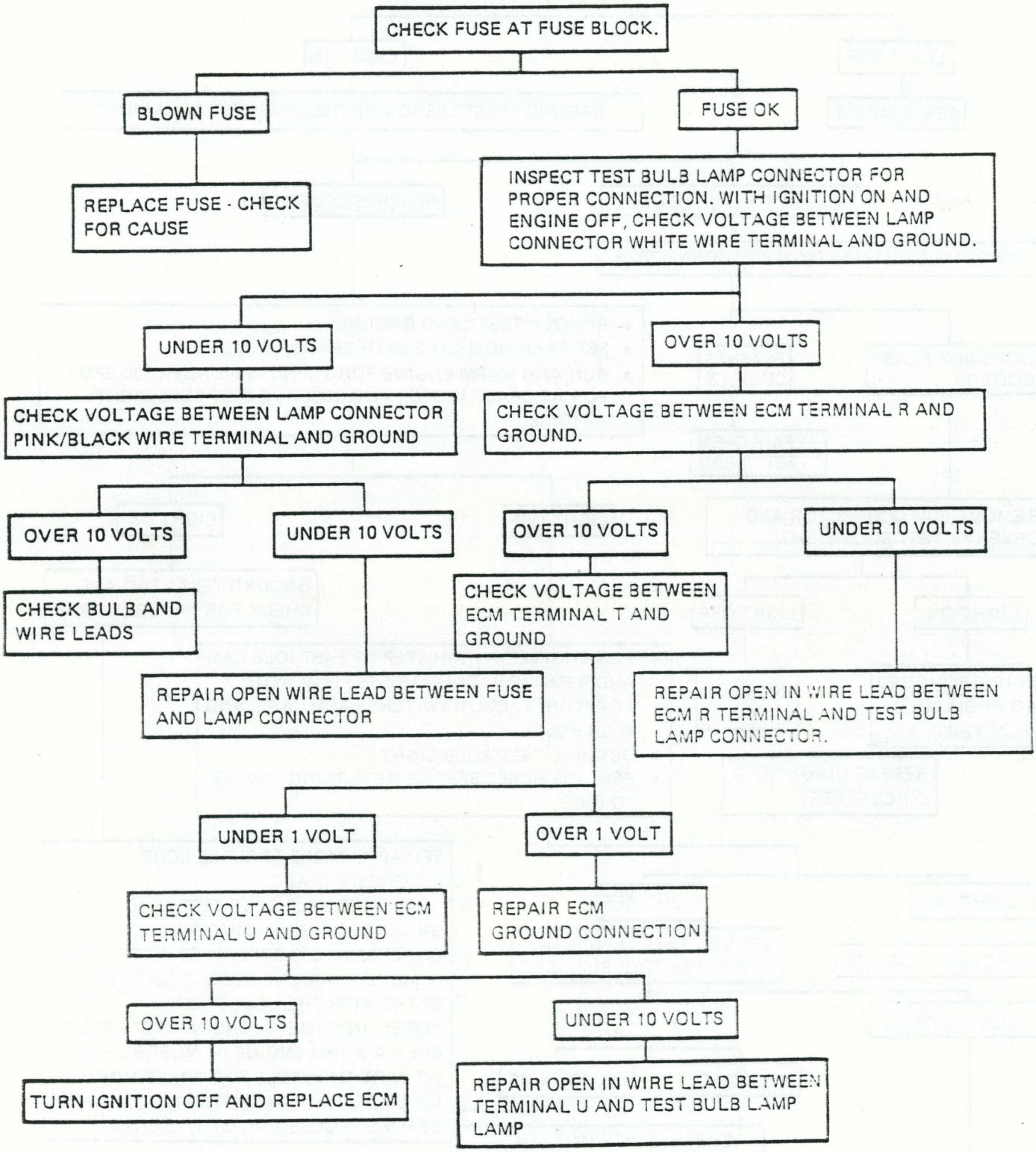

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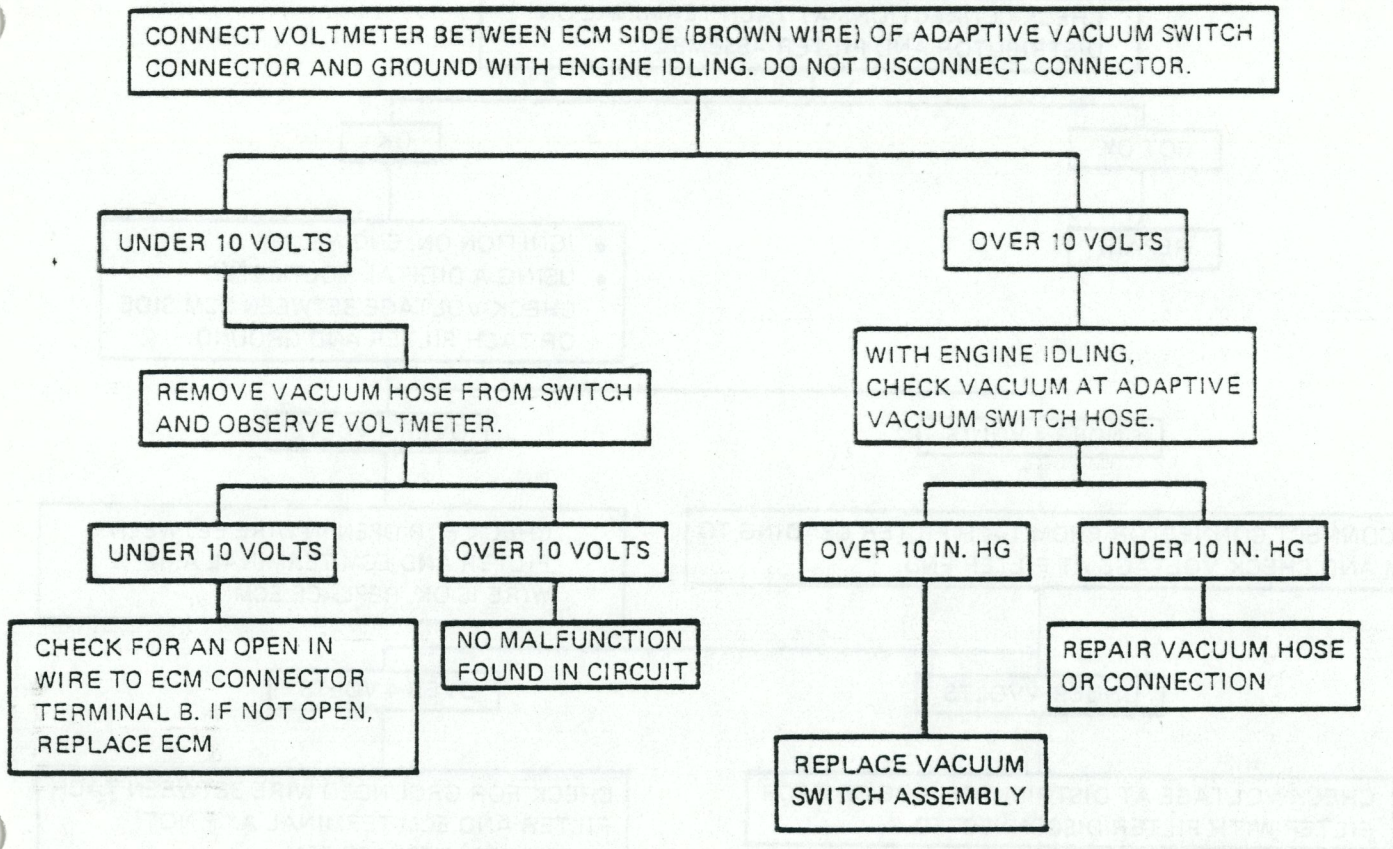
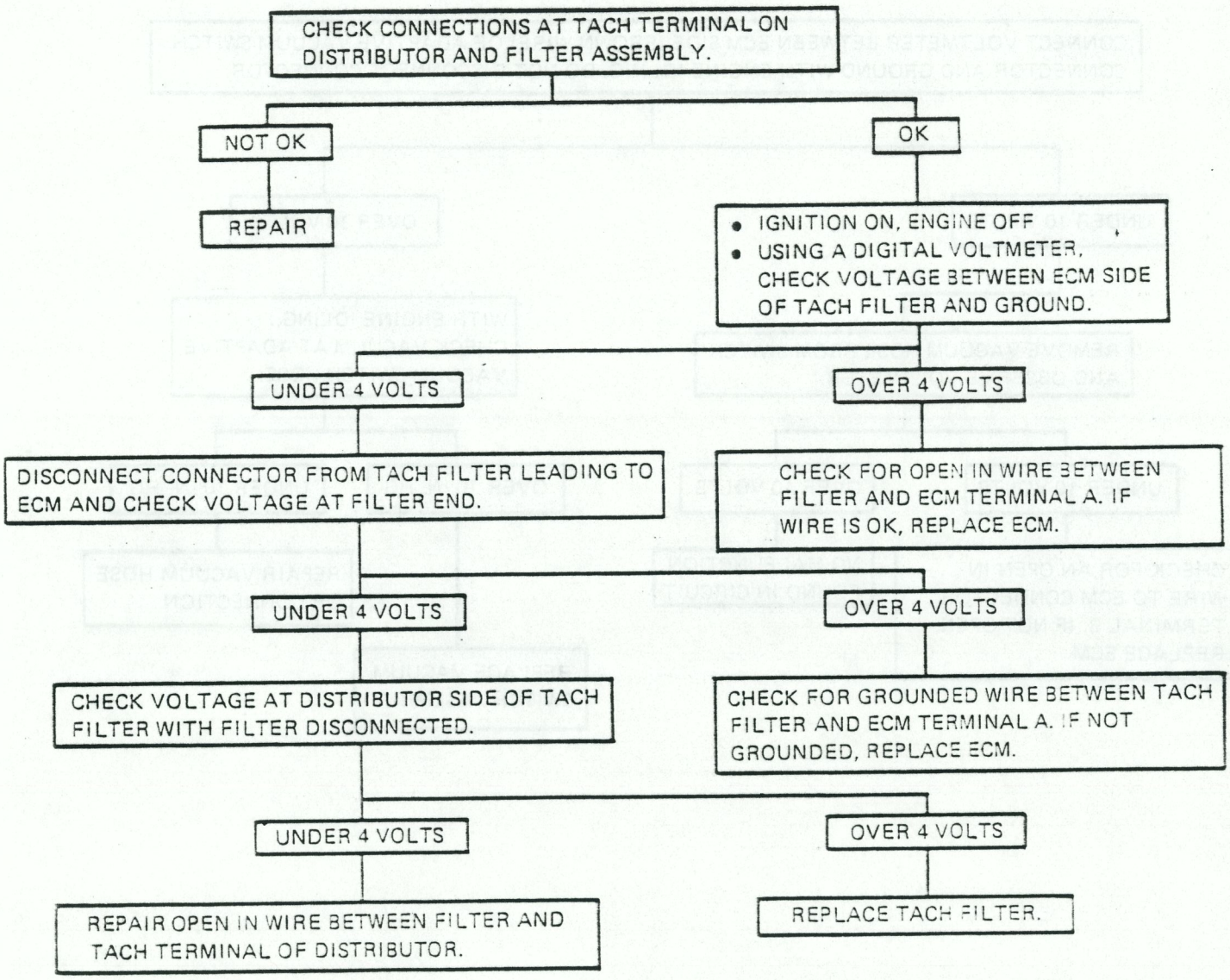
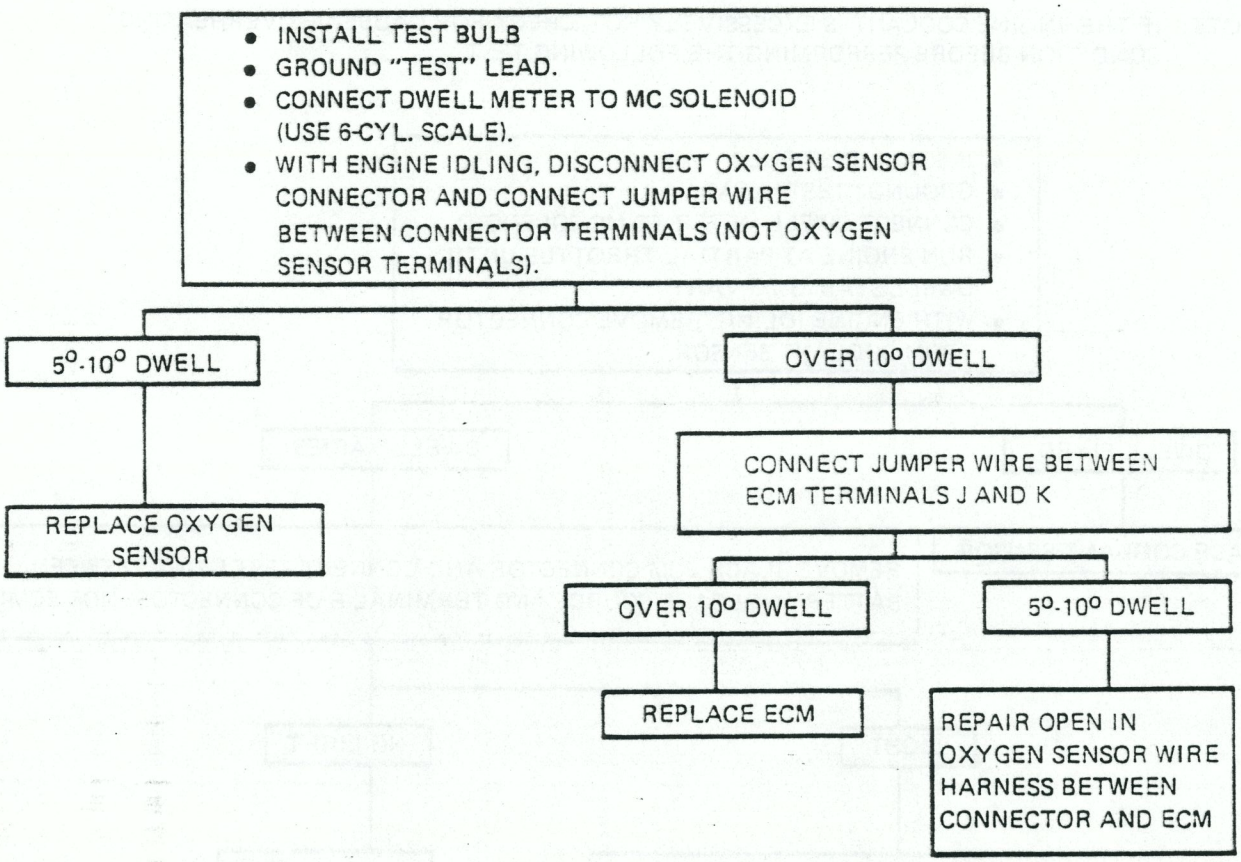
Chart 7—Adaptive Vacuum Switch Circuit Test



TROUBLE CODE 12

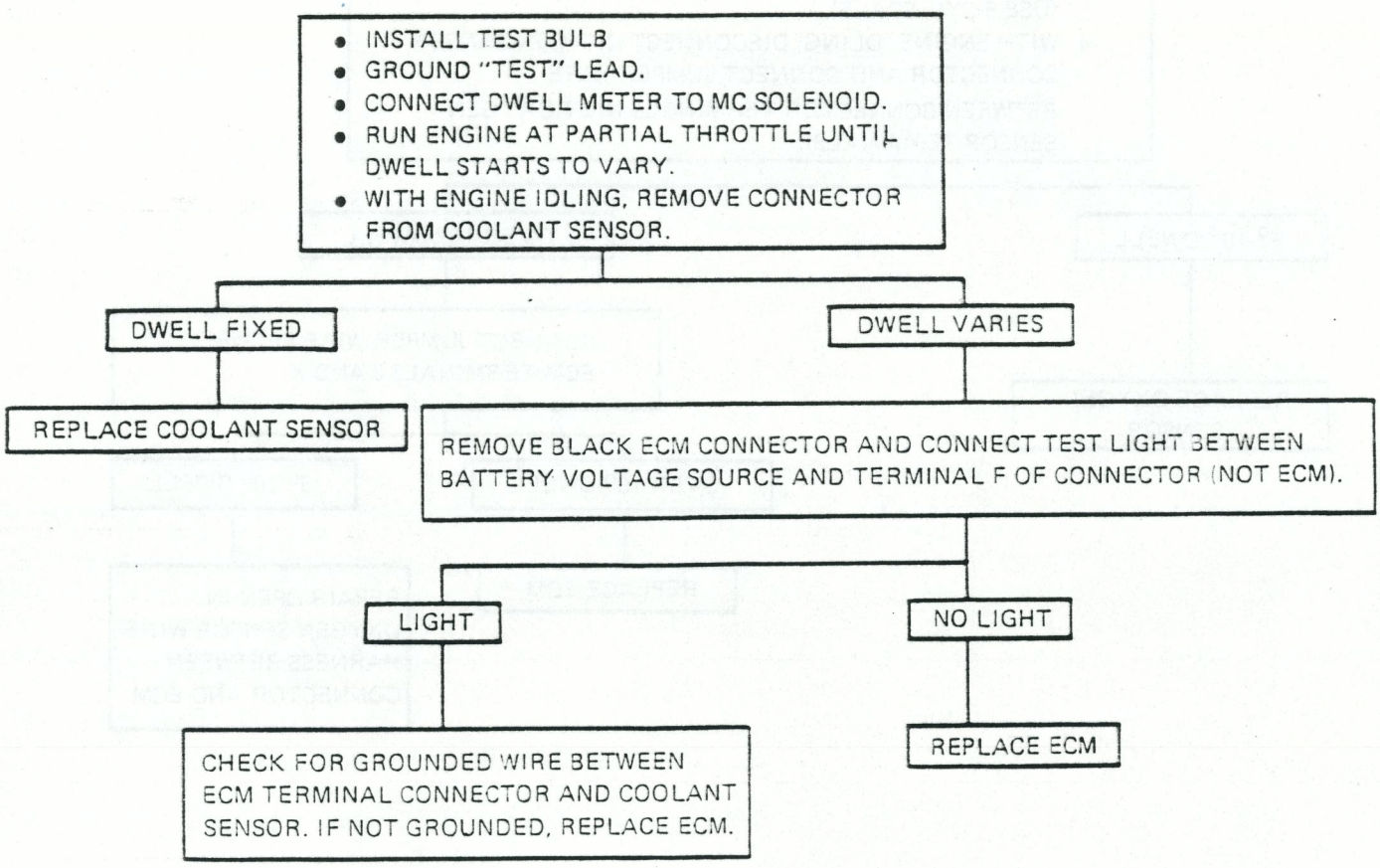


TROUBLE CODE 13



TROUBLE CODE 14

NOTE: IF THE ENGINE COOLANT IS EXCESSIVELY HOT, CHECK FOR CAUSE OF OVERHEATING CONDITION BEFORE PERFORMING THE FOLLOWING TEST.



TROUBLE CODE 15

- INSTALL TEST BULB
- GROUND "TEST" LEAD.
- CONNECT DWELL METER TO MC SOLENOID (USE 6 CYL. SCALE)
- STOP AND START ENGINE AND RUN AT PARTIAL THROTTLE FOR 3 MINUTES AND OBSERVE DWELL.
- WITH ENGINE IDLING, REMOVE CONNECTOR FROM COOLANT SENSOR AND CONNECT JUMPER WIRE BETWEEN CONNECTOR TERMINALS.

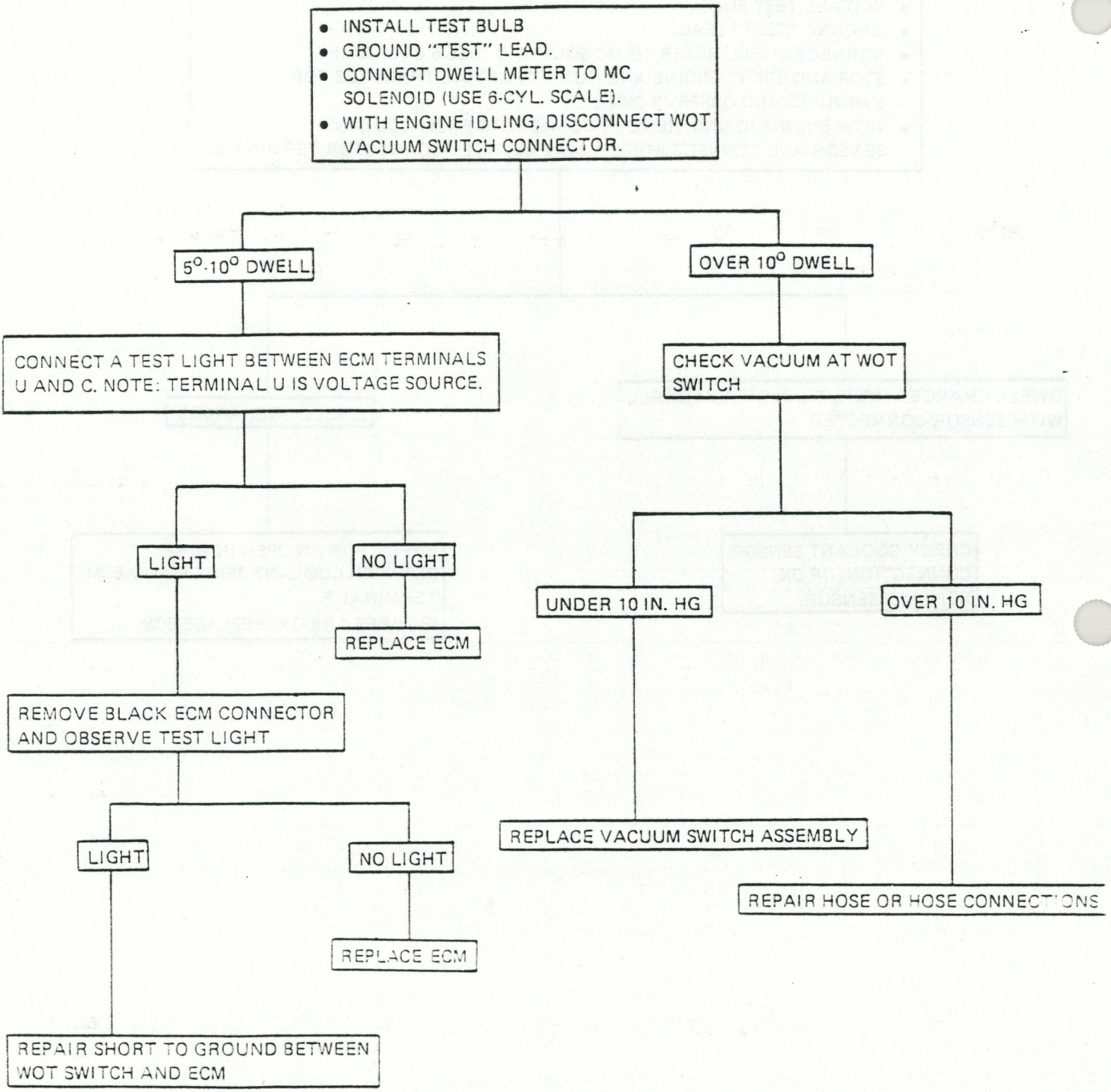
DWELL CHANGED MORE THAN 5°FROM DWELL WITH SENSOR CONNECTED

CHECK COOLANT SENSOR CONNECTION. IF OK, REPLACE SENSOR.

DWELL UNCHANGED

CHECK FOR AN OPEN IN WIRES BETWEEN COOLANT SENSOR AND ECM TERMINAL F.
IF WIRES ARE OK, REPLACE ECM.

TROUBLE CODE 21 AND 22 TOGETHER



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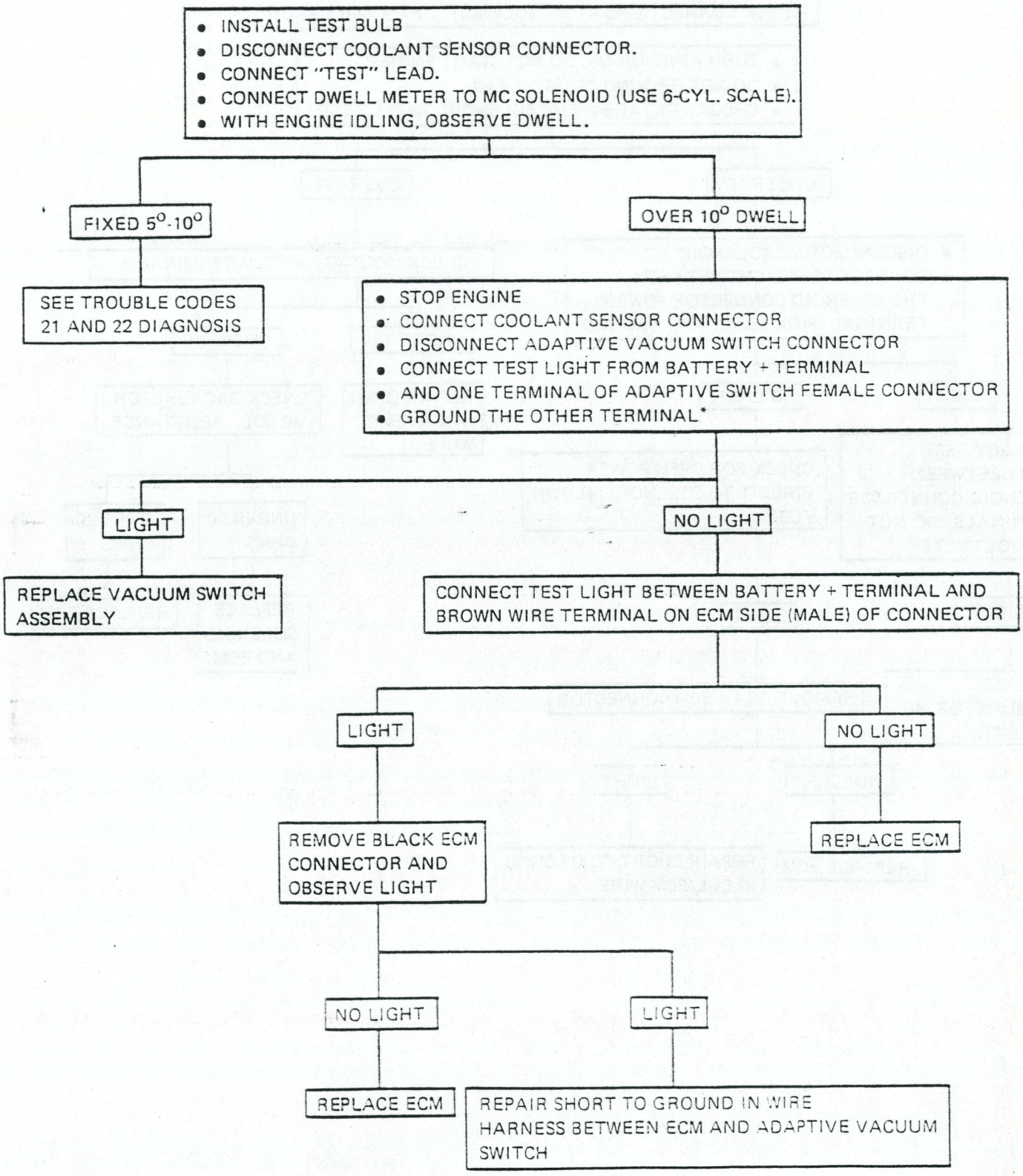
TROUBLE CODE 22



*OXYGEN SENSORS MAY COOL OFF AT IDLE AND THE DWELL CHANGE FROM VARYING TO FIXED BETWEEN 10°-50°. IF THIS OCCURS, RUNNING THE ENGINE AT FAST IDLE WILL WARM IT UP AGAIN.

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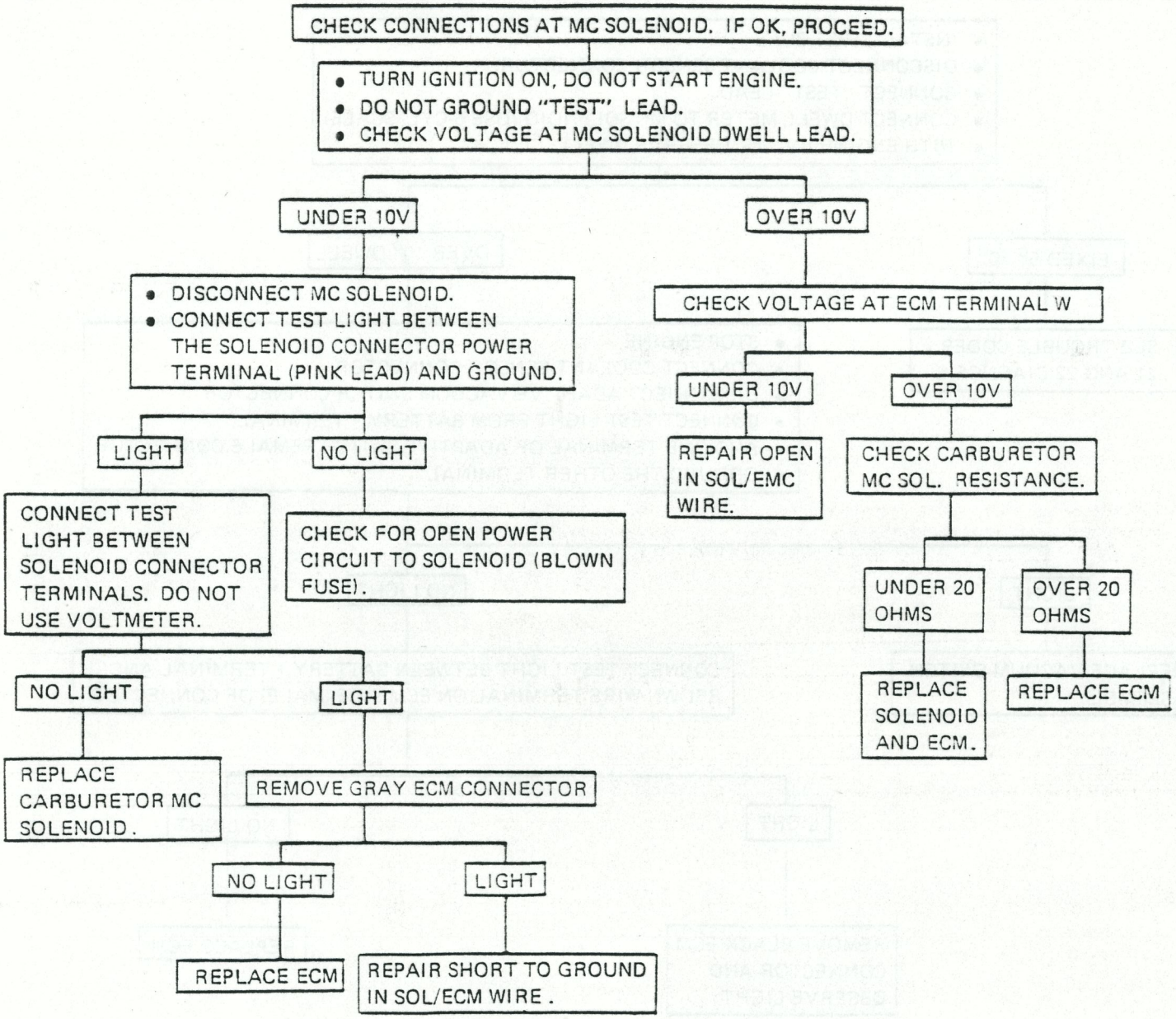
TROUBLE CODE 23



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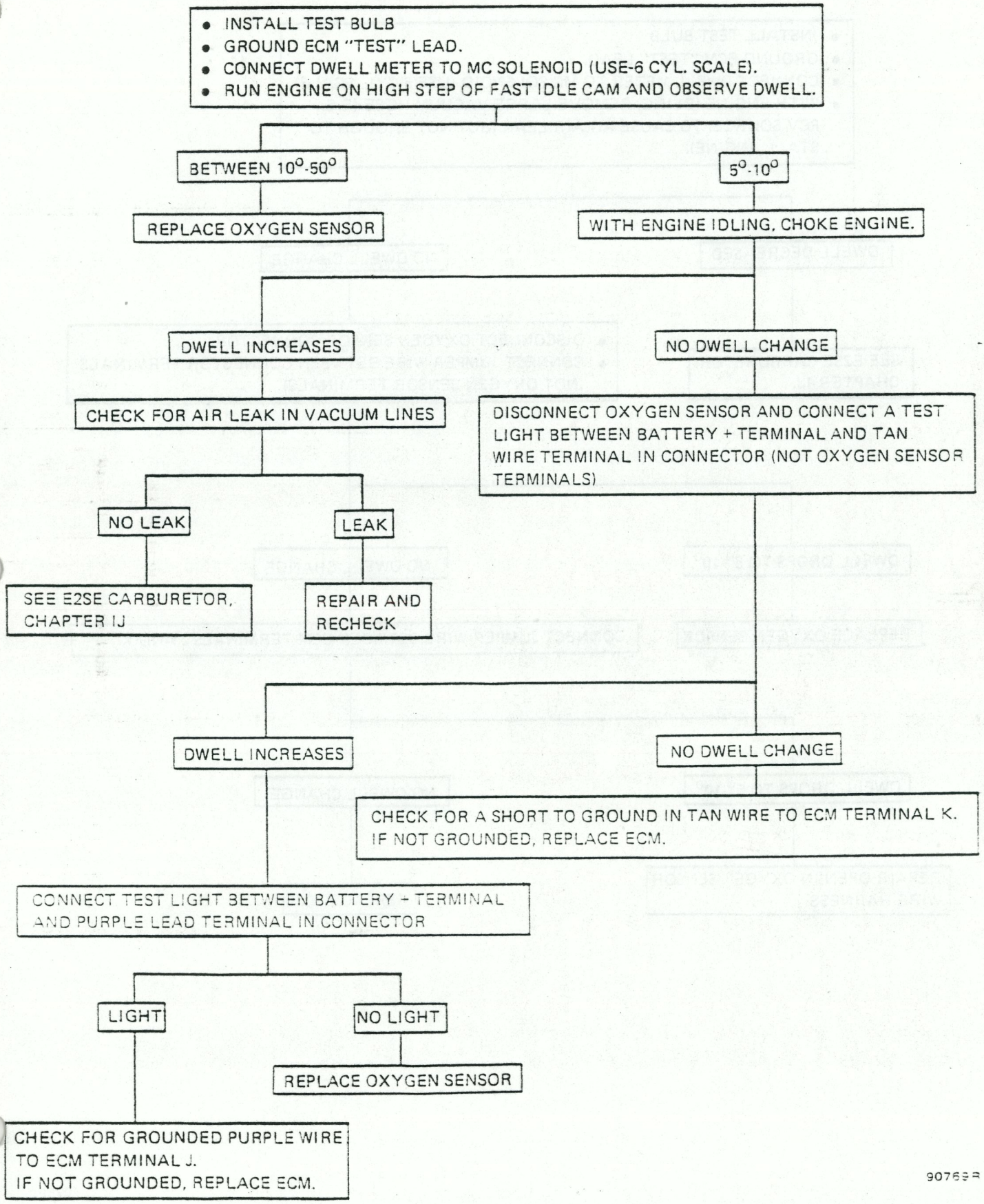
TROUBLE CODE 44

NOTE: IF CODES 44 AND 55 ARE BOTH FLASHED, REPLACE OXYGEN SENSOR AND PERFORM SYSTEM OPERATIONAL TEST.



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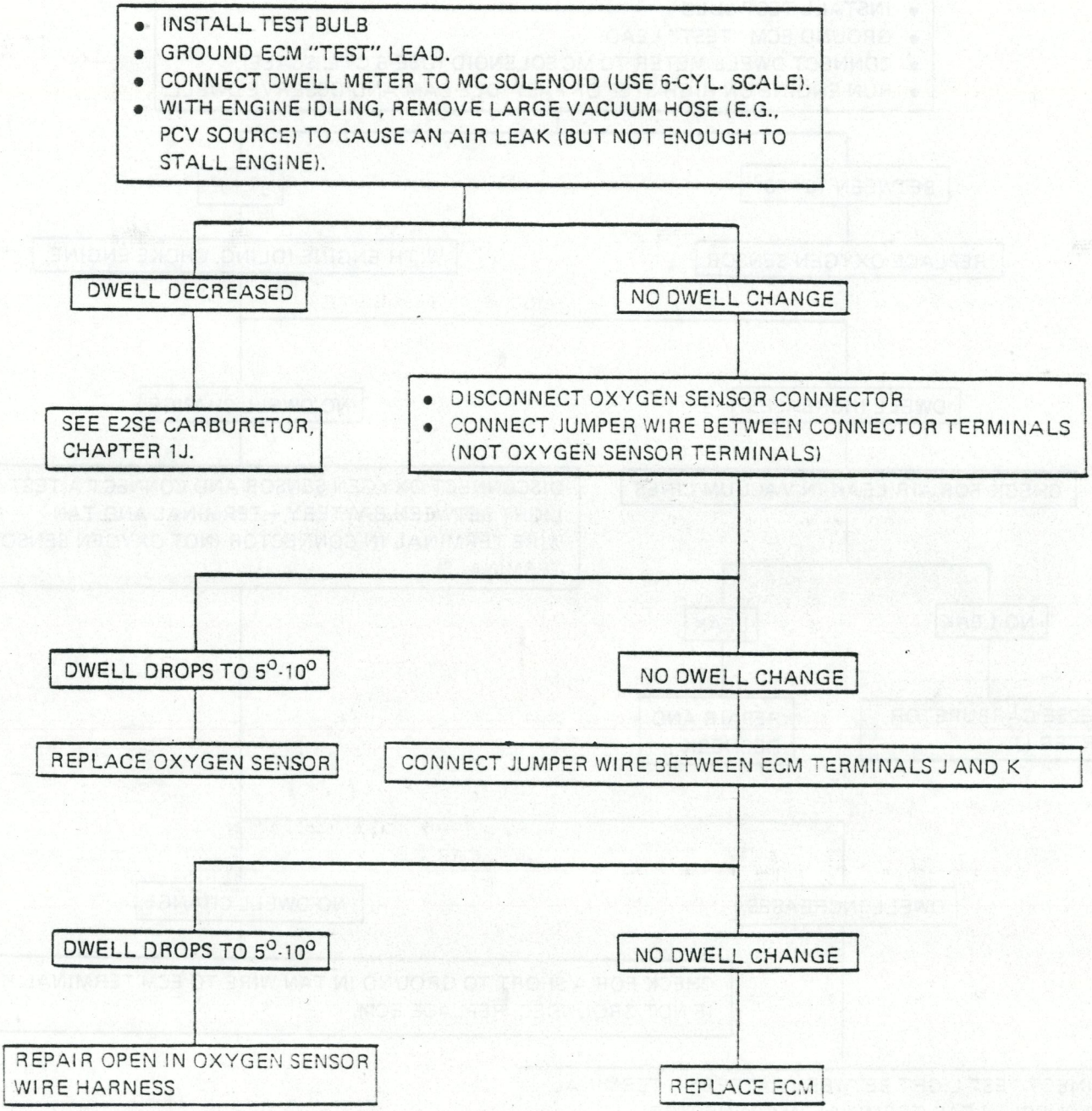
TROUBLE CODE 45



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TROUBLE CODE 51-55

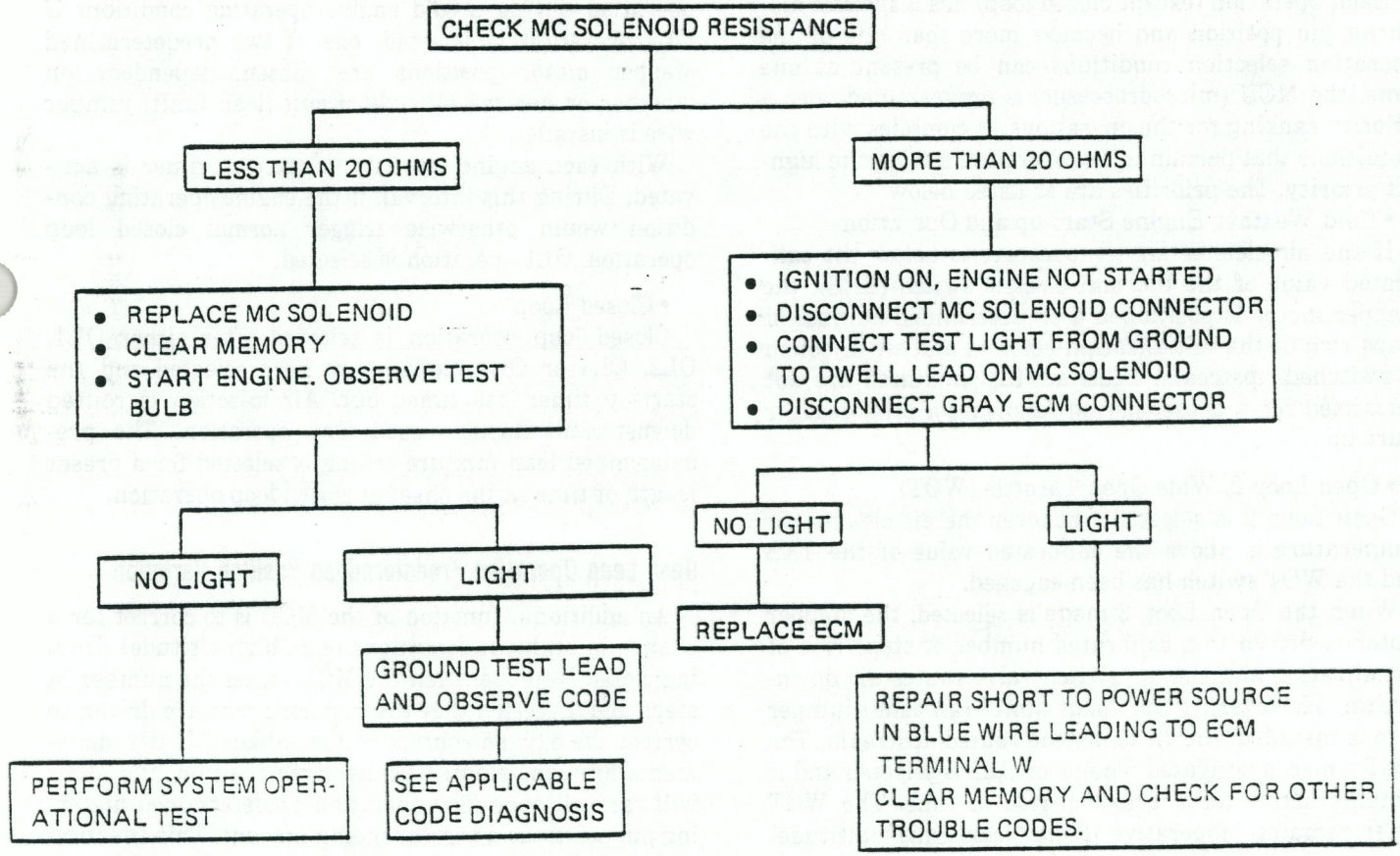
TROUBLE CODE 51

CHECK TO ENSURE ALL CALIBRATION UNIT PINS ARE FULLY INSERTED IN THE SOCKET AND ALIGNMENT IS CORRECT. IF OK, REPLACE ECM.

TROUBLE CODES 52-53

REPLACE ECM IF TEST BULB ILLUMINATED. NO TEST BULB LIGHT, INTERMITTENT ECM MALFUNCTION.

TROUBLE CODE 54



TROUBLE CODE 55

CHECK FOR AN OPEN IN OXYGEN SENSOR RETURN WIRE TO ECM TERMINAL K. IF OK, REPLACE ECM.

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DIAGNOSTIC PROCEDURES FOR CEC SYSTEM

General

The open loop mode of operation occurs when:
- starting engine, engine is cold or air cleaner air is cold,
- engine is idling,
- engine is at wide open throttle (WOT).

When any of these conditions occur, the metering pins are driven to a predetermined programmed position for each condition. Because the positions are predetermined and no feedback from the oxygen sensor relative to the results is accepted, this type of operation is referred to as open loop operation. The five open loop operations are characterized by the metering pins being driven to a position where they are stopped and remain stationary.

Operational Priorities

Each operation (except closed loop) has a specific metering pin position and because more than one of the operation selection conditions can be present at one time, the MCU (microprocessor) is programmed with a priority ranking for the operations. It complies with the conditions that pertain to the operation having the highest priority. The priorities are as listed below.

- Cold Weather Engine Start-up and Operation

If the air cleaner air temperature is below the calibrated value of the thermal electric switch (TES), the stepper motor is positioned a predetermined number of steps rich of the initialization position and air injection is switched upstream. Lean air/fuel mixtures are not permitted for a preset period following a cold weather start-up.

- Open Loop 2, Wide Open Throttle (WOT)

Open Loop 2 is selected whenever the air cleaner air temperature is above the calibrated value of the TES and the WOT switch has been engaged.

When the Open Loop 2 mode is selected, the stepper motor is driven to a calibrated number of steps rich of initialization and the air switch valve routes air downstream. However, if the "lean limit" (altitude) jumper wire is installed, the air is instead routed upstream. The WOT timer is activated whenever OL2 is selected and it remains active for a preset period of time. The WOT timer remains inoperative if the "lean limit" (altitude) jumper wire is installed.

- Open Loop 4

Open Loop 4 is selected whenever manifold vacuum falls below a predetermined level. During OL4 operation, the stepper motor is positioned at the initialization position. Air injection is switched upstream during OL4 operation. However, air is diverted downstream if the extended OL4 timer is activated and if "lean limit" (altitude) jumper wire is not installed. Air is also diverted downstream if the WOT timer is activated.

- Open Loop 3

Open Loop 3 is selected when the spark advance vacuum level falls below a predetermined level.

When the OL3 mode is selected, the engine rpm is also determined. If the rpm voltage is greater than the calibrated value, an engine deceleration condition is assumed to exist. If the rpm voltage is less than the calibrated value, an engine idle condition is assumed to exist.

Both deceleration and idle conditions are independently selectable to be either an open loop or closed loop situation. If selected as an open loop situation, the air is directed upstream.

- Open Loop 1

Open Loop 1 will be selected if the air cleaner air temperature is above a calibrated value and Open Loop 2, 3 or 4 is not selected, and if the engine coolant temperature is below the calibrated value.

The OL1 mode operates in lieu of normal closed-loop operation during a cold engine operating condition. If OL1 operation is selected, one of two predetermined stepper motor positions are chosen, dependent on whether or not the altitude circuit (lean limit) jumper wire is installed.

With each engine start-up, a start-up timer is activated. During this interval, if the engine operating condition would otherwise trigger normal closed loop operation, OL1 operation is selected.

- Closed Loop

Closed loop operation is selected after either OL1, OL2, OL3 or OL4 modes have been selected and the start-up timer has timed out. Air injection is routed downstream during closed loop operation. The predetermined lean mixture ceiling is selected for a preset length of time at the onset of closed loop operation.

Open Loop Operation Predetermined Position Variation

An additional function of the MCU is to correct for a change in ambient conditions (e.g., high altitude). During closed loop operation the MCU stores the number of steps and direction that the metering pins are driven to correct the oxygen content of the exhaust. If the movements are consistently to the same position, the MCU will vary all open loop operation predetermined metering pin positions a corresponding amount. This function allows the open loop air/fuel mixture ratios to be "tailored" to the existing ambient condition during each uninterrupted use of the system. This optimizes emission control and engine performance for the ambient operating condition involved.

Closed Loop Operation

The CEC system controls the air/fuel ratio with movable air metering pins, visible from the top of the carburetor air horn, that are driven by the stepper motor. The

stepper motor moves the metering pins in increments or small steps via electrical impulses generated by the MCU. The MCU causes the stepper motor to drive the metering pins to a richer or leaner position in reaction to the voltage input from the oxygen sensor located in the exhaust manifold. The oxygen sensor voltage varies in reaction to changes in oxygen content present in the exhaust gas. Because the content of oxygen in the exhaust gas indicates the completeness of the combustion process, it is a reliable indicator of the air/fuel mixture that is entering the combustion chamber.

Because the oxygen sensor only reacts to oxygen, any air leak or malfunction between the carburetor and sensor may cause the sensor to provide an erroneous voltage output. This could be caused by a fouled spark plug, manifold air leak or malfunctioning secondary air check valve.

The engine operation characteristics never quite permit the MCU to compute a single metering pin position that constantly provides the optimum air/fuel mixture. Therefore, closed loop operation is characterized by constant movement of the metering pins because the MCU is forced constantly to make small corrections in the air/fuel mixture in an attempt to create an optimum air/fuel mixture ratio.

Self-Diagnostic System

The CEC System (fig. 1J-162) should be considered as a possible source of trouble for engine performance, fuel economy and exhaust emission complaints only after normal tests that would apply to a vehicle without the system have been performed. An integral self-diagnostic subsystem detects the problems that are most likely to occur.

The self-diagnostic subsystem illuminates a **Check Engine** display on the instrument panel when a fault occurs. A trouble code will be flashed to identify the malfunction.

As a routine bulb and system check, the display will also be illuminated when the ignition switch is first turned **on** and the engine not started. This indicates that the self-diagnostic system is functioning normally (i.e., no engine rpm voltage). When the engine is started, the display will remain illuminated for a few seconds.

When a fault has been detected, the trouble code will be flashed five times. The series of code flashes will not be repeated (unless the ignition is turned off and then the engine restarted).

A trouble code indicates a problem within a specific circuit, for example, code 12 indicates a problem in the temperature sensing circuit. This includes the coolant temperature switch, wire harness, thermal electric switch (TES) and the MCU. The procedure for determining which of the three is at fault is located in the Diagnostic Test charts. For other trouble code diagnosis, refer to Trouble Codes.

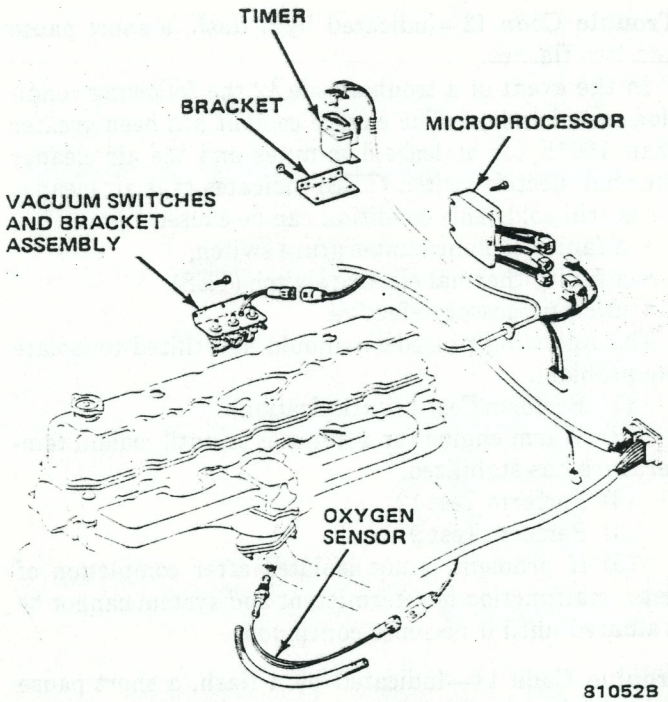

Fig. 1J-162 CEC System

Because the self-diagnostic subsystem does not detect all possible faults, the absence of a flashed code does not indicate absolutely that there is no problem with the system. To determine this, a system operational test is necessary. It is necessary when the **Check Engine** display does not indicate a problem (no code flashed) but the system is suspected because no other reason can be found for a specific complaint. A test lamp, digital volt-ohmmeter, tachometer, vacuum gauge and jumper wires are required to diagnose system problems.

Long Term Memory

The MCU does not have a long term memory.

Trouble Codes

The **Check Engine** display will only be illuminated and flashed under the conditions listed below when a malfunction exists. When the malfunction is corrected, the display will be extinguished and the code will be reset.

Trouble Code 11—indicated by a flash, a short pause and a second flash.

In the event of a continuous Check Engine display, or a trouble code 11 flashed, after the engine has been started, the following conditions are involved:

- no rpm (tach) voltage to the microprocessor,
- loss of full battery voltage or defective ground connection,
- a short in the **Check Engine** display circuit,
- the microprocessor is defective.

Diagnostic Tests 3 and 4 should be performed to isolate the problem.

Trouble Code 12—indicated by a flash, a short pause and two flashes.

In the event of a trouble code 12 the following conditions are involved. The engine coolant has been greater than 160°F for at least 8 minutes and the air cleaner thermal electric switch (TES) indicates that air cleaner air is still cold. This condition can be caused by:

- a faulty coolant temperature switch,
- a faulty thermal electric switch (TES),
- microprocessor defective.

The following procedure should be utilized to isolate the problem.

(1) Perform Test 1 (initialization).

(2) Warm engine for 4 minutes or until coolant temperature has stabilized.

(3) Perform Test 12.

(4) Perform Test 9.

(5) If problem is not isolated after completion of tests, malfunction is intermittent and system cannot be evaluated until it becomes continuous.

Trouble Code 14—Indicated by a flash, a short pause and 4 flashes.

In the event of a trouble code 14, the following condition is involved. The WOT switch mounted on the carburetor indicates a wide open throttle condition while the adaptive vacuum switch indicates engine vacuum to be greater than 10 in. Hg. The condition indicates a failure in one of the following areas:

- WOT switch is stuck in actuated position (switch failure),
- adaptive vacuum switch fails to close when vacuum is removed (switch failure),
- short circuit in WOT switch wiring harness,
- open circuit in adaptive vacuum switch wiring harness,
- microprocessor is defective.

The following procedure should be utilized to isolate the problem.

(1) Perform Test 1 (initialization).

(2) Warm engine for 4 minutes or until engine temperature has stabilized, turn engine off.

(3) Perform Tests 9 and 10.

(4) If problem is not isolated after completion of tests, malfunction is intermittent and system cannot be evaluated further until it becomes continuous.

Trouble Code 21—indicated by 2 flashes, a short pause and 1 flash.

In the event of a trouble code 21, the following conditions are involved. The MCU input indicates that an engine idle condition exists with less than 10 in. Hg of manifold vacuum present. This condition indicates a failure in one of the following areas:

- faulty OL3 vacuum switch or an open in the wiring to the switch,
- faulty adaptive vacuum switch or a short circuit in the wiring to the switch,
- air leak into manifold or ported vacuum,
- microprocessor defective.

The following procedure should be utilized to isolate the problem.

(1) Perform Test 1 (initialization).

(2) Warm engine for 4 minutes or until engine temperature has stabilized. Turn engine off.

(3) Perform Tests 9, 10 and 14.

(4) If problem is not isolated after completion of tests, malfunction is intermittent and system cannot be evaluated until it becomes continuous.

Trouble Code 23—indicated by 2 flashes, a short pause and three flashes.

In the event of a trouble code 23, the following condition is involved. The MCU data inputs indicate that manifold vacuum has been less than 4 in. Hg for more than 10 minutes or that WOT condition has existed for more than 10 minutes. This condition indicates a failure in one of the following areas:

- OL4 and adaptive vacuum switches are defective,
- WOT switch is defective,
- manifold vacuum is not present at vacuum switches,
- microprocessor is defective.

The following procedure should be utilized to isolate the problem.

(1) Perform Test 1 (initialization).

(2) Warm engine for 4 minutes or until engine temperature has stabilized, turn engine off.

(3) Perform Tests 9 and 10.

(4) If problem is not isolated after completion of tests, malfunction is intermittent and system cannot be evaluated until it becomes continuous.

Trouble Code 24—indicated by 2 flashes, a short pause and 4 flashes.

In the event of a trouble 24, the following condition is involved. The coolant temperature switch does not indicate that the coolant temperature has reached 160°F (71°C) after twenty minutes of operation.

A failure exists in one of the following areas:

- coolant temperature switch (for intake manifold heater and OL1 switch),
- wiring harness has an open circuit in OL1, OL4, OL2 switches input wires.

The following procedure should be utilized to isolate the problem.

(1) Perform Test 1 (initialization).

(2) Warm engine for 4 minutes or until temperature has stabilized, turn engine off.

(3) Perform Test 9.

(4) If problem is not isolated after completion of tests, malfunction is intermittent and system cannot be evaluated until it becomes continuous.

Initialization

When the ignition system is turned off, the MCU is also turned off. It has no long term memory circuit for

prior operation. As a result, it has an initialization function that is activated when the ignition switch is turned On.

The MCU initialization function moves the metering pins to the predetermined starting position by first driving them all the way to the rich end stop and then driving them in the lean direction by a predetermined number of steps. No matter where they were before initialization, they will be at the correct position at the end of every initialization period.

Because each open loop operation metering pin position is dependent on the initialization function, this function is the first test in the diagnostic procedure.

Diagnostic Tests

The steps in each test will provide a systematic evaluation of each component that could cause the operational malfunction or trouble code indicated.

After completing a repair, repeat the test to ensure the malfunction has been eliminated.

The equipment required to perform the tests is a tachometer, a hand vacuum pump, a digital volt-ohmmeter (DVOM) with a minimum ohms-per-volt input impedance of 10 meg-ohms and a no. 158 bulb (with socket and jumper wires).

WARNING: *When performing system diagnostic tests, the following safety precautions* ***must*** *be followed.*

(1) *Shape a sheet of clear acrylic plastic at least 0.250-inch thick and 15 inches x 15 inches, as depicted in figure 1J-163.*

(2) *Secure acrylic sheet with air cleaner wing nut after top of air cleaner has been removed.*

(3) *Wear eye protection whenever performing tests.*

(4) *When engine is operating, keep hands and arms clear of fan, drive pulleys and belts. Do not wear loose clothing. Do not stand in direct line with fan blades.*

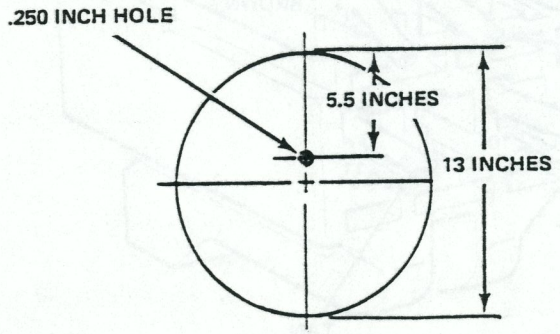

Fig. 1J-163 Air Cleaner Cover

Diagnostic Test 1: Initialization

(1) Remove air cleaner cover. Observe WARNING above. Follow test procedure outlined in Test 1. Refer to figures 1J-164, 1J-165, 1J-166 and 1J-167.

NOTE: *The metering pins operate in tandem. Only the upper pin is visible.*

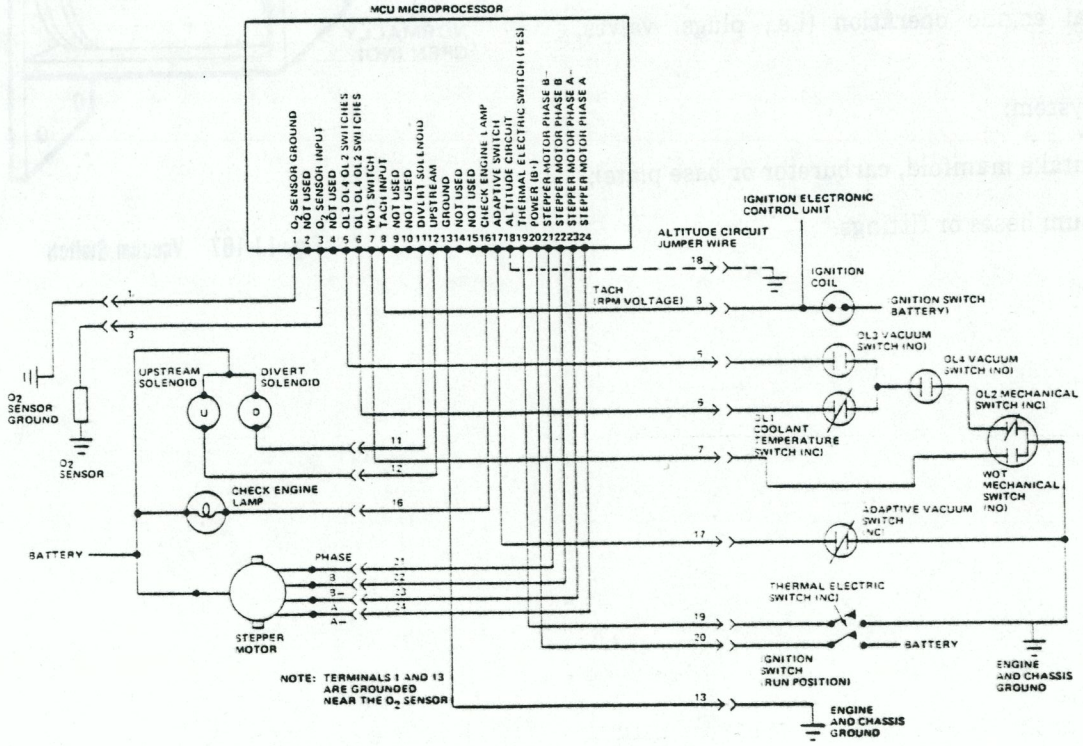

Fig. 1J-164 CEC System Wiring Diagram

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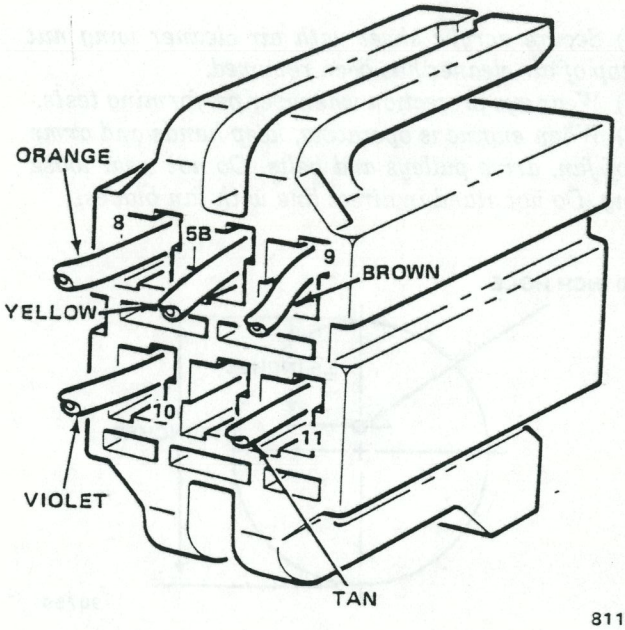


Fig. 1J-165 Stepper Motor Connector

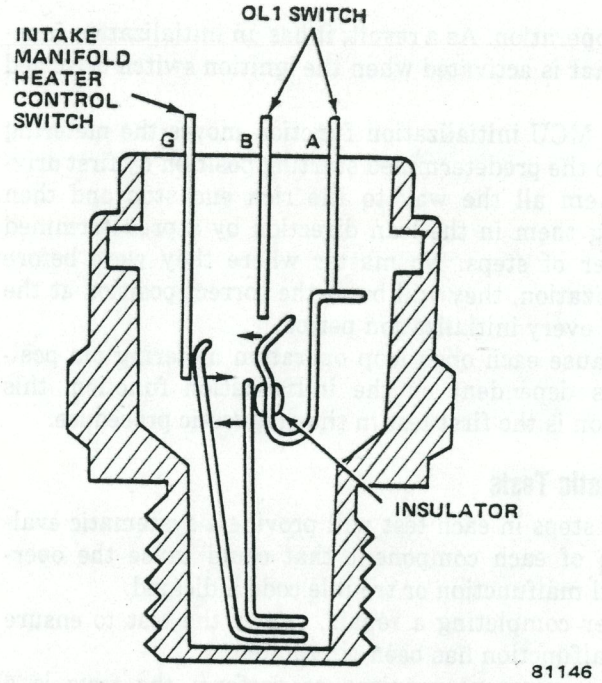


Fig. 1J-166 Coolant Temperature Switch

Test Results

If after completing the **Tests** the problem persists, other engine associated systems that can affect air/fuel mixture, combustion efficiency or exhaust gas composition can be causing the fault. These systems include:

- basic carburetor adjustments;
- mechanical engine operation (i.e., plugs, valves, rings);
- ignition System;
- gaskets (intake manifold, carburetor or base plate);
- loose vacuum hoses or fittings.

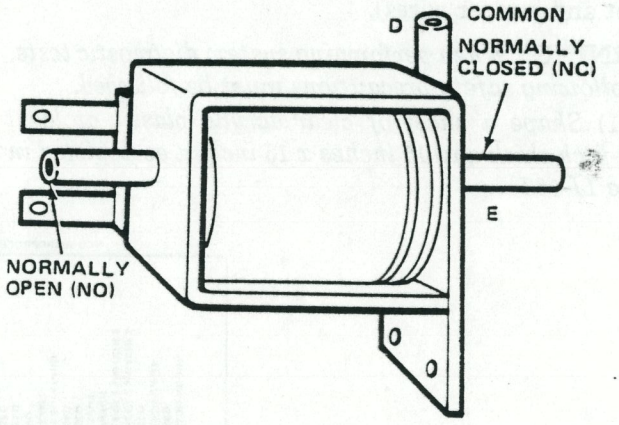
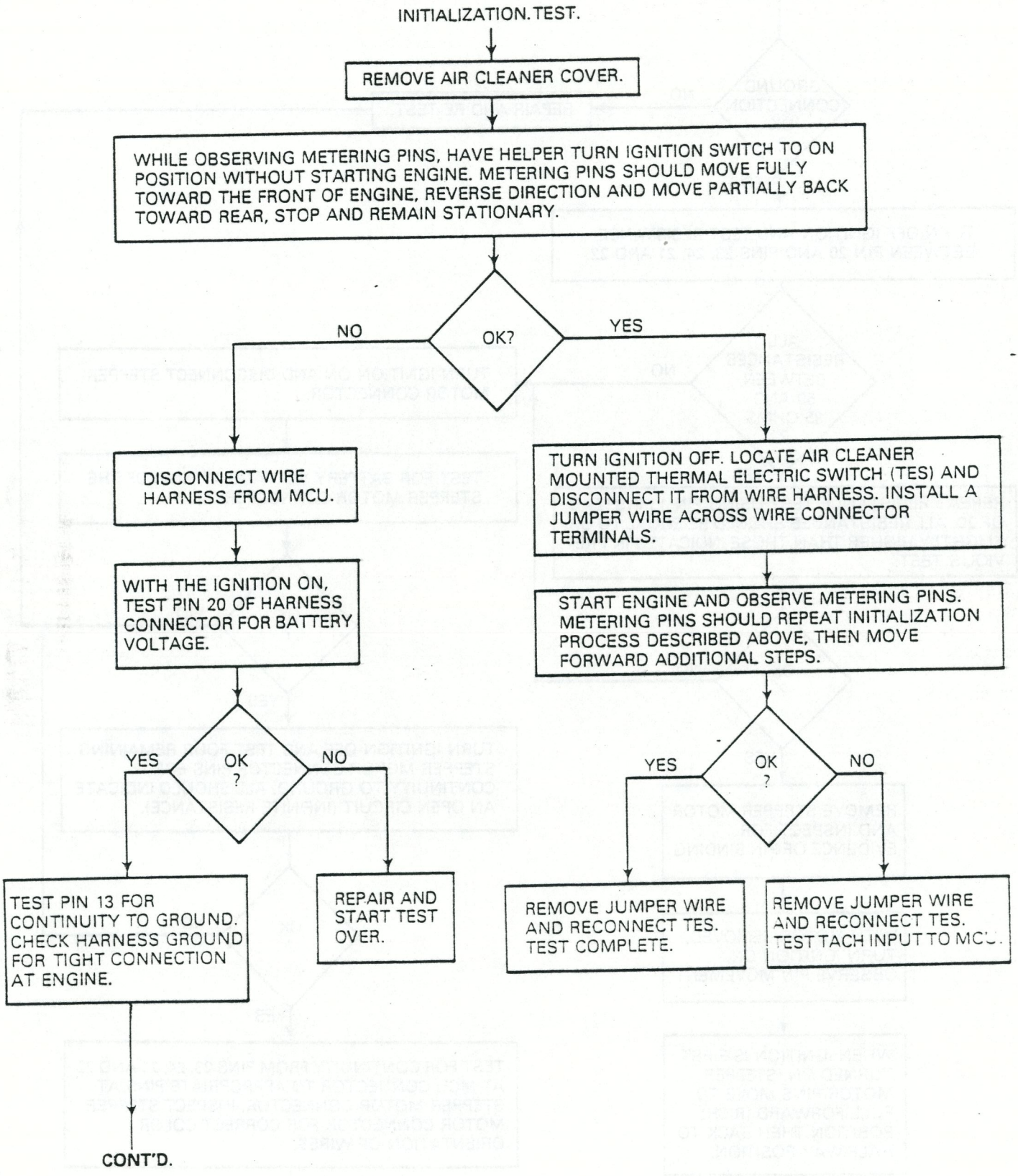


Fig. 1J-167 Vacuum Switch

Diagnostic Test 1



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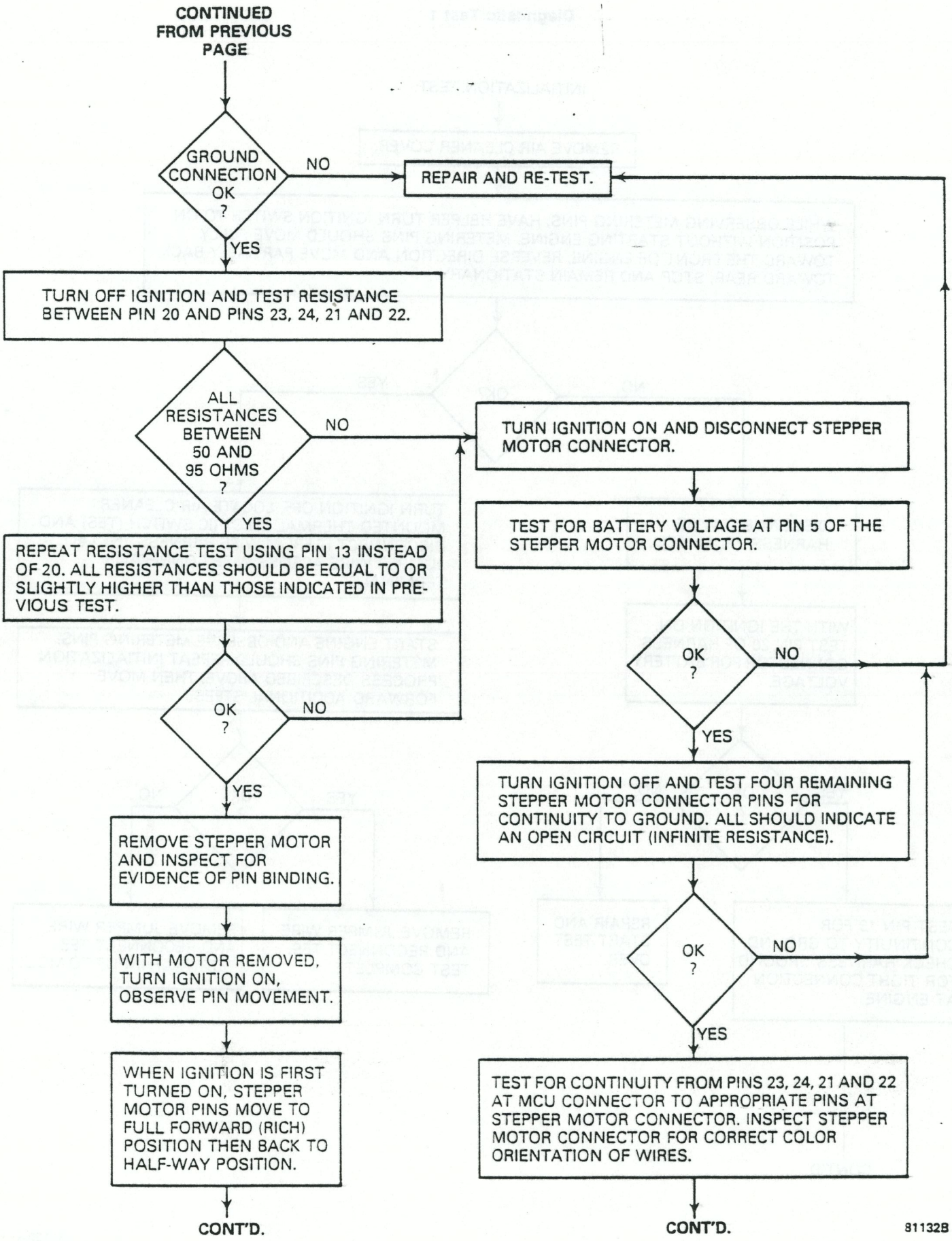
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GROUND CONNECTION OK ?
NO
REPAIR AND RE-TEST.
YES
TURN OFF IGNITION AND TEST RESISTANCE BETWEEN PIN 20 AND PINS 23, 24, 21 AND 22.
ALL RESISTANCES BETWEEN 50 AND 95 OHMS ?
NO
YES
REPEAT RESISTANCE TEST USING PIN 13 INSTEAD OF 20. ALL RESISTANCES SHOULD BE EQUAL TO OR SLIGHTLY HIGHER THAN THOSE INDICATED IN PREVIOUS TEST.
OK ?
NO
YES
REMOVE STEPPER MOTOR AND INSPECT FOR EVIDENCE OF PIN BINDING.
WITH MOTOR REMOVED, TURN IGNITION ON, OBSERVE PIN MOVEMENT.
WHEN IGNITION IS FIRST TURNED ON, STEPPER MOTOR PINS MOVE TO FULL FORWARD (RICH) POSITION THEN BACK TO HALF-WAY POSITION.
CONT'D.
TURN IGNITION ON AND DISCONNECT STEPPER MOTOR CONNECTOR.
TEST FOR BATTERY VOLTAGE AT PIN 5 OF THE STEPPER MOTOR CONNECTOR.
OK ?
NO
YES
TURN IGNITION OFF AND TEST FOUR REMAINING STEPPER MOTOR CONNECTOR PINS FOR CONTINUITY TO GROUND. ALL SHOULD INDICATE AN OPEN CIRCUIT (INFINITE RESISTANCE).
OK ?
NO
YES
TEST FOR CONTINUITY FROM PINS 23, 24, 21 AND 22 AT MCU CONNECTOR TO APPROPRIATE PINS AT STEPPER MOTOR CONNECTOR. INSPECT STEPPER MOTOR CONNECTOR FOR CORRECT COLOR ORIENTATION OF WIRES.
CONT'D.
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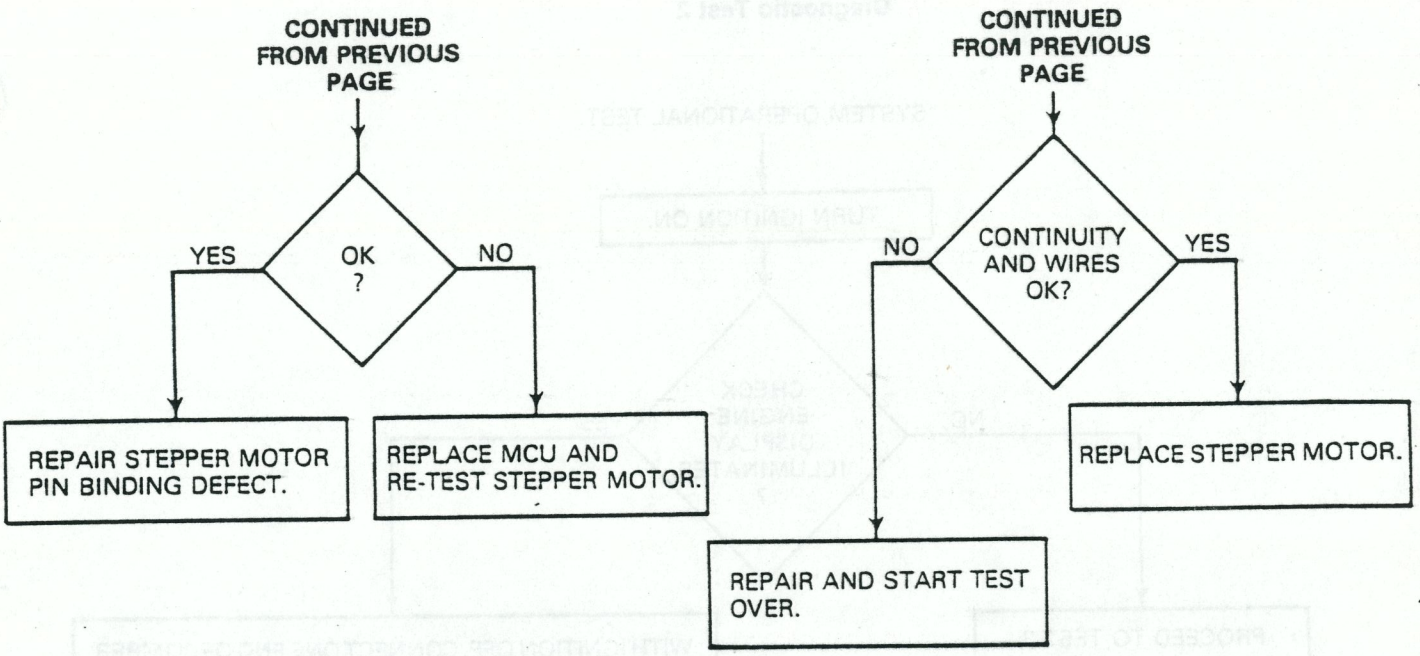
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OK ?
YES
NO
REPAIR STEPPER MOTOR PIN BINDING DEFECT.
REPLACE MCU AND RE-TEST STEPPER MOTOR.
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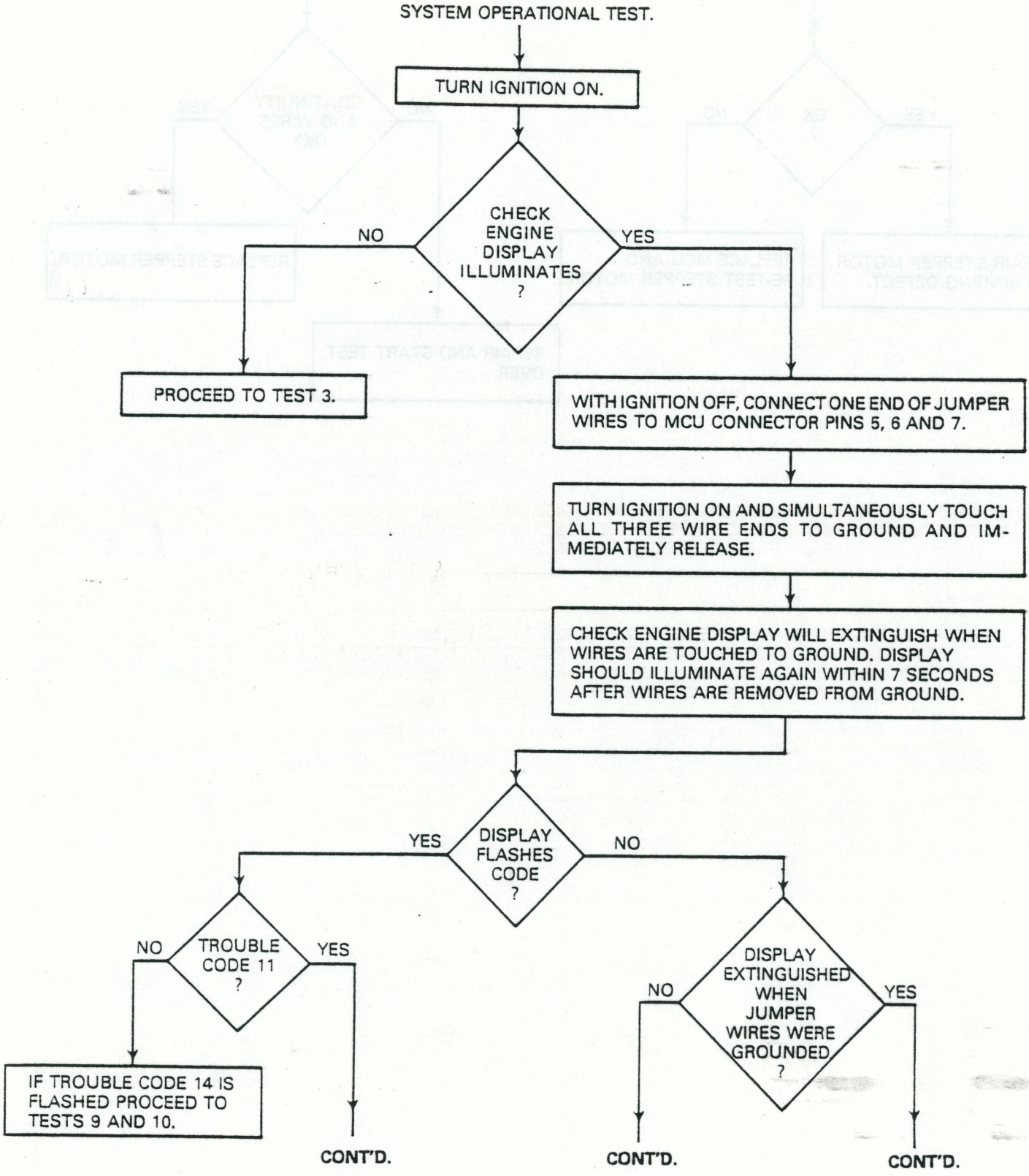
CONTINUITY AND WIRES OK?
NO
YES
REPAIR AND START TEST OVER.
REPLACE STEPPER MOTOR.

Diagnostic Test 2



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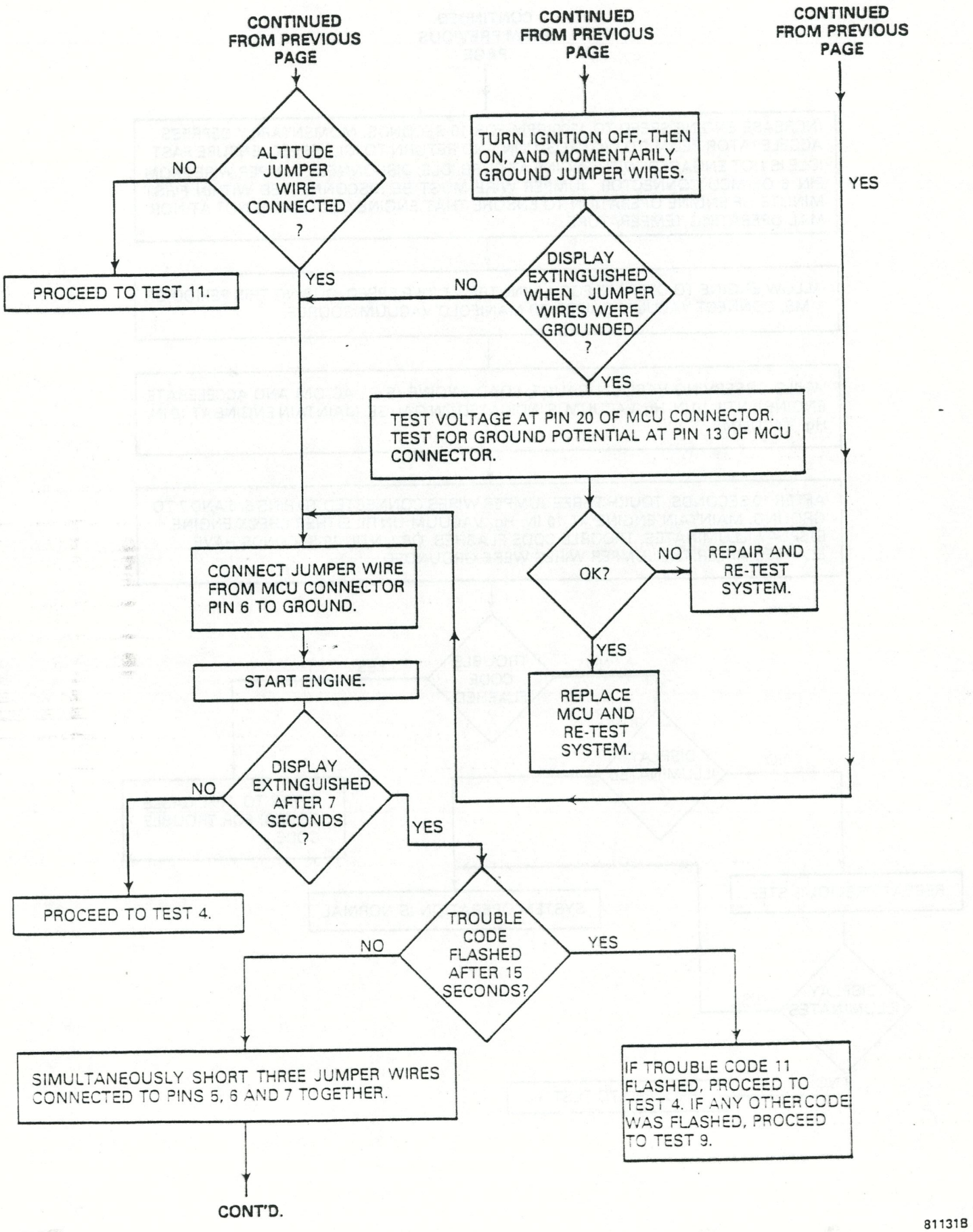
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ALTITUDE JUMPER WIRE CONNECTED ?
NO
YES
PROCEED TO TEST 11.
TURN IGNITION OFF, THEN ON, AND MOMENTARILY GROUND JUMPER WIRES.
DISPLAY EXTINGUISHED WHEN JUMPER WIRES WERE GROUNDED ?
NO
YES
YES
TEST VOLTAGE AT PIN 20 OF MCU CONNECTOR. TEST FOR GROUND POTENTIAL AT PIN 13 OF MCU CONNECTOR.
OK?
NO
REPAIR AND RE-TEST SYSTEM.
YES
REPLACE MCU AND RE-TEST SYSTEM.
CONNECT JUMPER WIRE FROM MCU CONNECTOR PIN 6 TO GROUND.
START ENGINE.
DISPLAY EXTINGUISHED AFTER 7 SECONDS ?
NO
YES
PROCEED TO TEST 4.
TROUBLE CODE FLASHED AFTER 15 SECONDS?
NO
YES
SIMULTANEOUSLY SHORT THREE JUMPER WIRES CONNECTED TO PINS 5, 6 AND 7 TOGETHER.
IF TROUBLE CODE 11 FLASHED, PROCEED TO TEST 4. IF ANY OTHER CODE WAS FLASHED, PROCEED TO TEST 9.
CONT'D.

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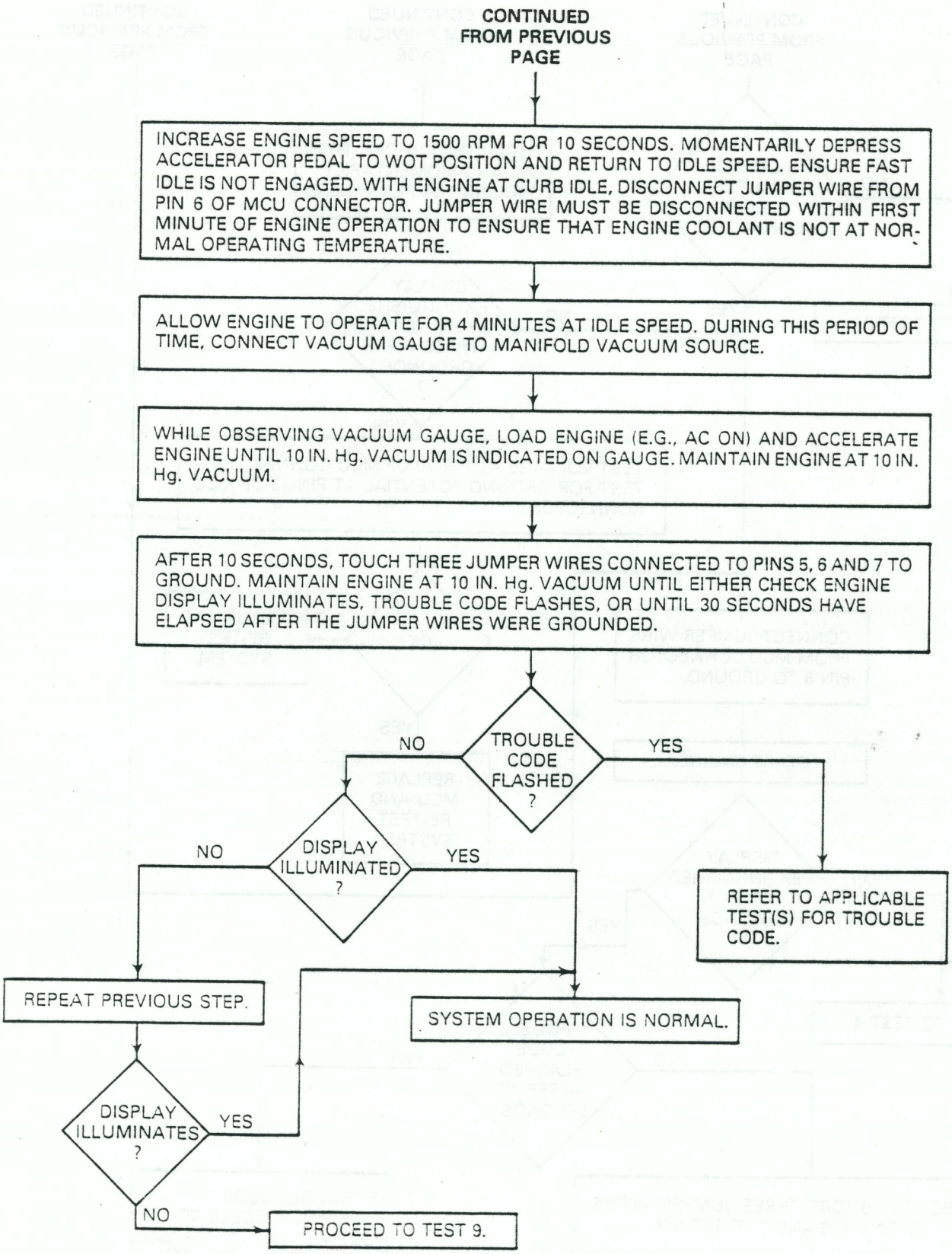
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INCREASE ENGINE SPEED TO 1500 RPM FOR 10 SECONDS. MOMENTARILY DEPRESS ACCELERATOR PEDAL TO WOT POSITION AND RETURN TO IDLE SPEED. ENSURE FAST IDLE IS NOT ENGAGED. WITH ENGINE AT CURB IDLE, DISCONNECT JUMPER WIRE FROM PIN 6 OF MCU CONNECTOR. JUMPER WIRE MUST BE DISCONNECTED WITHIN FIRST MINUTE OF ENGINE OPERATION TO ENSURE THAT ENGINE COOLANT IS NOT AT NORMAL OPERATING TEMPERATURE.
ALLOW ENGINE TO OPERATE FOR 4 MINUTES AT IDLE SPEED. DURING THIS PERIOD OF TIME, CONNECT VACUUM GAUGE TO MANIFOLD VACUUM SOURCE.
WHILE OBSERVING VACUUM GAUGE, LOAD ENGINE (E.G., AC ON) AND ACCELERATE ENGINE UNTIL 10 IN. Hg. VACUUM IS INDICATED ON GAUGE. MAINTAIN ENGINE AT 10 IN. Hg. VACUUM.
AFTER 10 SECONDS, TOUCH THREE JUMPER WIRES CONNECTED TO PINS 5, 6 AND 7 TO GROUND. MAINTAIN ENGINE AT 10 IN. Hg. VACUUM UNTIL EITHER CHECK ENGINE DISPLAY ILLUMINATES, TROUBLE CODE FLASHES, OR UNTIL 30 SECONDS HAVE ELAPSED AFTER THE JUMPER WIRES WERE GROUNDED.
TROUBLE CODE FLASHED ?
NO
YES
DISPLAY ILLUMINATED ?
NO
YES
REFER TO APPLICABLE TEST(S) FOR TROUBLE CODE.
REPEAT PREVIOUS STEP.
SYSTEM OPERATION IS NORMAL.
DISPLAY ILLUMINATES ?
YES
NO
PROCEED TO TEST 9.

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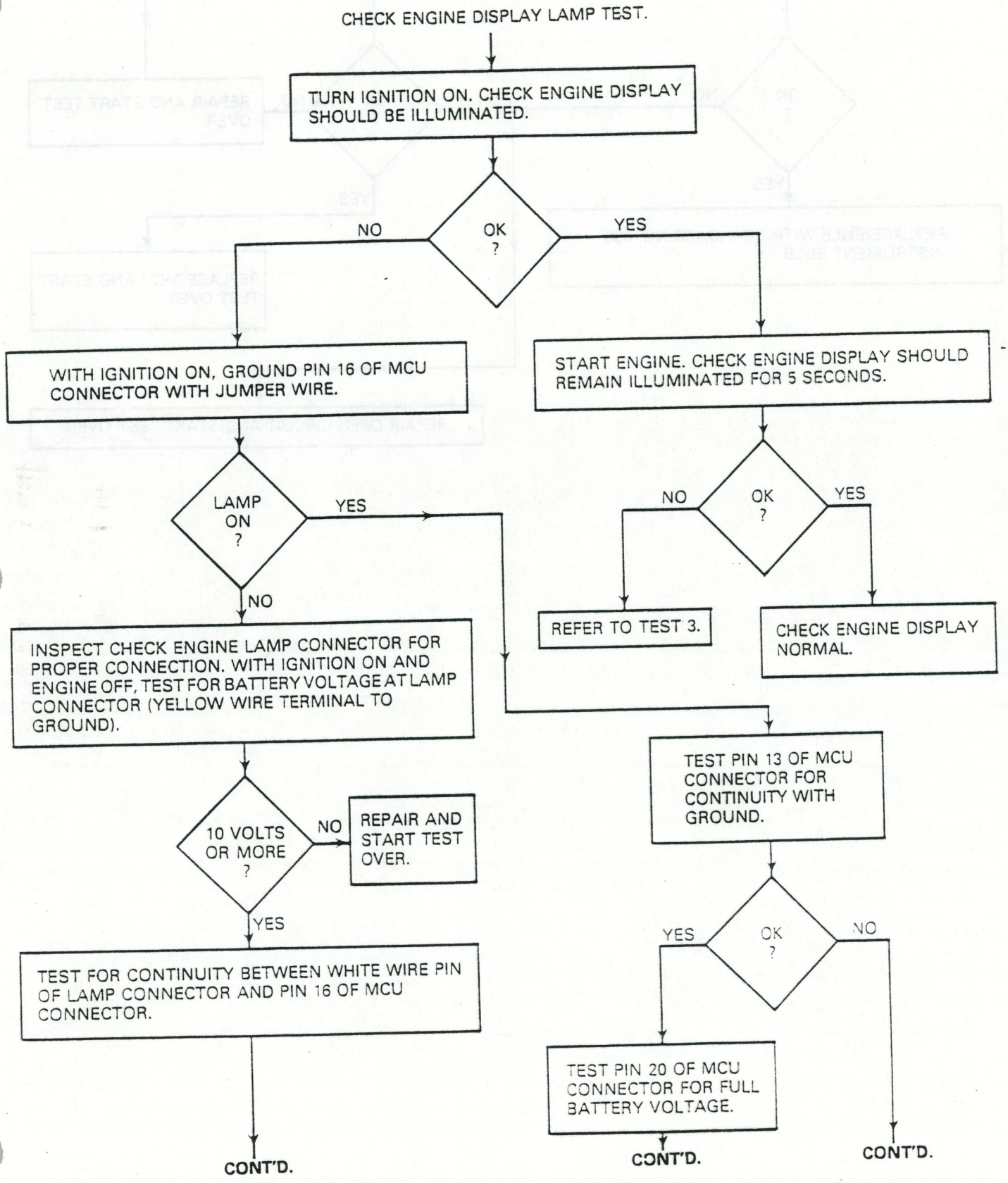
Diagnostic Test 3



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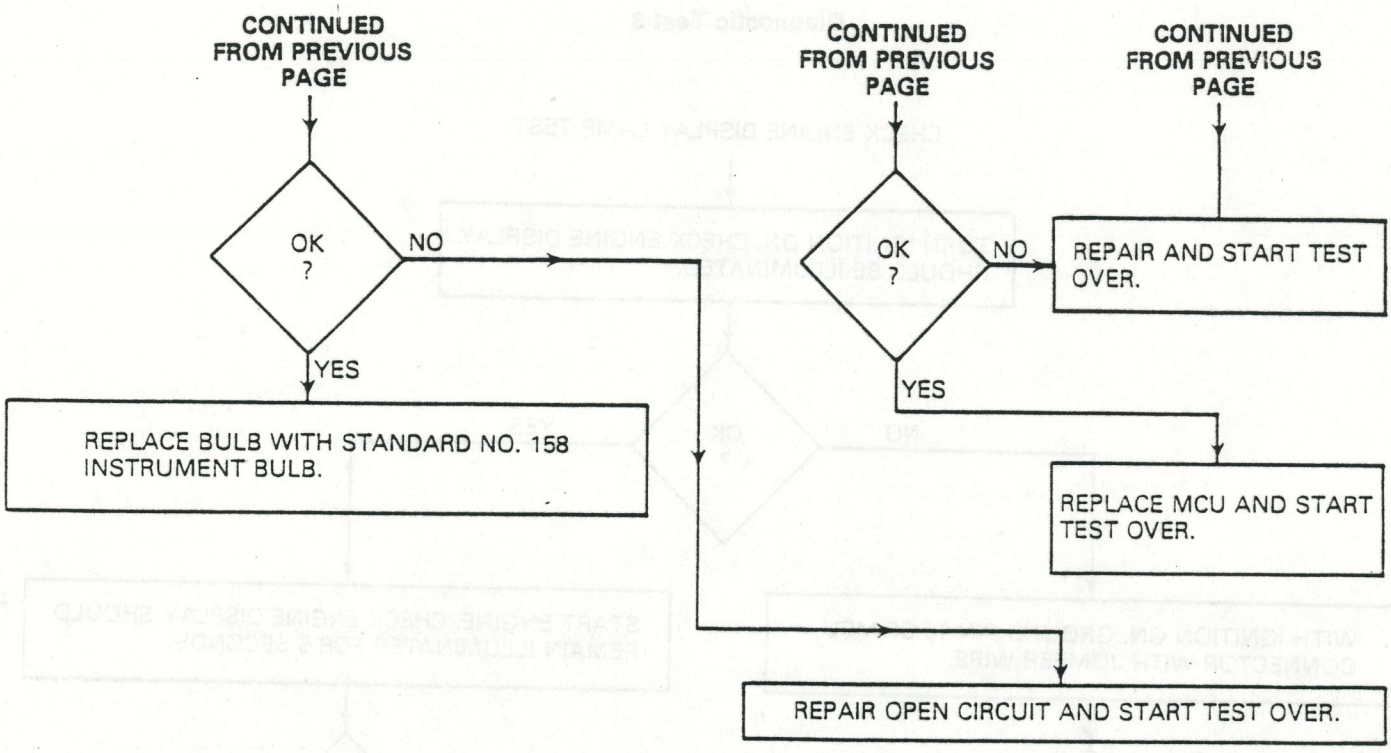
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OK ?
NO
YES
REPLACE BULB WITH STANDARD NO. 158 INSTRUMENT BULB.
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OK ?
NO
REPAIR AND START TEST OVER.
YES
REPLACE MCU AND START TEST OVER.
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REPAIR OPEN CIRCUIT AND START TEST OVER.

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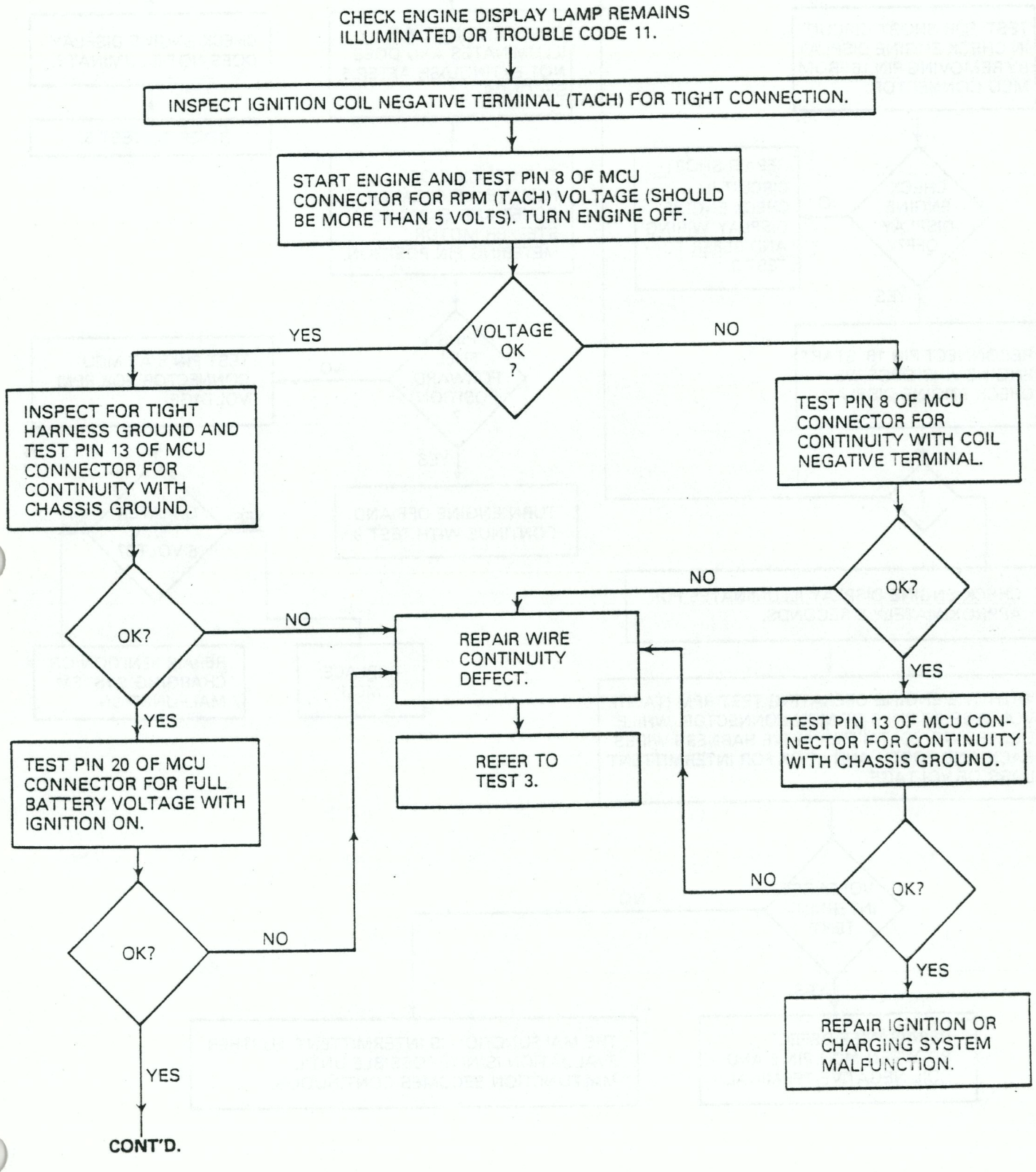
DIAGNOSTIC TEST 4



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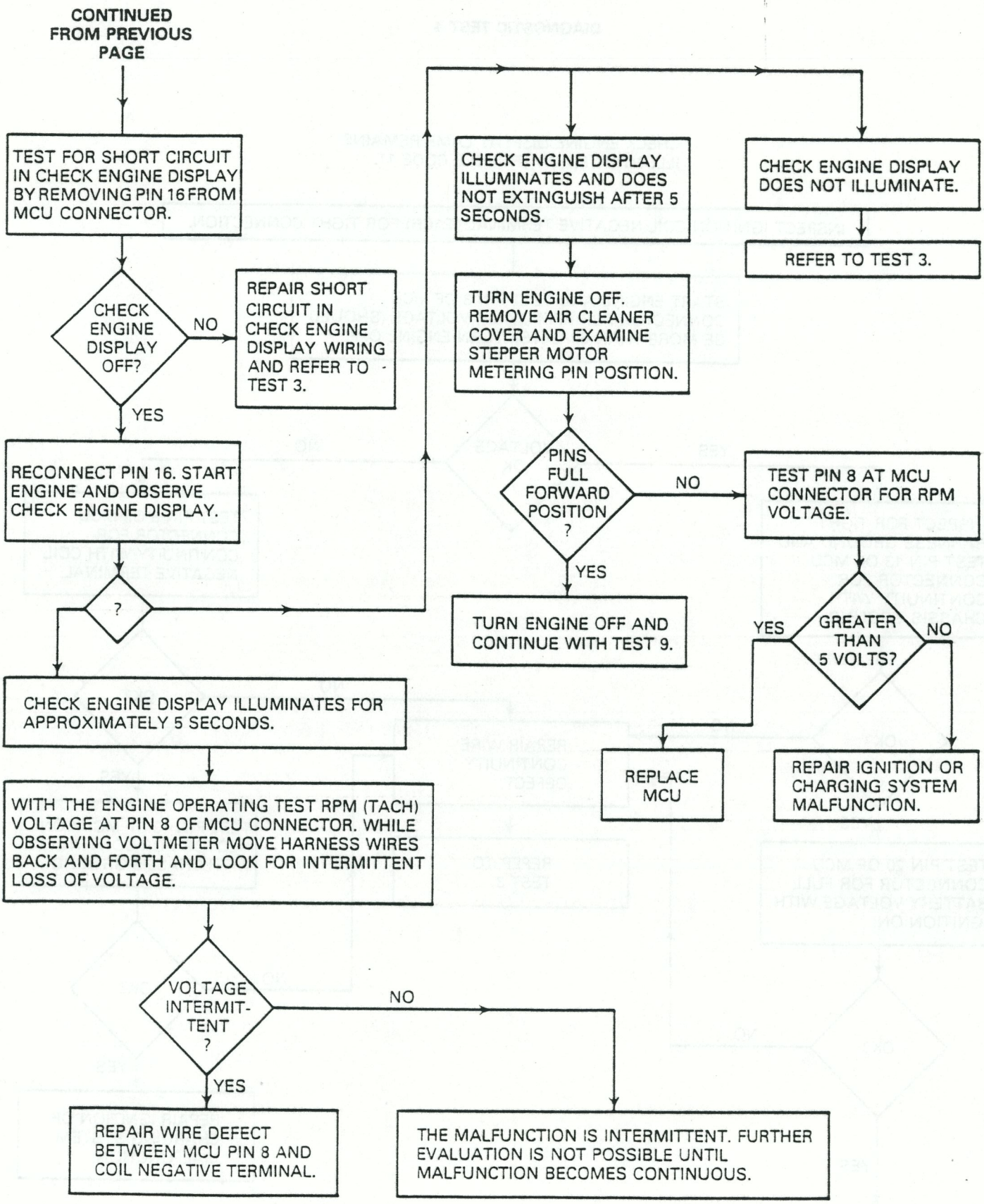
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TEST FOR SHORT CIRCUIT IN CHECK ENGINE DISPLAY BY REMOVING PIN 16 FROM MCU CONNECTOR.
CHECK ENGINE DISPLAY OFF?
NO
REPAIR SHORT CIRCUIT IN CHECK ENGINE DISPLAY WIRING AND REFER TO TEST 3.
YES
RECONNECT PIN 16. START ENGINE AND OBSERVE CHECK ENGINE DISPLAY.
?
CHECK ENGINE DISPLAY ILLUMINATES FOR APPROXIMATELY 5 SECONDS.
WITH THE ENGINE OPERATING TEST RPM (TACH) VOLTAGE AT PIN 8 OF MCU CONNECTOR. WHILE OBSERVING VOLTMETER MOVE HARNESS WIRES BACK AND FORTH AND LOOK FOR INTERMITTENT LOSS OF VOLTAGE.
VOLTAGE INTERMIT-TENT ?
NO
YES
REPAIR WIRE DEFECT BETWEEN MCU PIN 8 AND COIL NEGATIVE TERMINAL.
THE MALFUNCTION IS INTERMITTENT. FURTHER EVALUATION IS NOT POSSIBLE UNTIL MALFUNCTION BECOMES CONTINUOUS.
CHECK ENGINE DISPLAY ILLUMINATES AND DOES NOT EXTINGUISH AFTER 5 SECONDS.
TURN ENGINE OFF. REMOVE AIR CLEANER COVER AND EXAMINE STEPPER MOTOR METERING PIN POSITION.
PINS FULL FORWARD POSITION ?
NO
YES
TURN ENGINE OFF AND CONTINUE WITH TEST 9.
CHECK ENGINE DISPLAY DOES NOT ILLUMINATE.
REFER TO TEST 3.
TEST PIN 8 AT MCU CONNECTOR FOR RPM VOLTAGE.
GREATER THAN 5 VOLTS?
YES
NO
REPLACE MCU
REPAIR IGNITION OR CHARGING SYSTEM MALFUNCTION.

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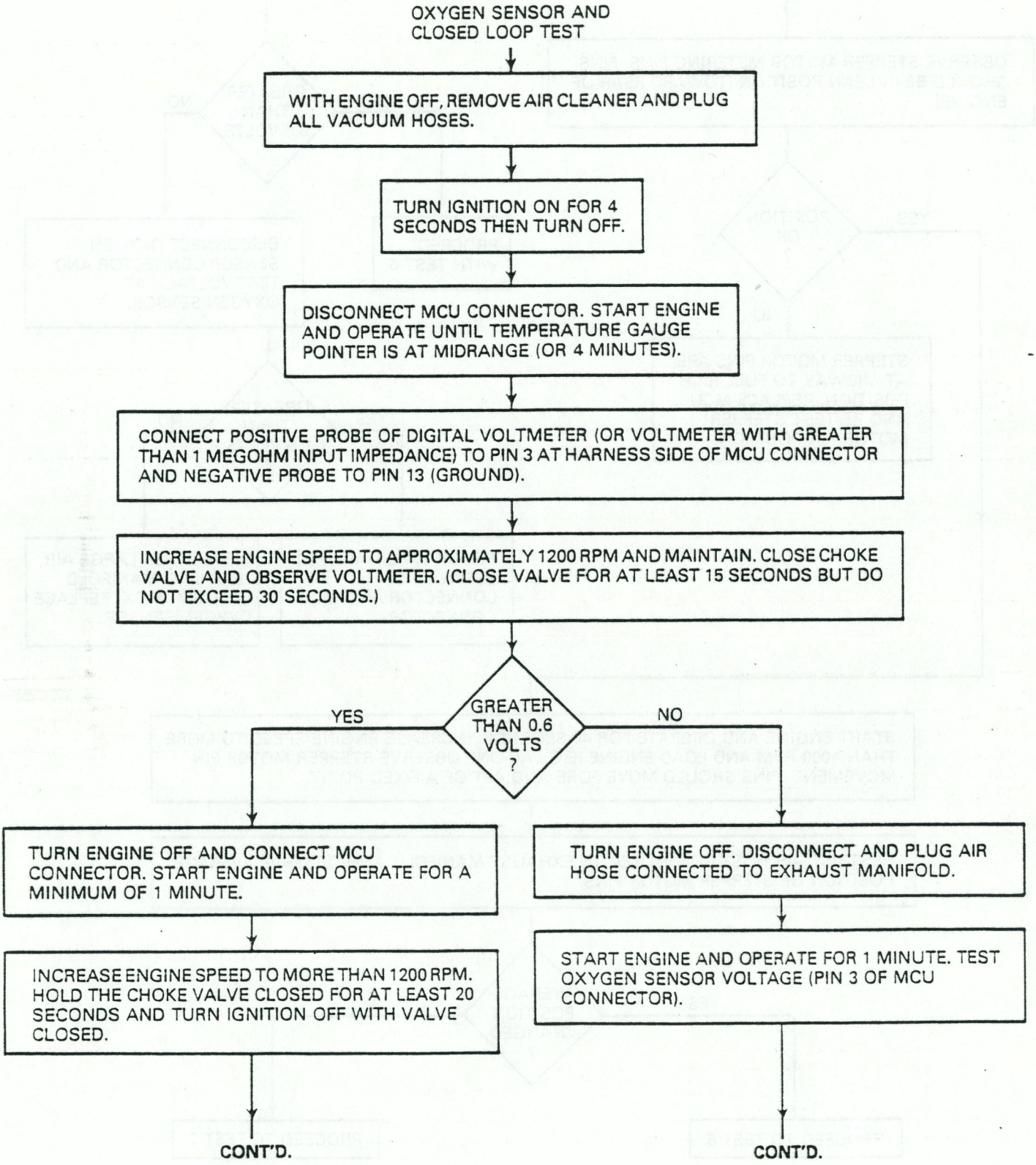
Diagnostic Test 5



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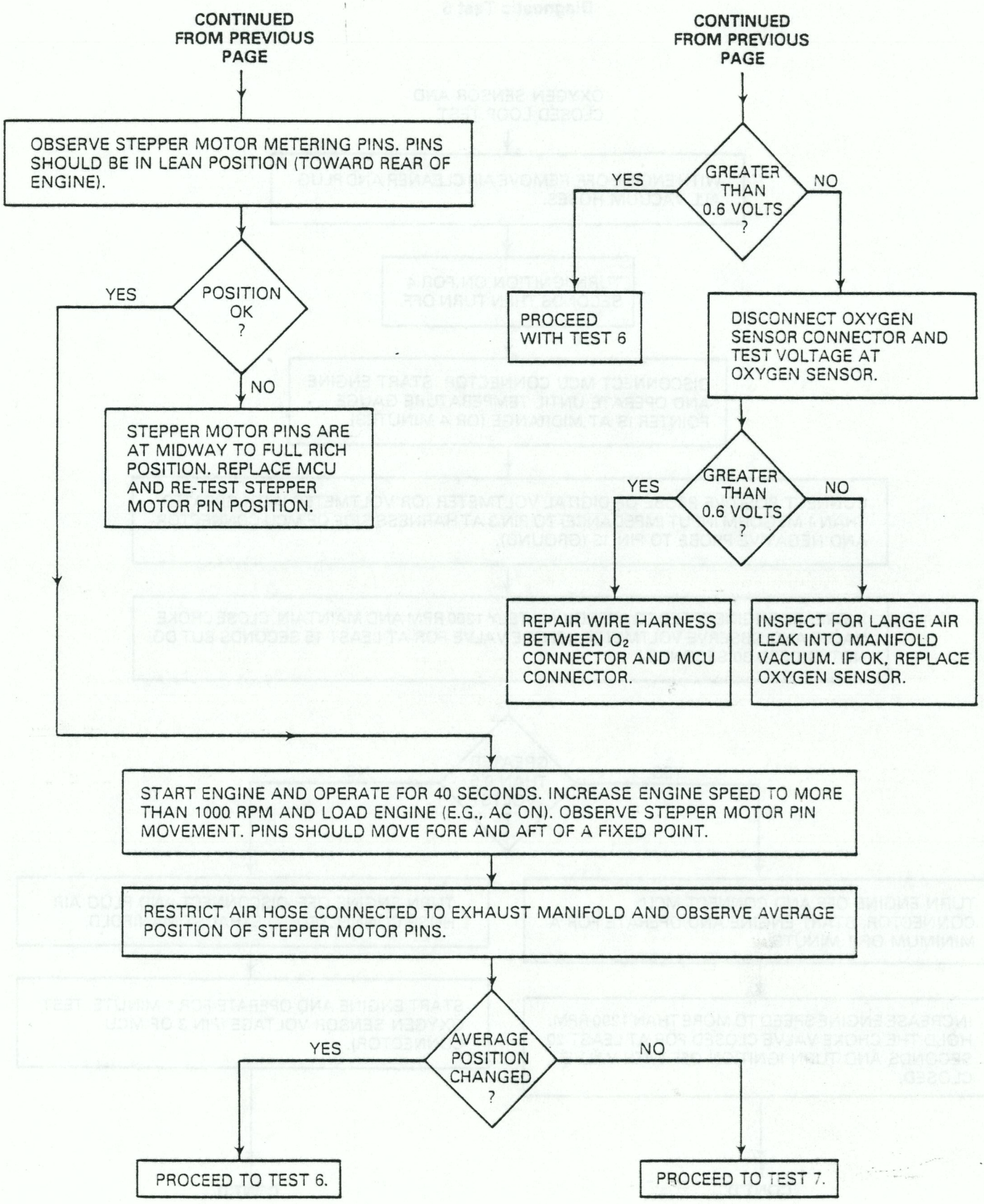
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OBSERVE STEPPER MOTOR METERING PINS. PINS SHOULD BE IN LEAN POSITION (TOWARD REAR OF ENGINE).
POSITION OK ?
YES
NO
STEPPER MOTOR PINS ARE AT MIDWAY TO FULL RICH POSITION. REPLACE MCU AND RE-TEST STEPPER MOTOR PIN POSITION.
CONTINUED FROM PREVIOUS PAGE
GREATER THAN 0.6 VOLTS ?
YES
NO
PROCEED WITH TEST 6
DISCONNECT OXYGEN SENSOR CONNECTOR AND TEST VOLTAGE AT OXYGEN SENSOR.
GREATER THAN 0.6 VOLTS ?
YES
NO
REPAIR WIRE HARNESS BETWEEN O_2 CONNECTOR AND MCU CONNECTOR.
INSPECT FOR LARGE AIR LEAK INTO MANIFOLD VACUUM. IF OK, REPLACE OXYGEN SENSOR.
START ENGINE AND OPERATE FOR 40 SECONDS. INCREASE ENGINE SPEED TO MORE THAN 1000 RPM AND LOAD ENGINE (E.G., AC ON). OBSERVE STEPPER MOTOR PIN MOVEMENT. PINS SHOULD MOVE FORE AND AFT OF A FIXED POINT.
RESTRICT AIR HOSE CONNECTED TO EXHAUST MANIFOLD AND OBSERVE AVERAGE POSITION OF STEPPER MOTOR PINS.
AVERAGE POSITION CHANGED ?
YES
NO
PROCEED TO TEST 6.
PROCEED TO TEST 7.

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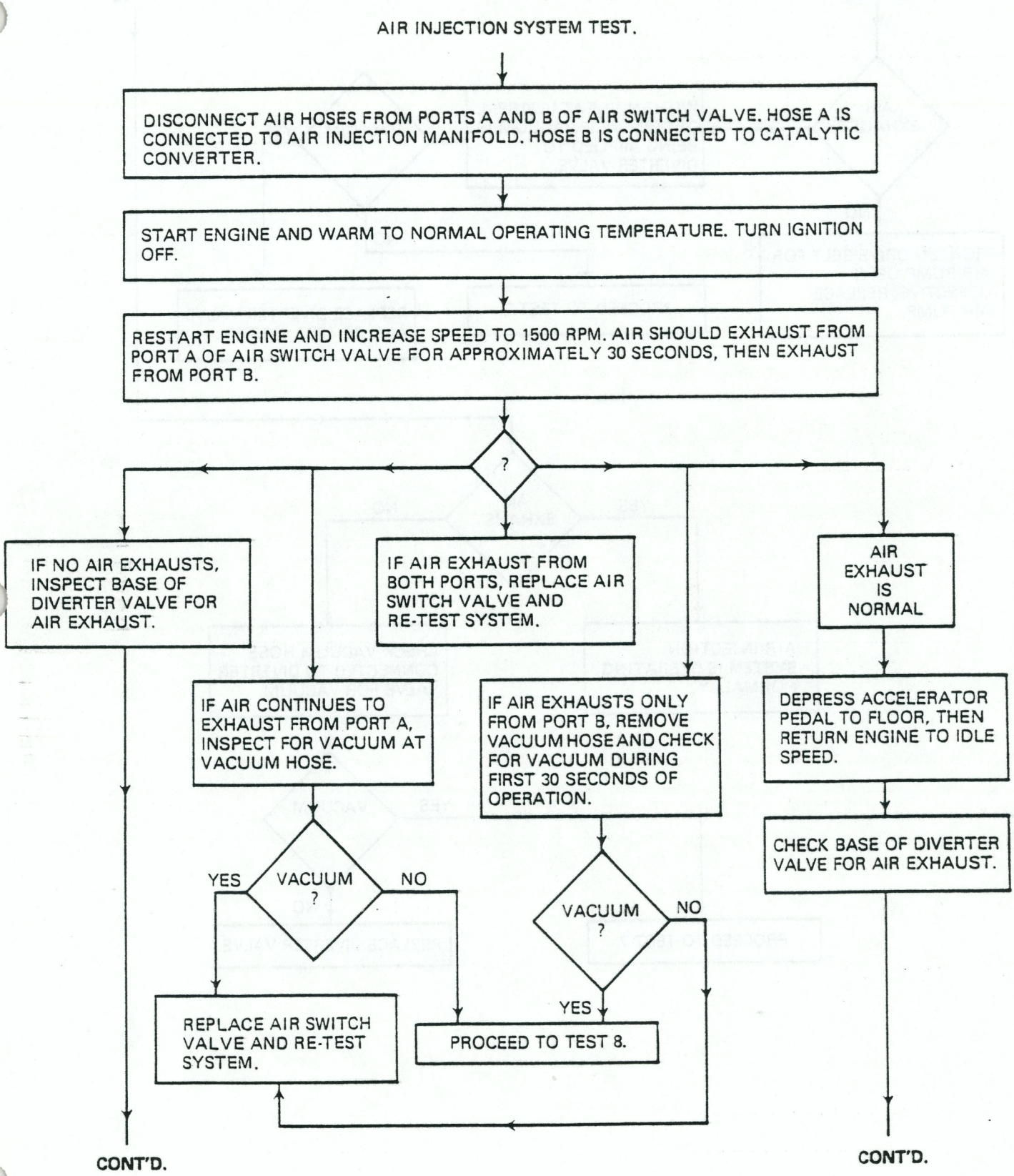
DIAGNOSTIC TEST 6



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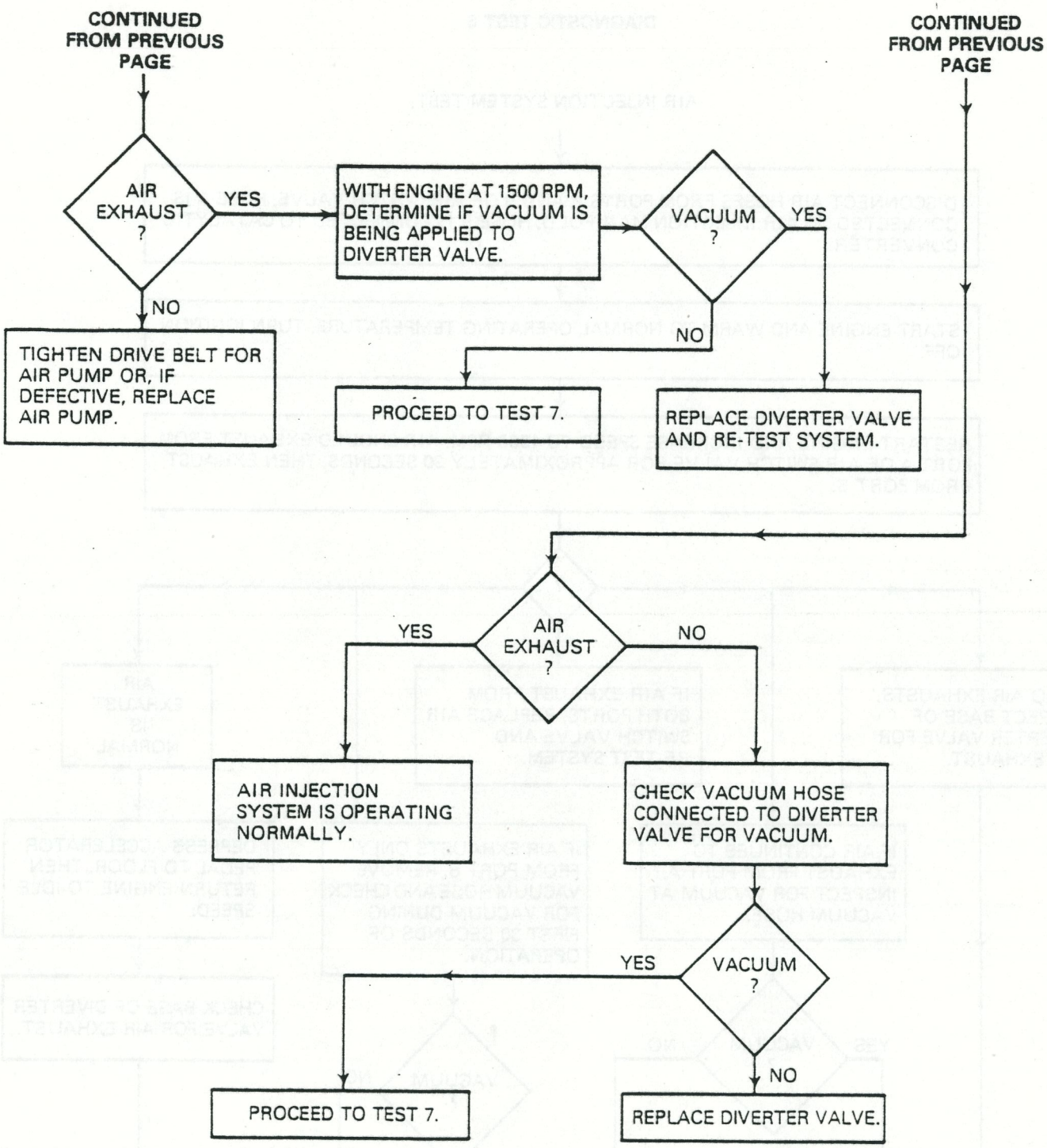
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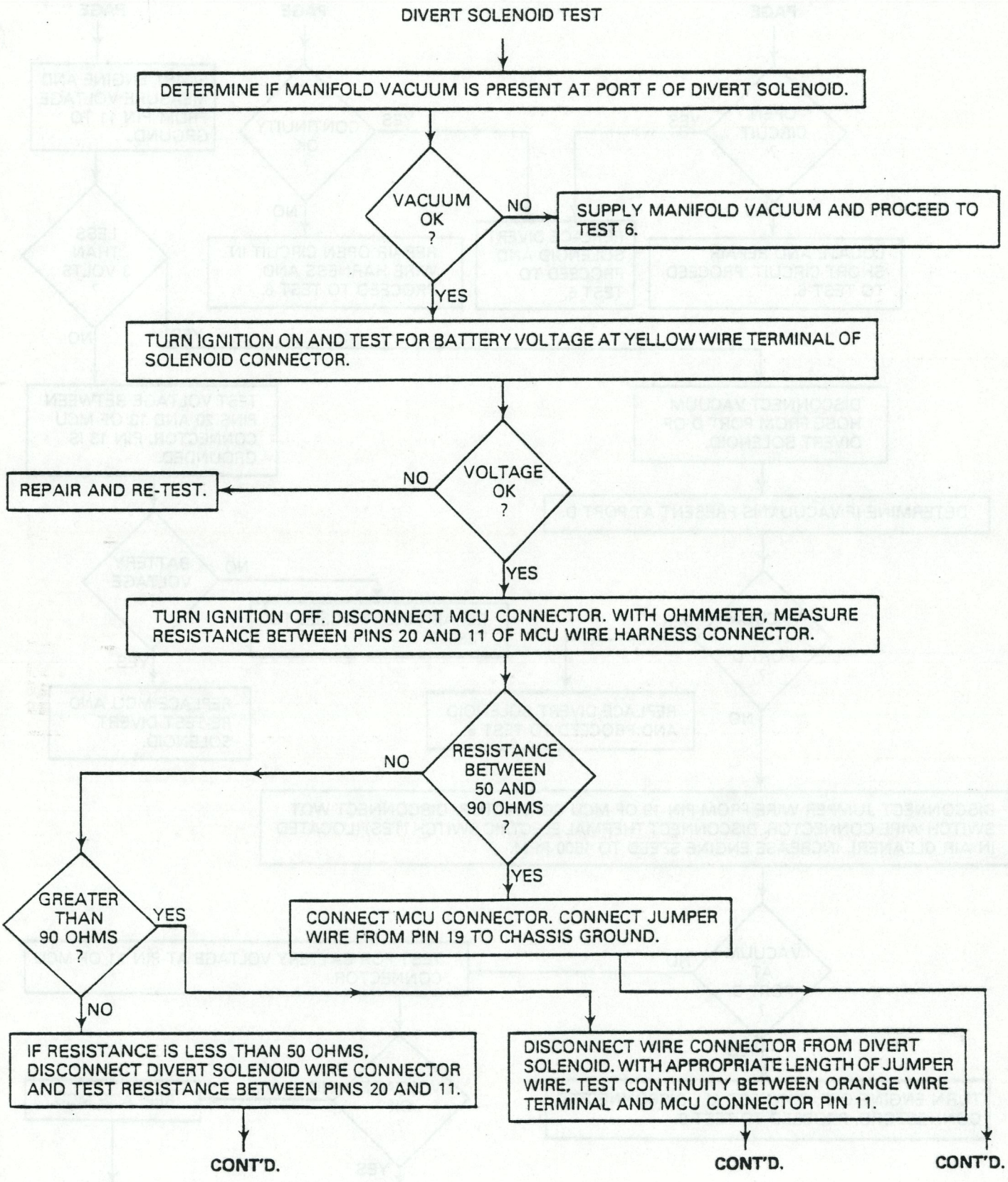
AIR EXHAUST ?
YES
NO
TIGHTEN DRIVE BELT FOR AIR PUMP OR, IF DEFECTIVE, REPLACE AIR PUMP.
WITH ENGINE AT 1500 RPM, DETERMINE IF VACUUM IS BEING APPLIED TO DIVERTER VALVE.
VACUUM ?
YES
NO
PROCEED TO TEST 7.
REPLACE DIVERTER VALVE AND RE-TEST SYSTEM.
CONTINUED FROM PREVIOUS PAGE
AIR EXHAUST ?
YES
NO
AIR INJECTION SYSTEM IS OPERATING NORMALLY.
CHECK VACUUM HOSE CONNECTED TO DIVERTER VALVE FOR VACUUM.
VACUUM ?
YES
NO
PROCEED TO TEST 7.
REPLACE DIVERTER VALVE.

81136B

Diagnostic Test 7



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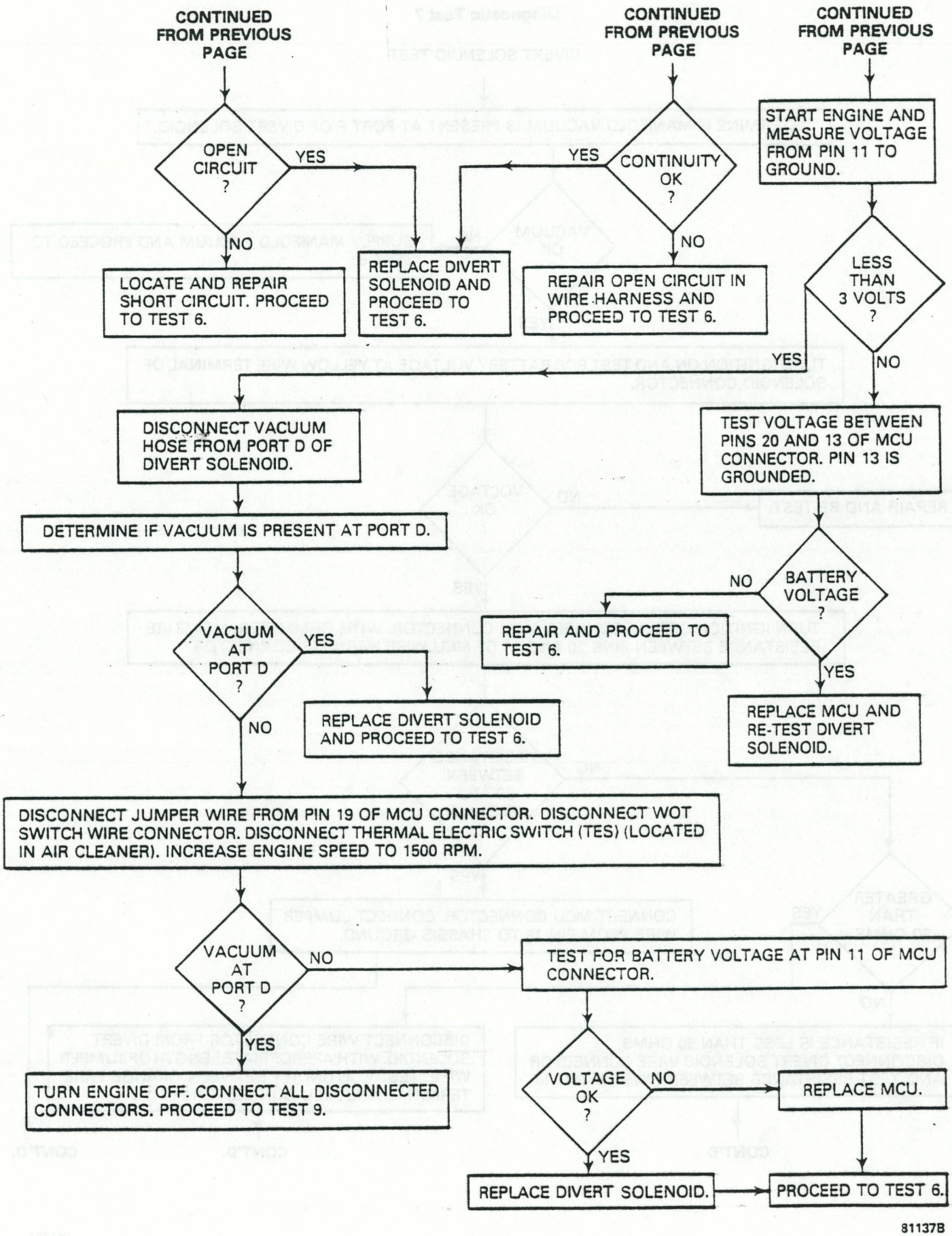
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OPEN CIRCUIT ?
YES
NO
LOCATE AND REPAIR SHORT CIRCUIT. PROCEED TO TEST 6.
REPLACE DIVERT SOLENOID AND PROCEED TO TEST 6.
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CONTINUITY OK ?
YES
NO
REPAIR OPEN CIRCUIT IN WIRE HARNESS AND PROCEED TO TEST 6.
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START ENGINE AND MEASURE VOLTAGE FROM PIN 11 TO GROUND.
LESS THAN 3 VOLTS ?
YES
NO
DISCONNECT VACUUM HOSE FROM PORT D OF DIVERT SOLENOID.
TEST VOLTAGE BETWEEN PINS 20 AND 13 OF MCU CONNECTOR. PIN 13 IS GROUNDED.
DETERMINE IF VACUUM IS PRESENT AT PORT D.
BATTERY VOLTAGE ?
NO
YES
REPAIR AND PROCEED TO TEST 6.
REPLACE MCU AND RE-TEST DIVERT SOLENOID.
VACUUM AT PORT D ?
YES
NO
REPLACE DIVERT SOLENOID AND PROCEED TO TEST 6.
DISCONNECT JUMPER WIRE FROM PIN 19 OF MCU CONNECTOR. DISCONNECT WOT SWITCH WIRE CONNECTOR. DISCONNECT THERMAL ELECTRIC SWITCH (TES) (LOCATED IN AIR CLEANER). INCREASE ENGINE SPEED TO 1500 RPM.
VACUUM AT PORT D ?
NO
YES
TEST FOR BATTERY VOLTAGE AT PIN 11 OF MCU CONNECTOR.
TURN ENGINE OFF. CONNECT ALL DISCONNECTED CONNECTORS. PROCEED TO TEST 9.
VOLTAGE OK ?
NO
YES
REPLACE MCU.
REPLACE DIVERT SOLENOID.
PROCEED TO TEST 6.
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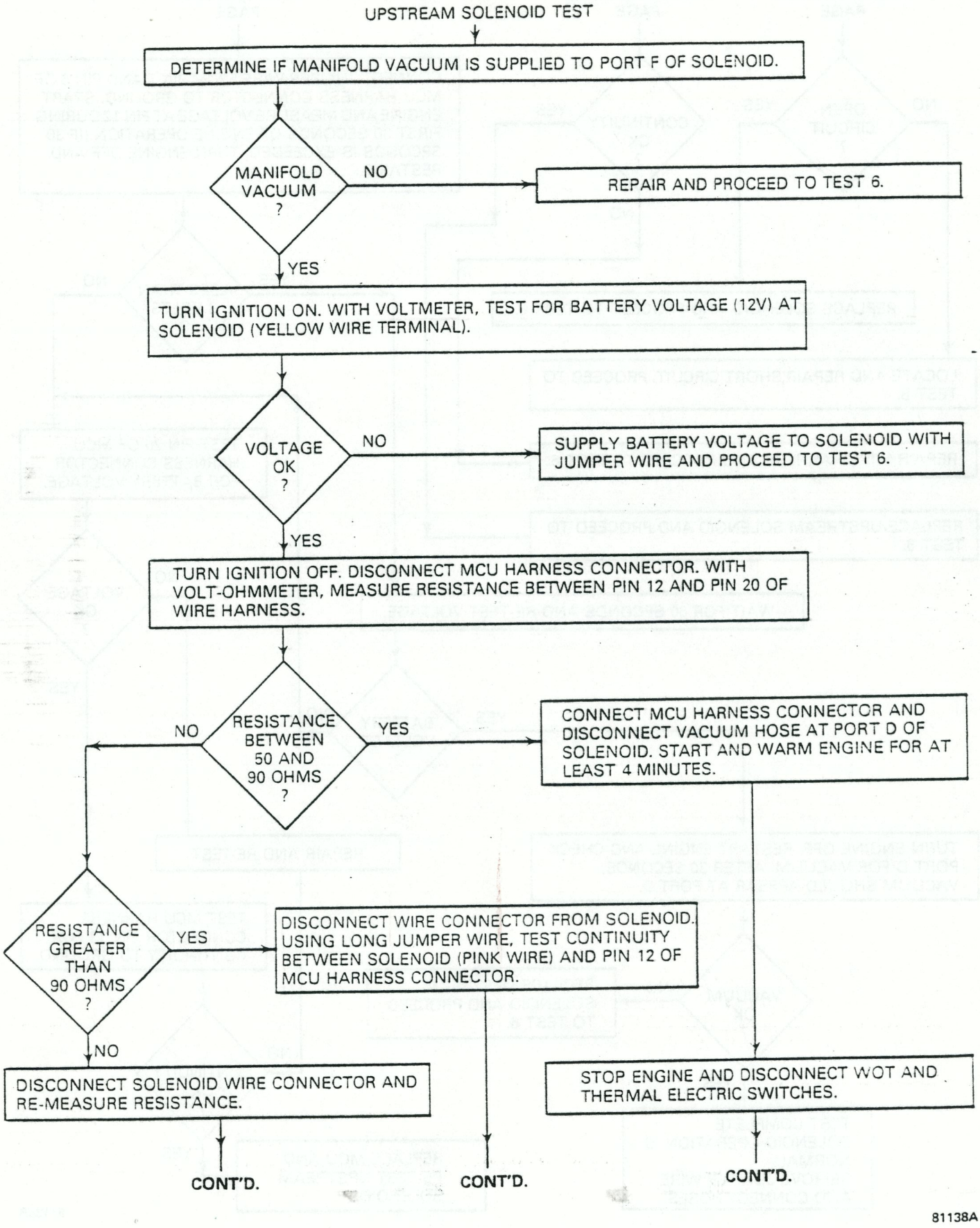
Diagnostic Test 8



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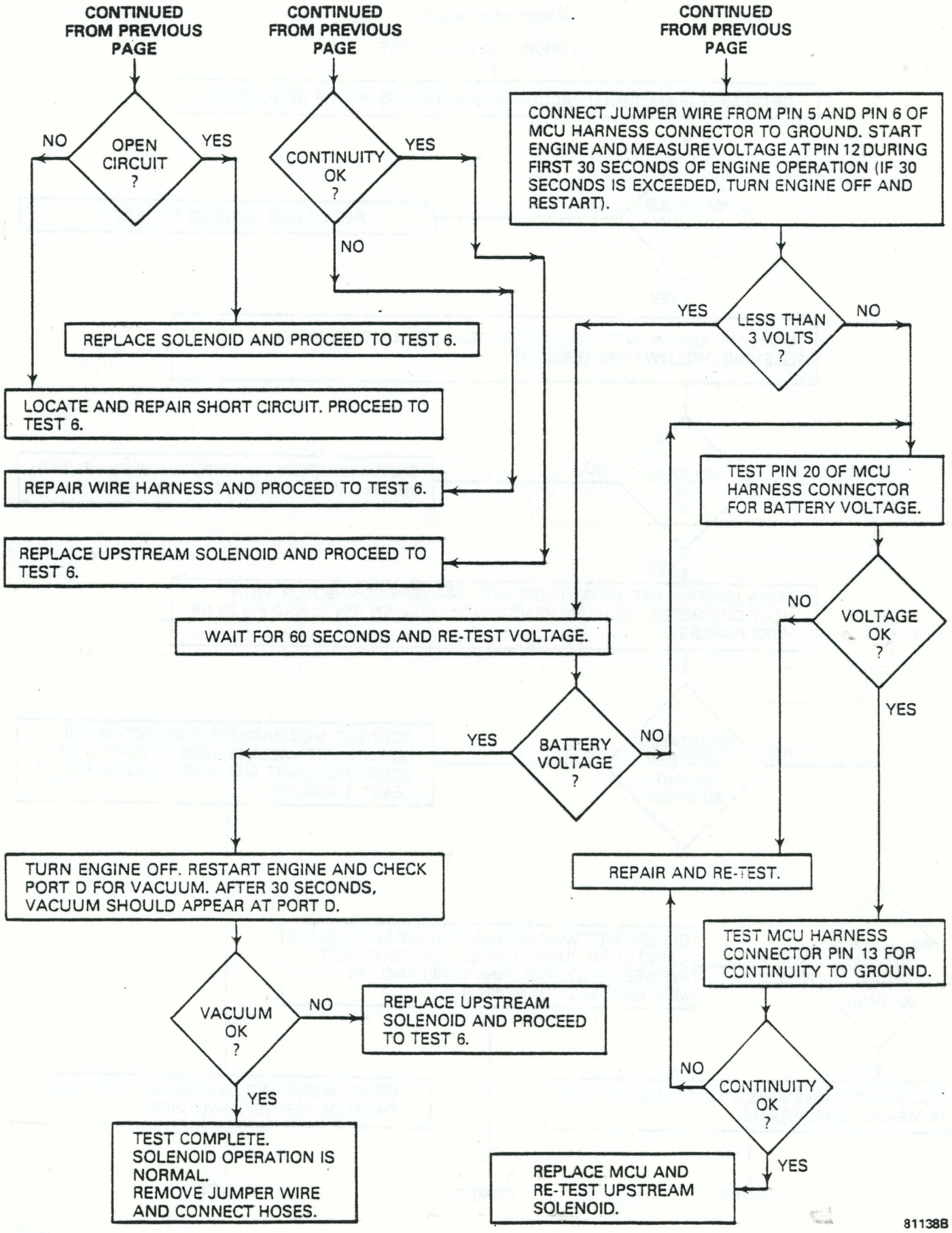
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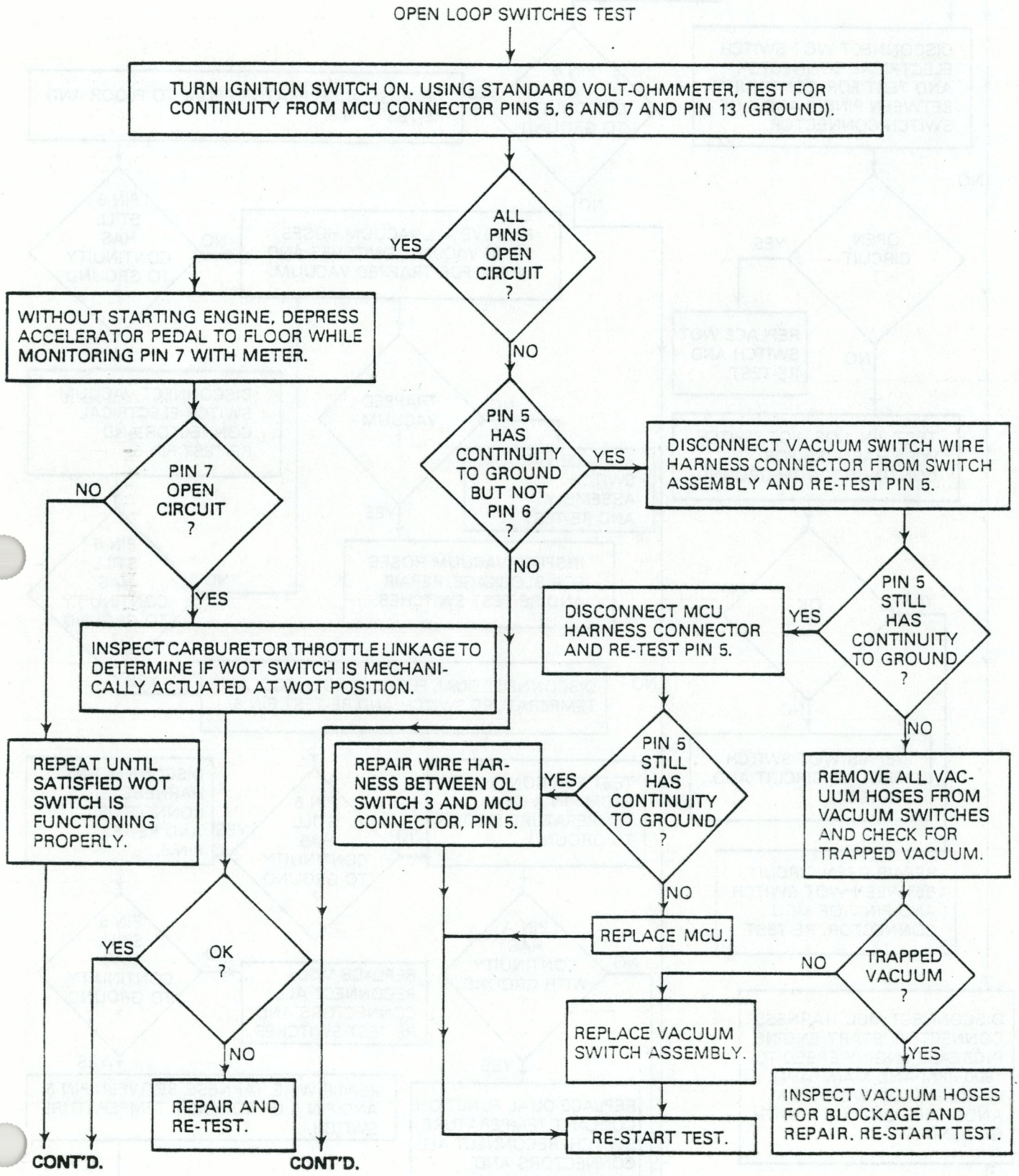
OPEN CIRCUIT ?
NO
YES
CONTINUITY OK ?
YES
NO
CONNECT JUMPER WIRE FROM PIN 5 AND PIN 6 OF MCU HARNESS CONNECTOR TO GROUND. START ENGINE AND MEASURE VOLTAGE AT PIN 12 DURING FIRST 30 SECONDS OF ENGINE OPERATION (IF 30 SECONDS IS EXCEEDED, TURN ENGINE OFF AND RESTART).
LESS THAN 3 VOLTS ?
YES
NO
REPLACE SOLENOID AND PROCEED TO TEST 6.
LOCATE AND REPAIR SHORT CIRCUIT. PROCEED TO TEST 6.
REPAIR WIRE HARNESS AND PROCEED TO TEST 6.
REPLACE UPSTREAM SOLENOID AND PROCEED TO TEST 6.
TEST PIN 20 OF MCU HARNESS CONNECTOR FOR BATTERY VOLTAGE.
WAIT FOR 60 SECONDS AND RE-TEST VOLTAGE.
VOLTAGE OK ?
NO
YES
BATTERY VOLTAGE ?
YES
NO
TURN ENGINE OFF. RESTART ENGINE AND CHECK PORT D FOR VACUUM. AFTER 30 SECONDS, VACUUM SHOULD APPEAR AT PORT D.
REPAIR AND RE-TEST.
TEST MCU HARNESS CONNECTOR PIN 13 FOR CONTINUITY TO GROUND.
VACUUM OK ?
NO
YES
REPLACE UPSTREAM SOLENOID AND PROCEED TO TEST 6.
CONTINUITY OK ?
NO
YES
TEST COMPLETE. SOLENOID OPERATION IS NORMAL. REMOVE JUMPER WIRE AND CONNECT HOSES.
REPLACE MCU AND RE-TEST UPSTREAM SOLENOID.
811388

DIAGNOSTIC TEST 9



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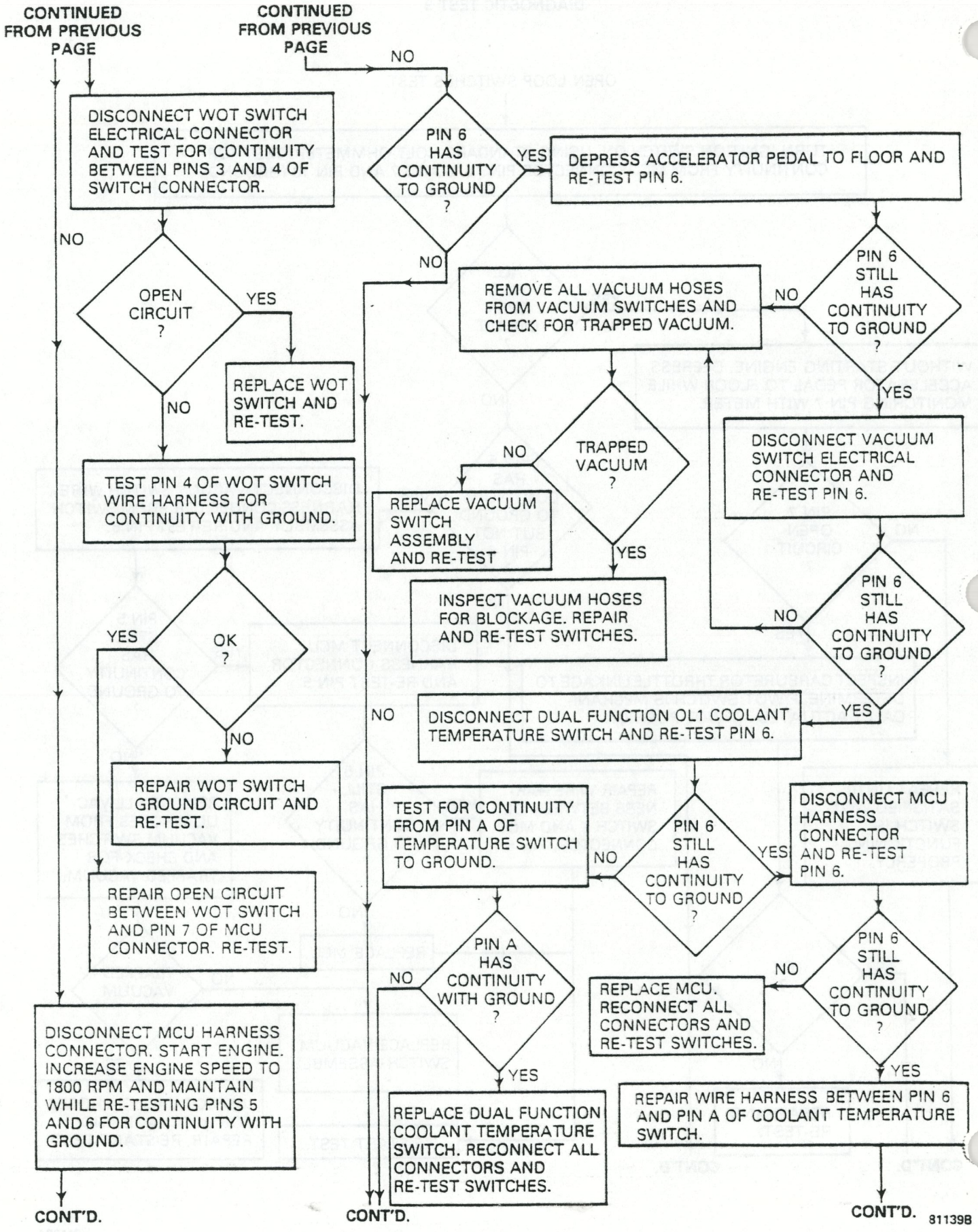
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DISCONNECT WOT SWITCH ELECTRICAL CONNECTOR AND TEST FOR CONTINUITY BETWEEN PINS 3 AND 4 OF SWITCH CONNECTOR.
OPEN CIRCUIT ?
YES
NO
REPLACE WOT SWITCH AND RE-TEST.
TEST PIN 4 OF WOT SWITCH WIRE HARNESS FOR CONTINUITY WITH GROUND.
OK ?
YES
NO
REPAIR WOT SWITCH GROUND CIRCUIT AND RE-TEST.
REPAIR OPEN CIRCUIT BETWEEN WOT SWITCH AND PIN 7 OF MCU CONNECTOR. RE-TEST.
DISCONNECT MCU HARNESS CONNECTOR. START ENGINE. INCREASE ENGINE SPEED TO 1800 RPM AND MAINTAIN WHILE RE-TESTING PINS 5 AND 6 FOR CONTINUITY WITH GROUND.
CONT'D.
NO
PIN 6 HAS CONTINUITY TO GROUND ?
YES
DEPRESS ACCELERATOR PEDAL TO FLOOR AND RE-TEST PIN 6.
NO
REMOVE ALL VACUUM HOSES FROM VACUUM SWITCHES AND CHECK FOR TRAPPED VACUUM.
NO
PIN 6 STILL HAS CONTINUITY TO GROUND ?
YES
TRAPPED VACUUM ?
NO
REPLACE VACUUM SWITCH ASSEMBLY AND RE-TEST
YES
INSPECT VACUUM HOSES FOR BLOCKAGE. REPAIR AND RE-TEST SWITCHES.
DISCONNECT VACUUM SWITCH ELECTRICAL CONNECTOR AND RE-TEST PIN 6.
PIN 6 STILL HAS CONTINUITY TO GROUND ?
NO
YES
NO
DISCONNECT DUAL FUNCTION OL1 COOLANT TEMPERATURE SWITCH AND RE-TEST PIN 6.
TEST FOR CONTINUITY FROM PIN A OF TEMPERATURE SWITCH TO GROUND.
PIN 6 STILL HAS CONTINUITY TO GROUND ?
NO
YES
DISCONNECT MCU HARNESS CONNECTOR AND RE-TEST PIN 6.
PIN A HAS CONTINUITY WITH GROUND ?
NO
YES
REPLACE DUAL FUNCTION COOLANT TEMPERATURE SWITCH. RECONNECT ALL CONNECTORS AND RE-TEST SWITCHES.
REPLACE MCU. RECONNECT ALL CONNECTORS AND RE-TEST SWITCHES.
PIN 6 STILL HAS CONTINUITY TO GROUND ?
NO
YES
REPAIR WIRE HARNESS BETWEEN PIN 6 AND PIN A OF COOLANT TEMPERATURE SWITCH.
CONT'D.
CONT'D.
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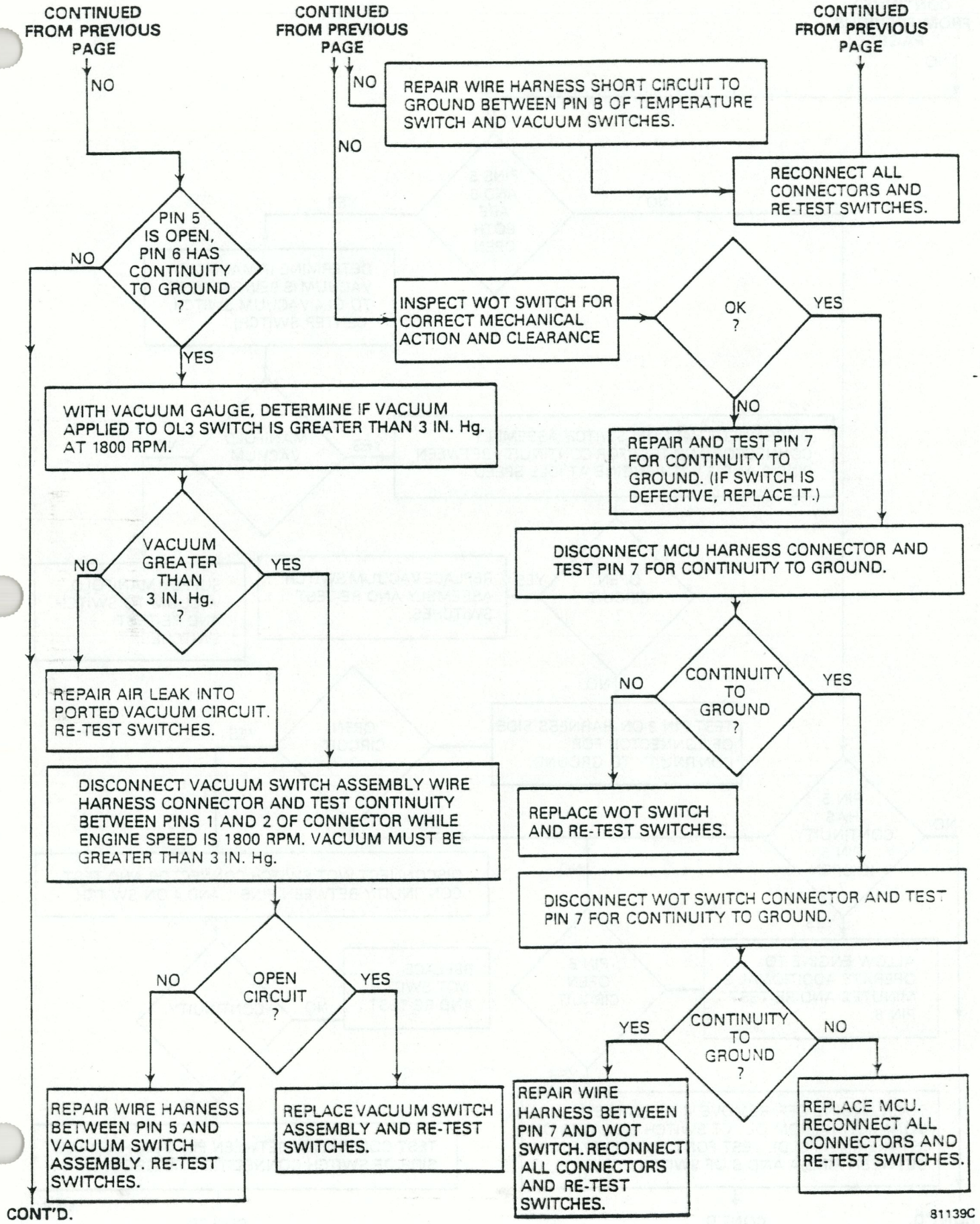
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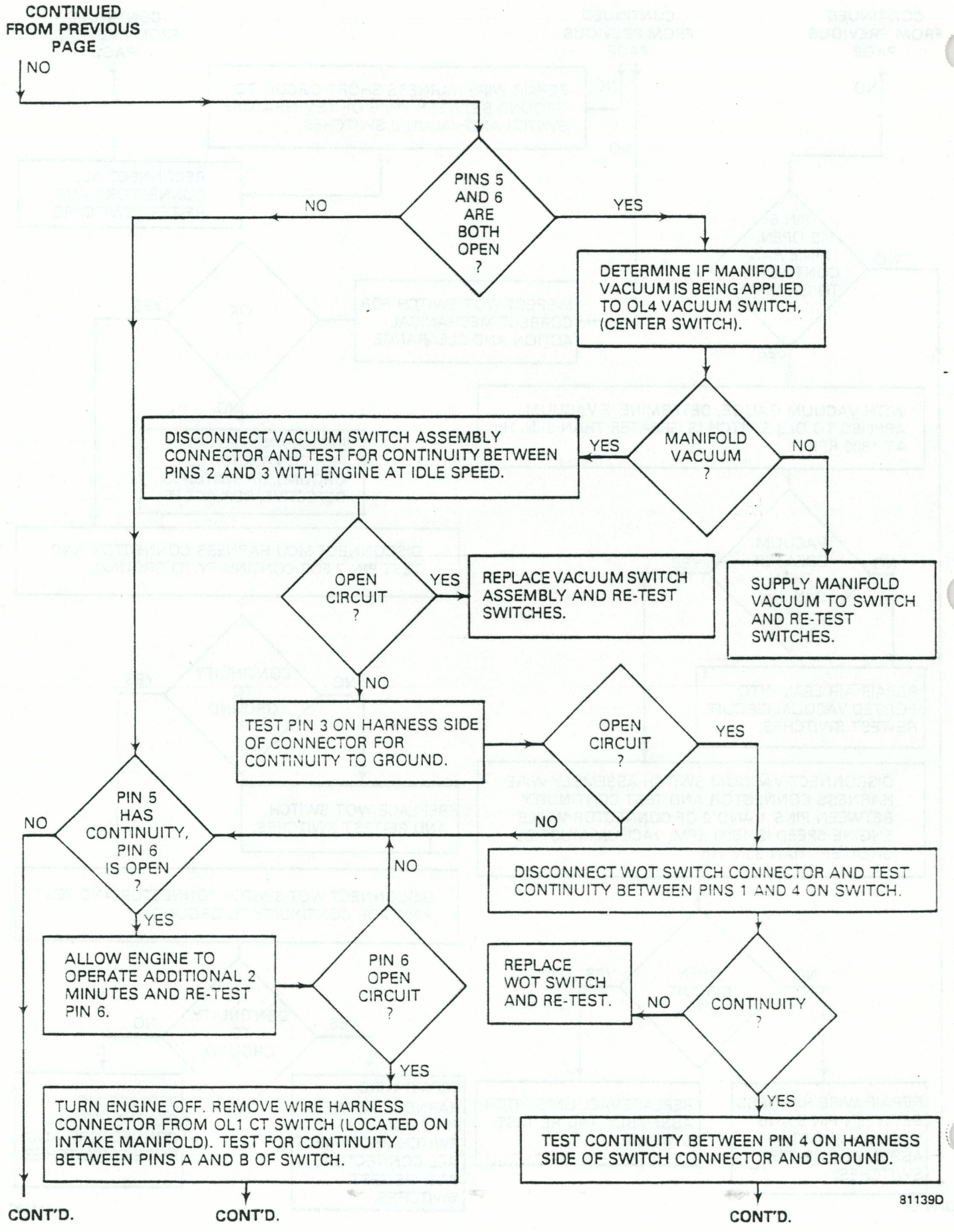
NO
REPAIR WIRE HARNESS SHORT CIRCUIT TO GROUND BETWEEN PIN B OF TEMPERATURE SWITCH AND VACUUM SWITCHES.
NO
RECONNECT ALL CONNECTORS AND RE-TEST SWITCHES.
PIN 5 IS OPEN, PIN 6 HAS CONTINUITY TO GROUND ?
NO
INSPECT WOT SWITCH FOR CORRECT MECHANICAL ACTION AND CLEARANCE
OK ?
YES
YES
NO
WITH VACUUM GAUGE, DETERMINE IF VACUUM APPLIED TO OL3 SWITCH IS GREATER THAN 3 IN. Hg. AT 1800 RPM.
REPAIR AND TEST PIN 7 FOR CONTINUITY TO GROUND. (IF SWITCH IS DEFECTIVE, REPLACE IT.)
DISCONNECT MCU HARNESS CONNECTOR AND TEST PIN 7 FOR CONTINUITY TO GROUND.
VACUUM GREATER THAN 3 IN. Hg. ?
NO
YES
CONTINUITY TO GROUND ?
NO
YES
REPAIR AIR LEAK INTO PORTED VACUUM CIRCUIT. RE-TEST SWITCHES.
DISCONNECT VACUUM SWITCH ASSEMBLY WIRE HARNESS CONNECTOR AND TEST CONTINUITY BETWEEN PINS 1 AND 2 OF CONNECTOR WHILE ENGINE SPEED IS 1800 RPM. VACUUM MUST BE GREATER THAN 3 IN. Hg.
REPLACE WOT SWITCH AND RE-TEST SWITCHES.
DISCONNECT WOT SWITCH CONNECTOR AND TEST PIN 7 FOR CONTINUITY TO GROUND.
OPEN CIRCUIT ?
NO
YES
CONTINUITY TO GROUND ?
YES
NO
REPAIR WIRE HARNESS BETWEEN PIN 5 AND VACUUM SWITCH ASSEMBLY. RE-TEST SWITCHES.
REPLACE VACUUM SWITCH ASSEMBLY AND RE-TEST SWITCHES.
REPAIR WIRE HARNESS BETWEEN PIN 7 AND WOT SWITCH. RECONNECT ALL CONNECTORS AND RE-TEST SWITCHES.
REPLACE MCU. RECONNECT ALL CONNECTORS AND RE-TEST SWITCHES.
CONT'D.
81139C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NO
PINS 5 AND 6 ARE BOTH OPEN ?
NO
YES
DETERMINE IF MANIFOLD VACUUM IS BEING APPLIED TO OL4 VACUUM SWITCH, (CENTER SWITCH).
MANIFOLD VACUUM ?
YES
NO
DISCONNECT VACUUM SWITCH ASSEMBLY CONNECTOR AND TEST FOR CONTINUITY BETWEEN PINS 2 AND 3 WITH ENGINE AT IDLE SPEED.
SUPPLY MANIFOLD VACUUM TO SWITCH AND RE-TEST SWITCHES.
OPEN CIRCUIT ?
YES
REPLACE VACUUM SWITCH ASSEMBLY AND RE-TEST SWITCHES.
NO
TEST PIN 3 ON HARNESS SIDE OF CONNECTOR FOR CONTINUITY TO GROUND.
OPEN CIRCUIT ?
YES
NO
PIN 5 HAS CONTINUITY, PIN 6 IS OPEN ?
NO
YES
DISCONNECT WOT SWITCH CONNECTOR AND TEST CONTINUITY BETWEEN PINS 1 AND 4 ON SWITCH.
ALLOW ENGINE TO OPERATE ADDITIONAL 2 MINUTES AND RE-TEST PIN 6.
PIN 6 OPEN CIRCUIT ?
NO
YES
REPLACE WOT SWITCH AND RE-TEST.
CONTINUITY ?
NO
YES
TURN ENGINE OFF. REMOVE WIRE HARNESS CONNECTOR FROM OL1 CT SWITCH (LOCATED ON INTAKE MANIFOLD). TEST FOR CONTINUITY BETWEEN PINS A AND B OF SWITCH.
TEST CONTINUITY BETWEEN PIN 4 ON HARNESS SIDE OF SWITCH CONNECTOR AND GROUND.
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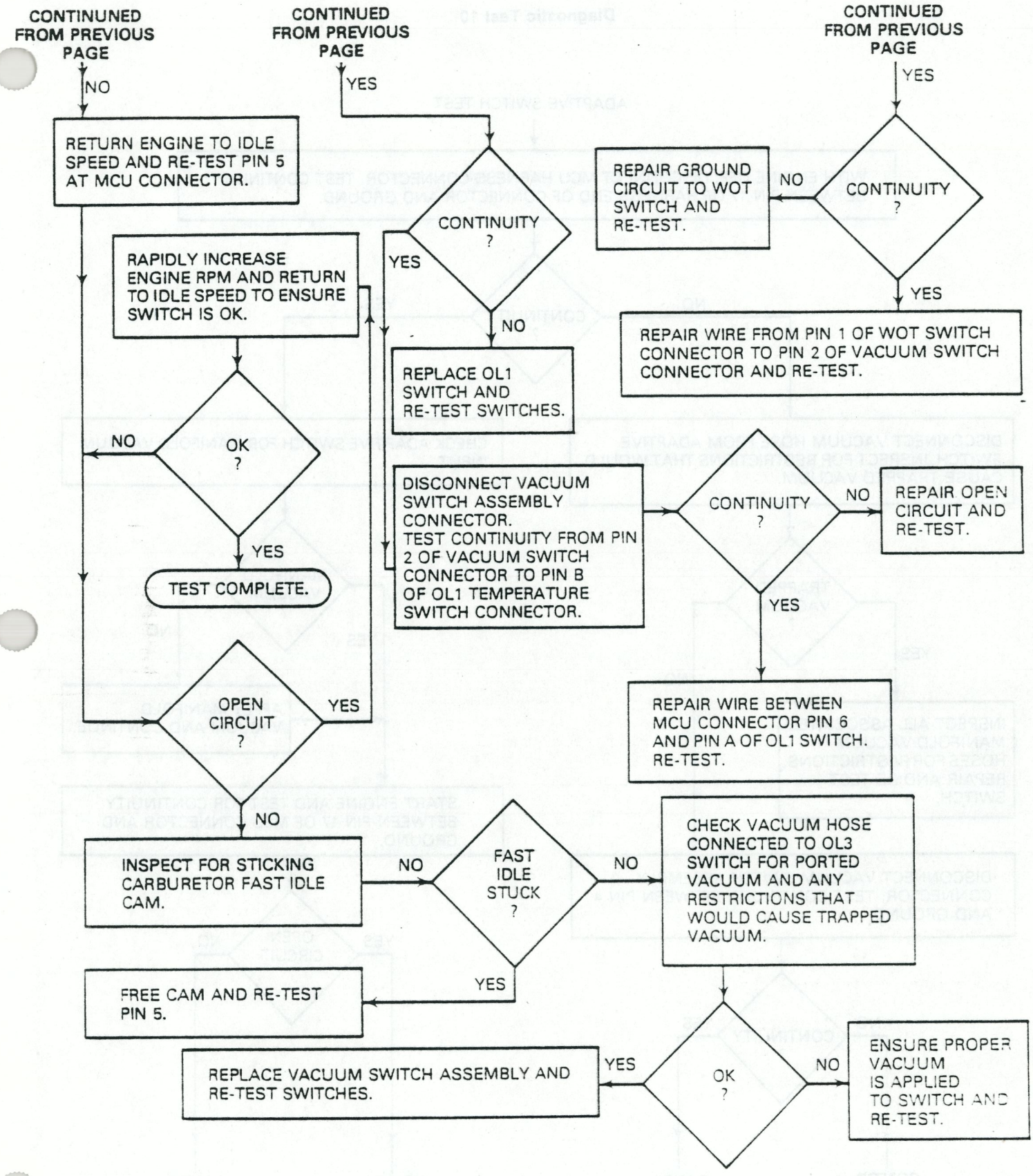
CONT'D.
CONT'D.
CONT'D.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NO
RETURN ENGINE TO IDLE SPEED AND RE-TEST PIN 5 AT MCU CONNECTOR.
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YES
CONTINUITY ?
YES
NO
REPLACE OL1 SWITCH AND RE-TEST SWITCHES.
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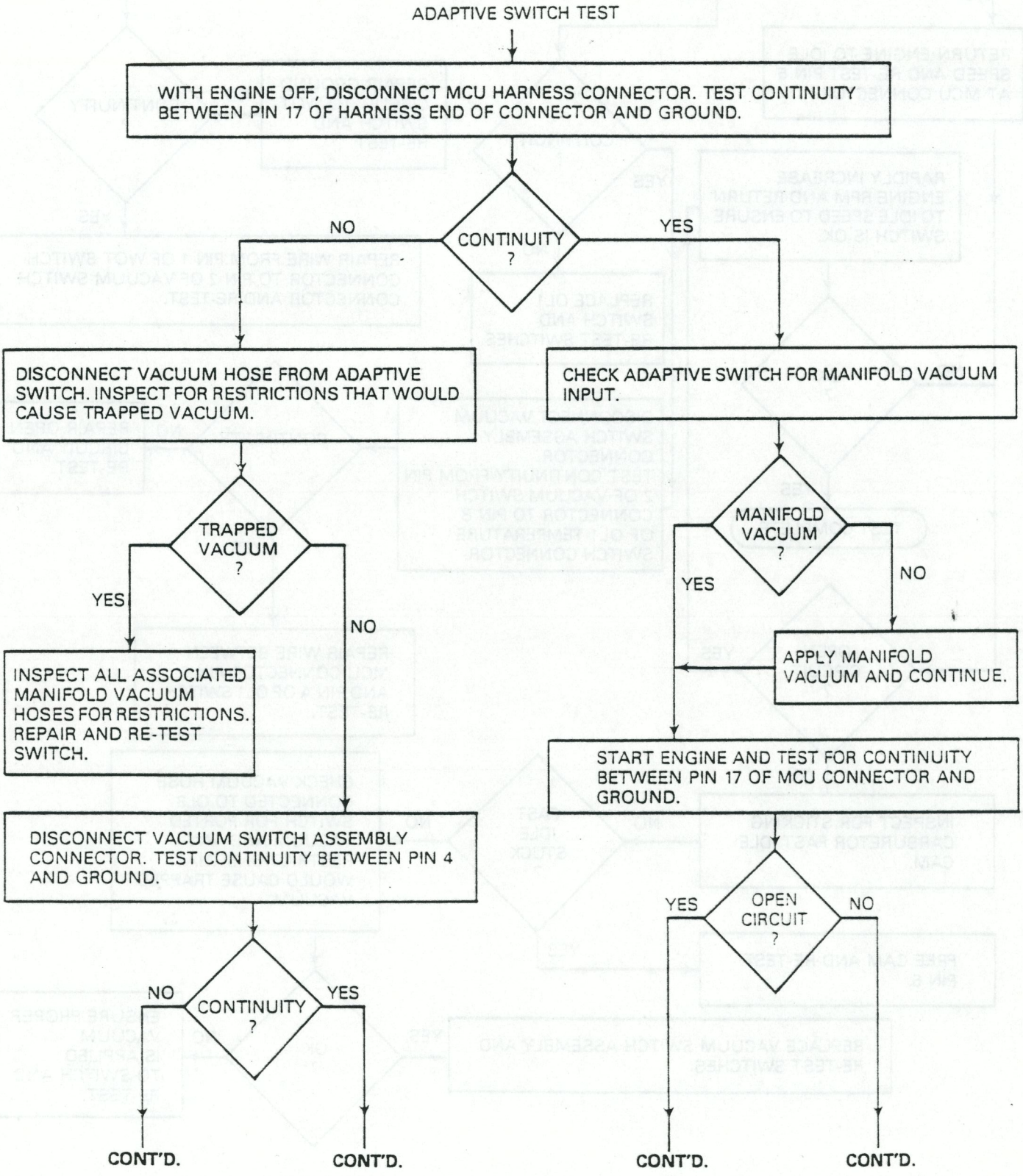
YES
CONTINUITY ?
NO
REPAIR GROUND CIRCUIT TO WOT SWITCH AND RE-TEST.
YES
REPAIR WIRE FROM PIN 1 OF WOT SWITCH CONNECTOR TO PIN 2 OF VACUUM SWITCH CONNECTOR AND RE-TEST.
RAPIDLY INCREASE ENGINE RPM AND RETURN TO IDLE SPEED TO ENSURE SWITCH IS OK.
OK ?
NO
YES
TEST COMPLETE.
DISCONNECT VACUUM SWITCH ASSEMBLY CONNECTOR.
TEST CONTINUITY FROM PIN 2 OF VACUUM SWITCH CONNECTOR TO PIN B OF OL1 TEMPERATURE SWITCH CONNECTOR.
CONTINUITY ?
NO
REPAIR OPEN CIRCUIT AND RE-TEST.
YES
REPAIR WIRE BETWEEN MCU CONNECTOR PIN 6 AND PIN A OF OL1 SWITCH. RE-TEST.
OPEN CIRCUIT ?
YES
NO
INSPECT FOR STICKING CARBURETOR FAST IDLE CAM.
NO
FAST IDLE STUCK ?
NO
CHECK VACUUM HOSE CONNECTED TO OL3 SWITCH FOR PORTED VACUUM AND ANY RESTRICTIONS THAT WOULD CAUSE TRAPPED VACUUM.
YES
FREE CAM AND RE-TEST PIN 5.
REPLACE VACUUM SWITCH ASSEMBLY AND RE-TEST SWITCHES.
YES
OK ?
NO
ENSURE PROPER VACUUM IS APPLIED TO SWITCH AND RE-TEST.

81139E

Diagnostic Test 10



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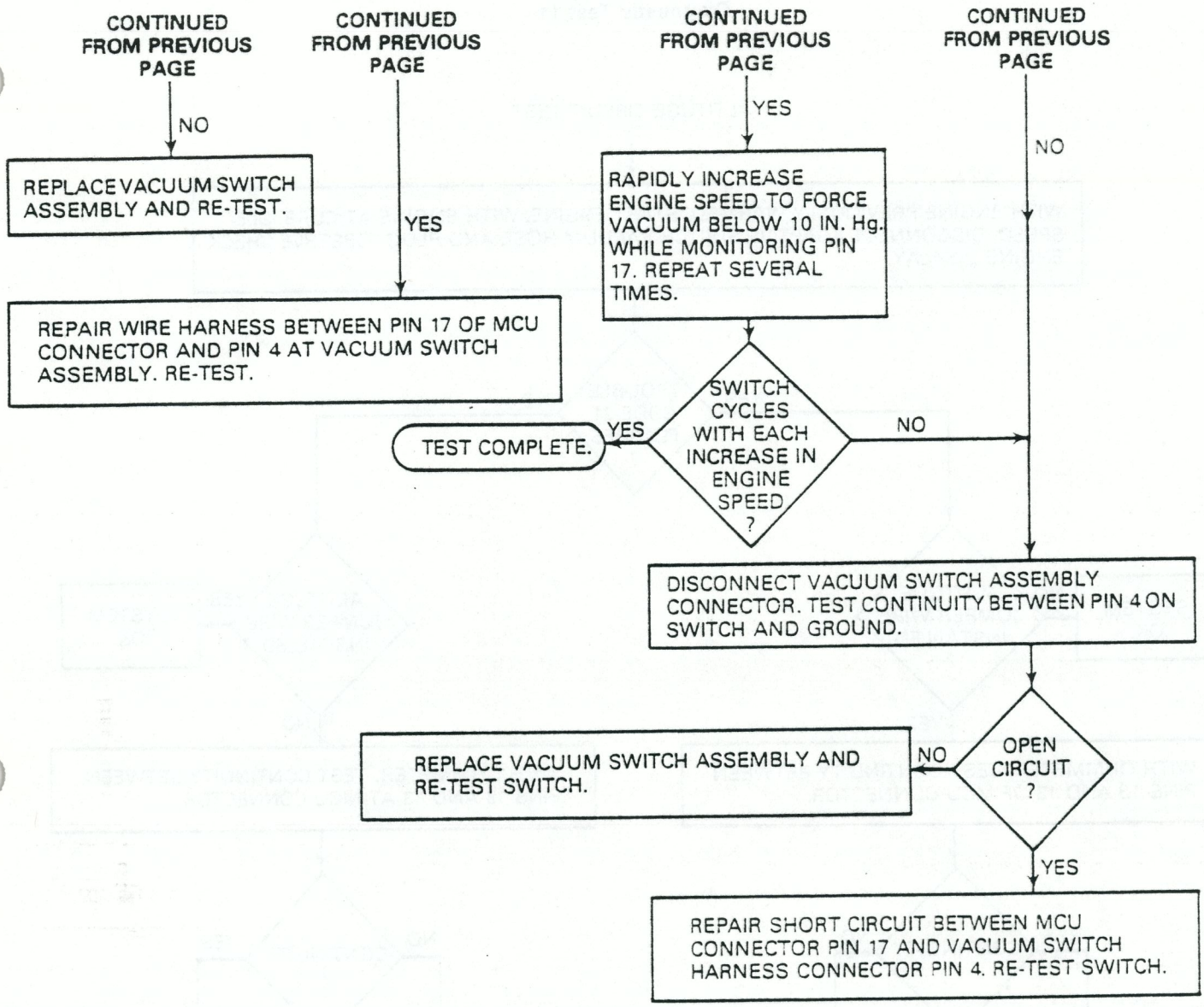
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NO
REPLACE VACUUM SWITCH ASSEMBLY AND RE-TEST.
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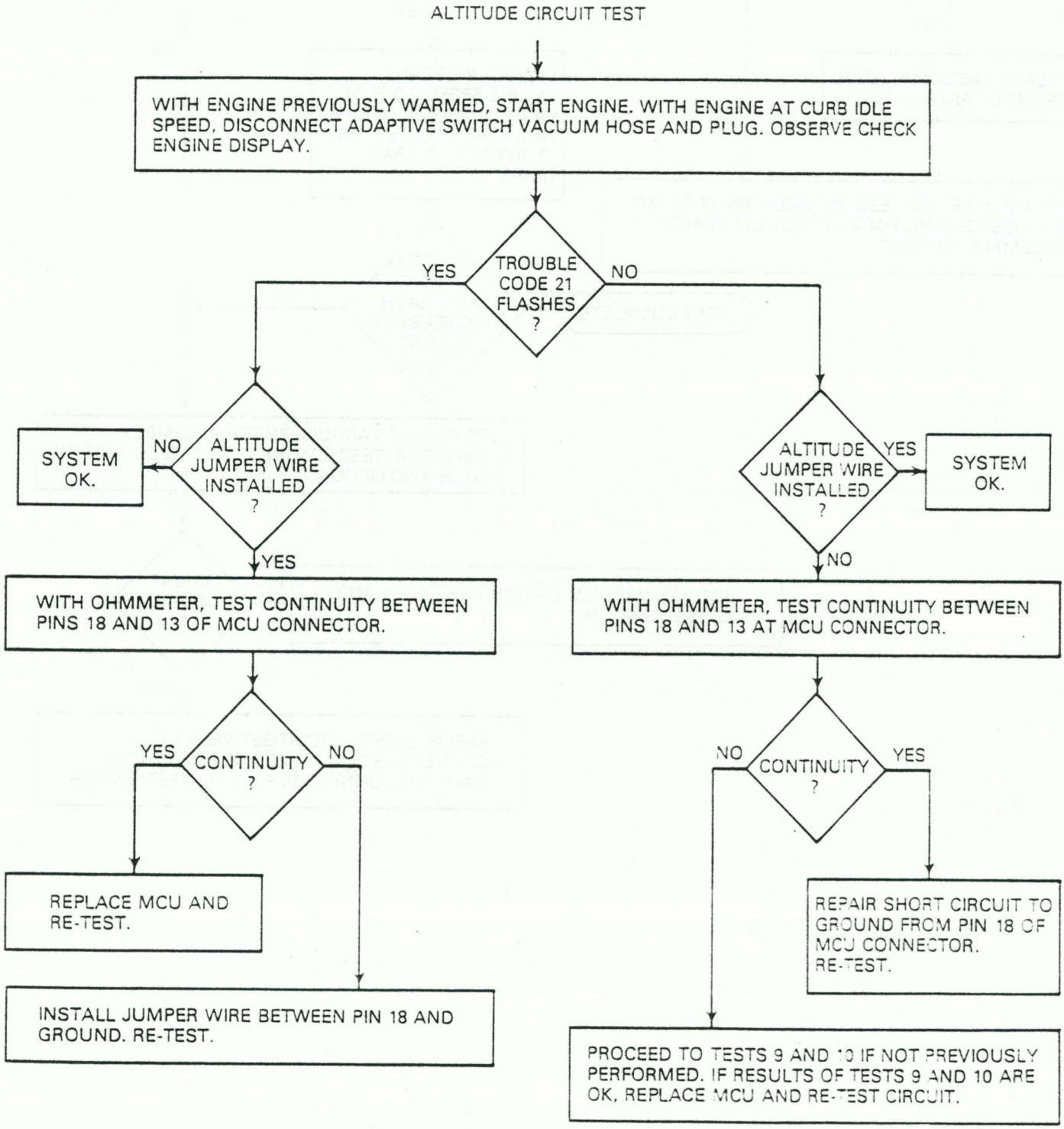
YES
REPAIR WIRE HARNESS BETWEEN PIN 17 OF MCU CONNECTOR AND PIN 4 AT VACUUM SWITCH ASSEMBLY. RE-TEST.
CONTINUED FROM PREVIOUS PAGE
YES
RAPIDLY INCREASE ENGINE SPEED TO FORCE VACUUM BELOW 10 IN. Hg. WHILE MONITORING PIN 17. REPEAT SEVERAL TIMES.
SWITCH CYCLES WITH EACH INCREASE IN ENGINE SPEED ?
YES
TEST COMPLETE.
NO
CONTINUED FROM PREVIOUS PAGE
NO
DISCONNECT VACUUM SWITCH ASSEMBLY CONNECTOR. TEST CONTINUITY BETWEEN PIN 4 ON SWITCH AND GROUND.
OPEN CIRCUIT ?
NO
REPLACE VACUUM SWITCH ASSEMBLY AND RE-TEST SWITCH.
YES
REPAIR SHORT CIRCUIT BETWEEN MCU CONNECTOR PIN 17 AND VACUUM SWITCH HARNESS CONNECTOR PIN 4. RE-TEST SWITCH.

Diagnostic Test 11



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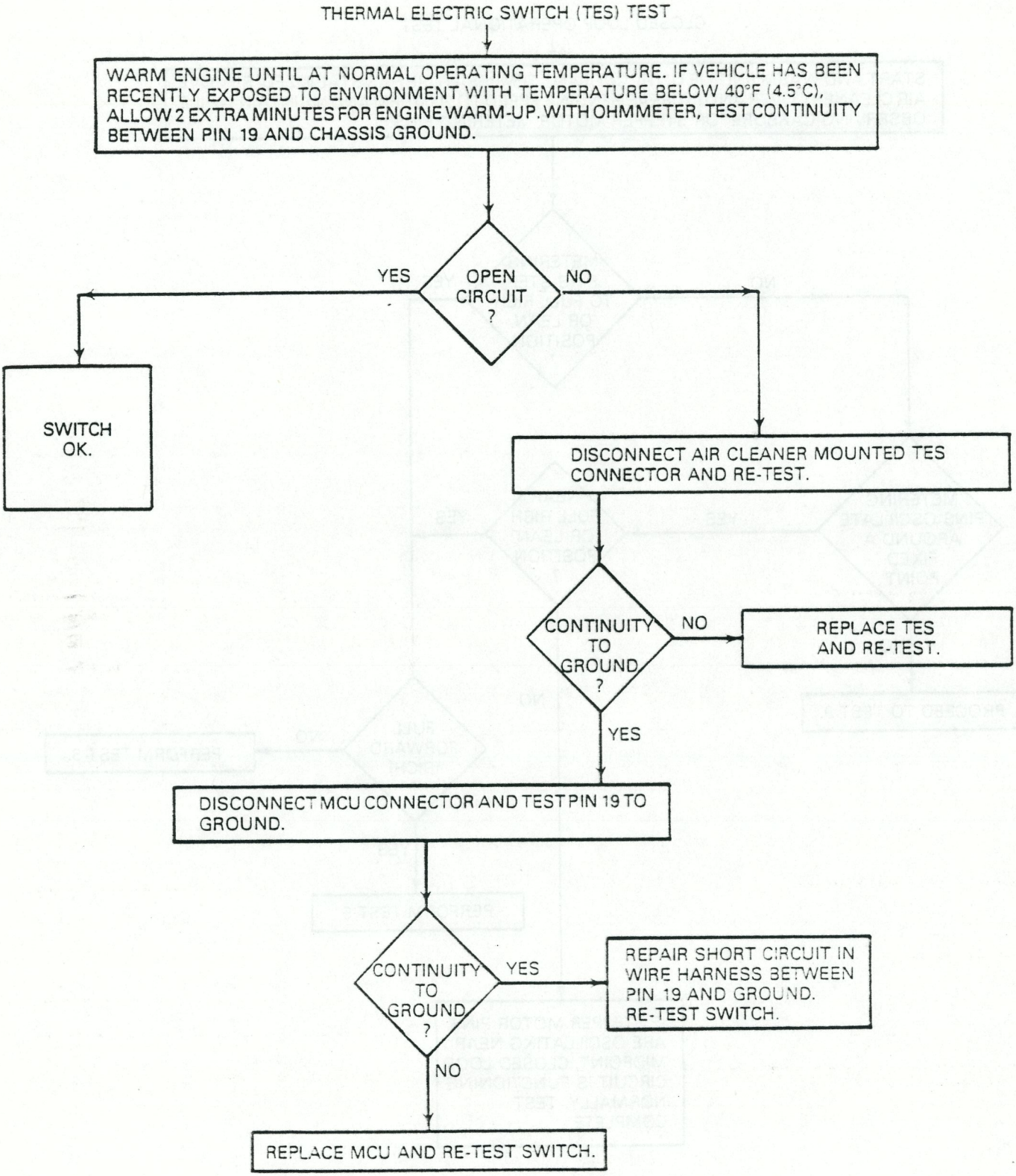
Diagnostic Test 12



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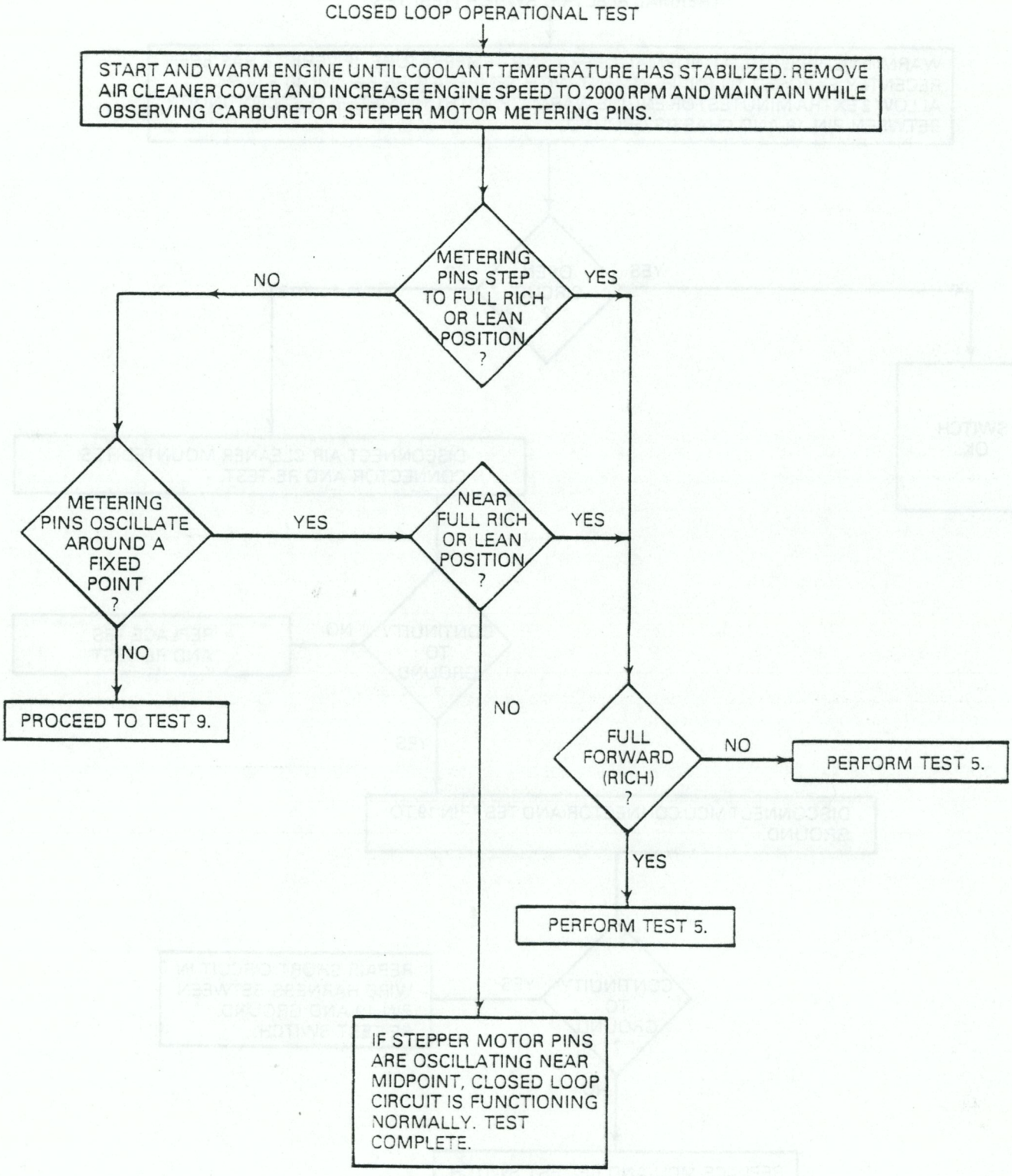

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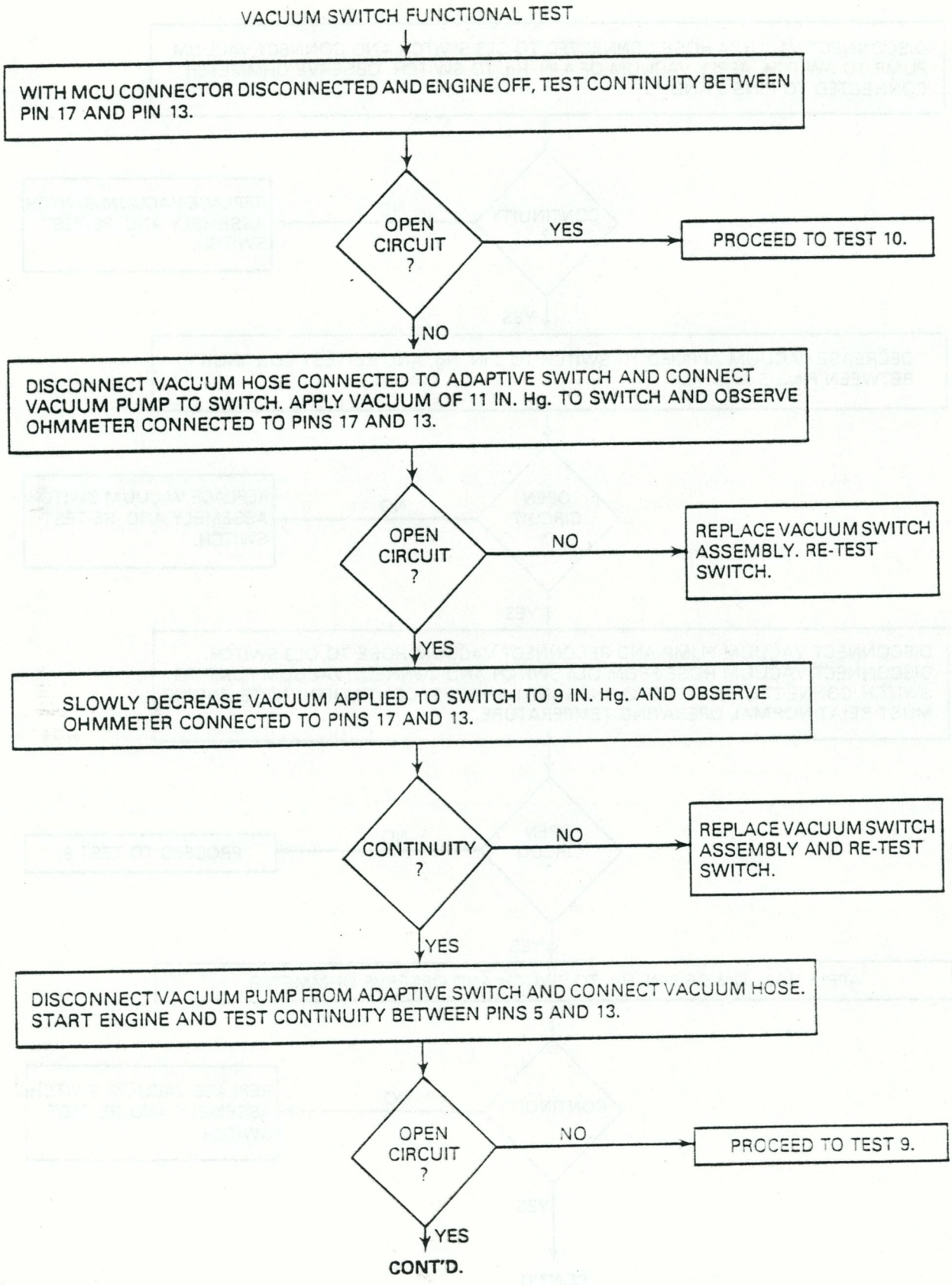
Diagnostic Test 14



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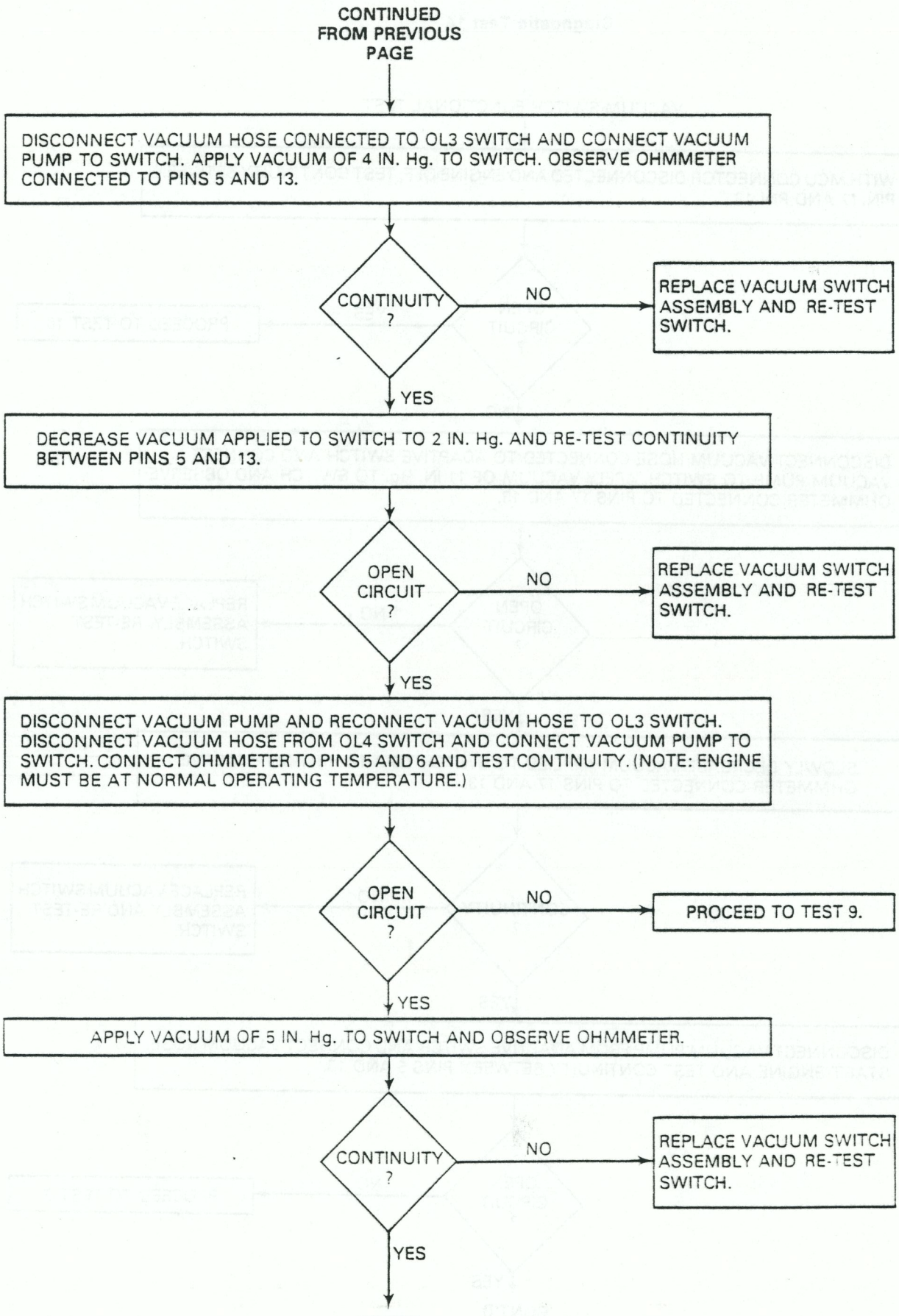
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DISCONNECT VACUUM HOSE CONNECTED TO OL3 SWITCH AND CONNECT VACUUM PUMP TO SWITCH. APPLY VACUUM OF 4 IN. Hg. TO SWITCH. OBSERVE OHMMETER CONNECTED TO PINS 5 AND 13.
CONTINUITY ?
NO
REPLACE VACUUM SWITCH ASSEMBLY AND RE-TEST SWITCH.
YES
DECREASE VACUUM APPLIED TO SWITCH TO 2 IN. Hg. AND RE-TEST CONTINUITY BETWEEN PINS 5 AND 13.
OPEN CIRCUIT ?
NO
REPLACE VACUUM SWITCH ASSEMBLY AND RE-TEST SWITCH.
YES
DISCONNECT VACUUM PUMP AND RECONNECT VACUUM HOSE TO OL3 SWITCH. DISCONNECT VACUUM HOSE FROM OL4 SWITCH AND CONNECT VACUUM PUMP TO SWITCH. CONNECT OHMMETER TO PINS 5 AND 6 AND TEST CONTINUITY. (NOTE: ENGINE MUST BE AT NORMAL OPERATING TEMPERATURE.)
OPEN CIRCUIT ?
NO
PROCEED TO TEST 9.
YES
APPLY VACUUM OF 5 IN. Hg. TO SWITCH AND OBSERVE OHMMETER.
CONTINUITY ?
NO
REPLACE VACUUM SWITCH ASSEMBLY AND RE-TEST SWITCH.
YES
CONT'D.

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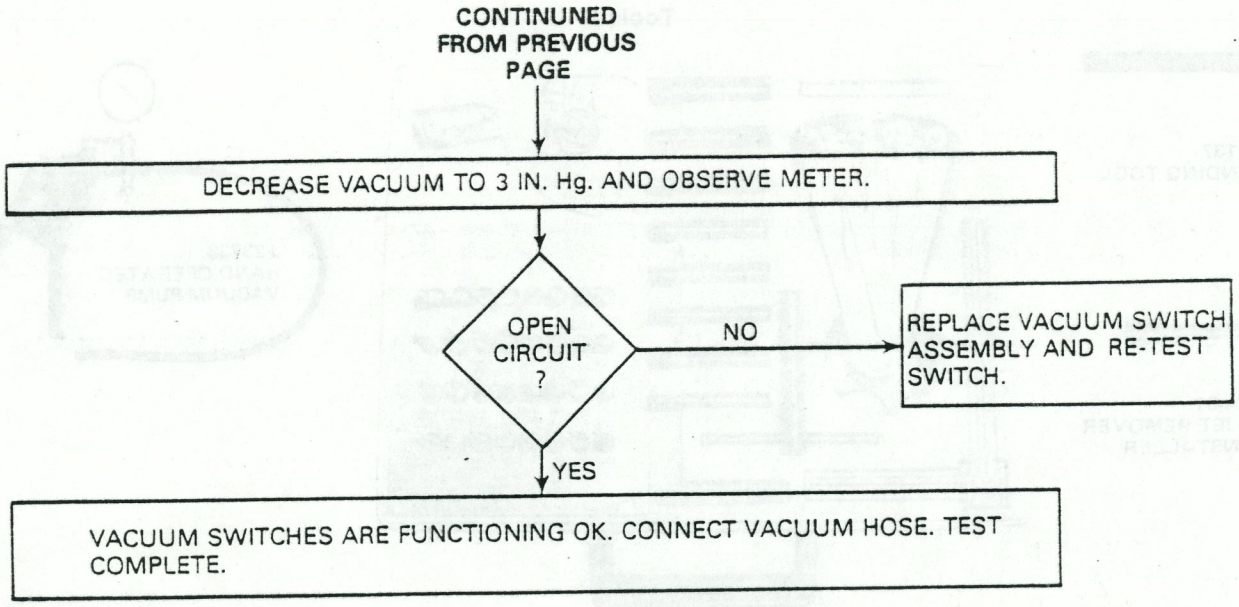
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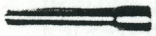
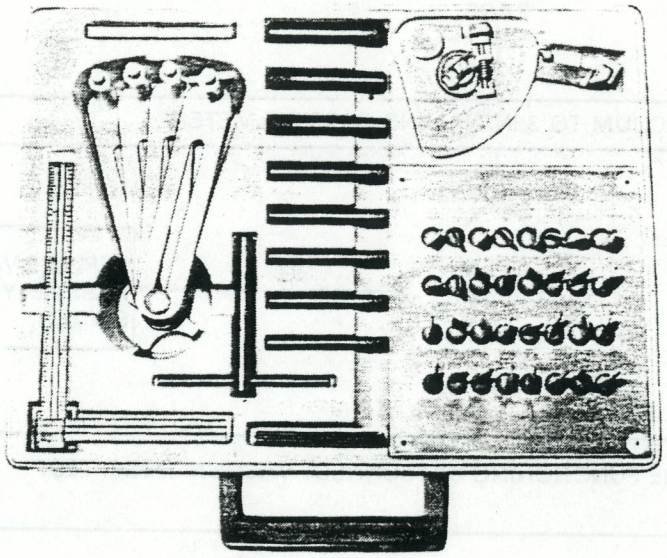
DECREASE VACUUM TO 3 IN. Hg. AND OBSERVE METER.
OPEN CIRCUIT ?
NO
REPLACE VACUUM SWITCH ASSEMBLY AND RE-TEST SWITCH.
YES
VACUUM SWITCHES ARE FUNCTIONING OK. CONNECT VACUUM HOSE. TEST COMPLETE.

Tools

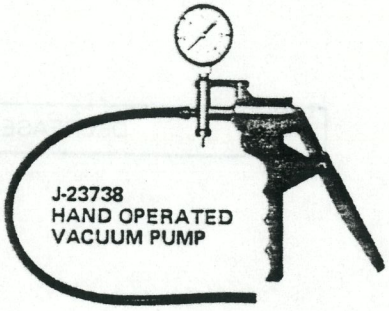
J-1137
BENDING TOOL



J-10174-01
MAIN JET REMOVER
AND INSTALLER



J-9789-C
UNIVERSAL CARBURETOR
GAUGE SET



J-23738
HAND OPERATED
VACUUM PUMP

EXHAUST SYSTEMS 1K

SECTION INDEX

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Catalytic Converter Systems	1K-13
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EXHAUST MANIFOLDS, MUFFLERS AND PIPES

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Pipe Replacement	1K-5
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GENERAL

The basic exhaust system for all Jeep vehicles consists of exhaust manifold(s), front exhaust pipe, catalytic converter, muffler and tailpipe.

CJ vehicles with four-, six- or eight-cylinder engines that are designated 49-State use a conventional oxidizing catalytic (COC) pellet-type converter (figs. 1K-1, 1K-2 and 1K-3). Four-cylinder engine CJ vehicles manufactured for sale in California use a three-way catalytic (TWC) pellet-type converter. Six-cylinder engine CJ vehicles manufactured for sale in California use a dual bed (COC and TWC) monolithic-type converter with "downstream" air injection.

Cherokee, Wagoneer and Truck vehicles use a conventional oxidizing catalytic (COC) pellet-type converter except six-cylinder engine models manufactured for sale in California. These models use a dual bed (COC and TWC) monolithic-type converter with "downstream" air injection (figs. 1K-4, 1K-5).

The exhaust system must be properly aligned to prevent stress, leakage and chassis contact. If the system contacts any body panel, it may amplify objectionable noises originating from the engine or the body. When inspecting an exhaust system, inspect for cracked or loose joints, stripped screw threads, and corrosion damage. Inspect for worn or broken hangers. Replace all parts that are badly corroded or damaged. Do not attempt to repair.

RESTRICTED EXHAUST SYSTEM DIAGNOSIS

A restricted or blocked exhaust system usually results in loss of power or backfire up through the carburetor. Verify that the condition is not caused by ignition timing or other ignition system malfunctions, then perform a visual inspection of the exhaust system. If the restriction cannot be located by visual inspection, perform the following test procedure.

(1) Attach vacuum gauge to intake manifold.

(2) Connect tachometer.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(3) Start engine and observe vacuum gauge. Gauge should indicate 16 to 21 in. Hg (54 to 71 kPa) of vacuum.

(4) Increase engine speed to 2,000 rpm and observe vacuum gauge. Vacuum will decrease when engine speed is increased rapidly, but should settle at 16 to 21 in. Hg (54 to 71 kPa) and remain steady. If vacuum decreases

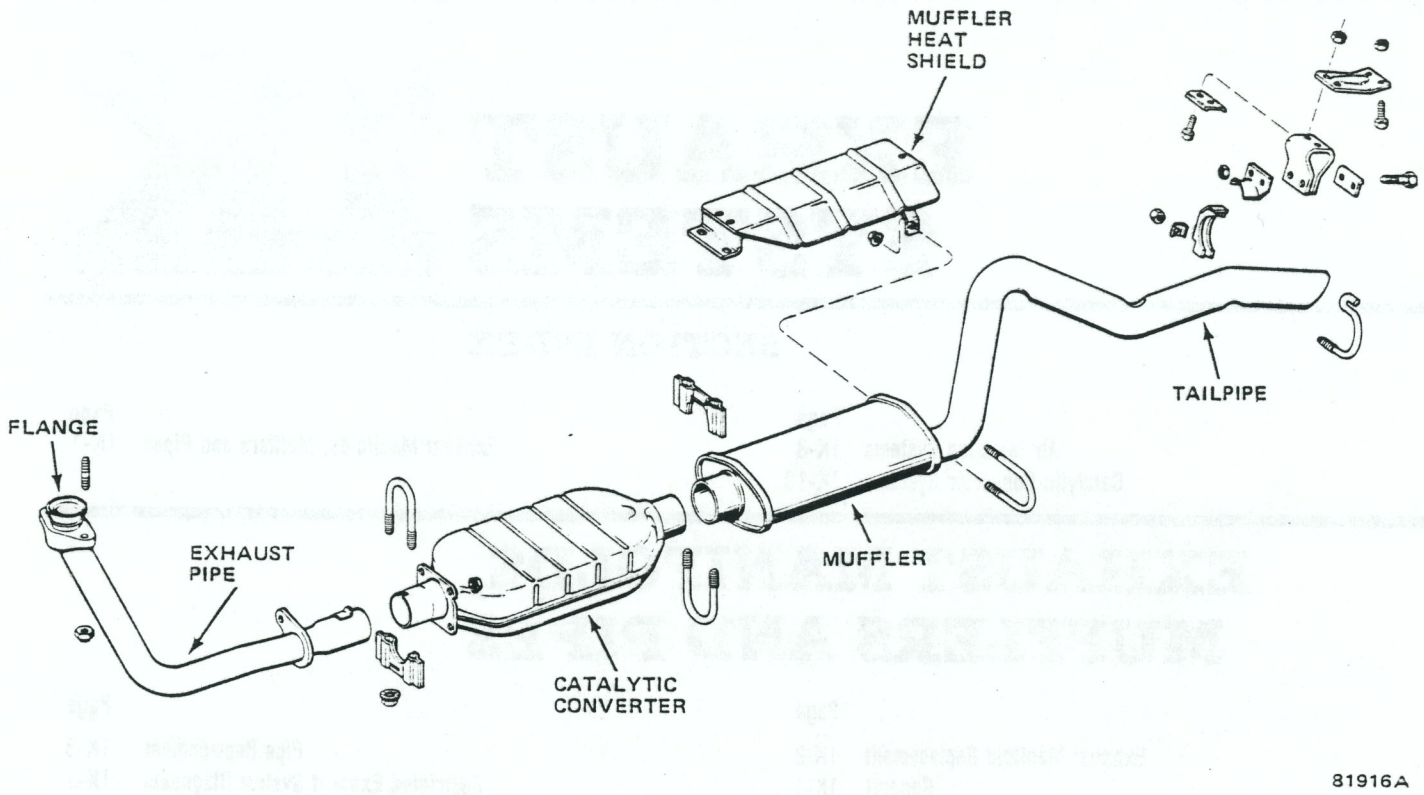


Fig. 1K-1 Four-Cylinder Engine Exhaust System—CJ Vehicles

below 16 in. Hg (54 kPa), exhaust system is restricted or blocked. Stop engine and proceed to step (5).

(5) Disconnect exhaust pipe at manifold.

(6) Start engine and increase speed to 2,000 rpm. Observe vacuum gauge.

(a) If vacuum settles at 16 to 21 in. Hg (54 to 71 kPa), restriction or blockage is in exhaust pipe, catalytic converter or muffler.

(b) If vacuum decreases below 16 in. Hg (54 kPa) with exhaust pipe disconnected, exhaust manifold is restricted.

(7) Connect exhaust pipe, remove muffler, start engine and observe vacuum gauge.

(a) If vacuum decreases below 16 in. Hg (54 kPa), restriction or blockage is in catalytic converter.

(b) If vacuum is normal, muffler is restricted.

NOTE: *If the converter has failed, always inspect the muffler to determine if converter debris has entered it.*

(8) Stop engine.

(9) Disconnect tachometer and vacuum gauge.

(10) For four- and six-cylinder engines, remove exhaust manifold. For eight-cylinder engines, remove both exhaust manifolds.

(11) Inspect exhaust manifold ports for casting flash by dropping length of chain into each port.

NOTE: *Do not use a wire or a light to inspect ports. The restricted opening may be large enough for wire or light to pass through but small enough to cause excessive back pressure at high engine rpm.*

(12) Remove casting flash. If flash is at lower end of port, it can usually be chipped out. If flash cannot be removed, replace manifold.

(13) Install exhaust manifold(s).

EXHAUST MANIFOLD REPLACEMENT

Four-Cylinder Engine

The exhaust manifold is located on the left hand side of the engine (fig. 1K-6). Refer to Chapter 1B—Engines for replacement procedure.

Six-Cylinder Engine

The intake and exhaust manifolds are attached with common bolts and nuts to the cylinder head on the left side of the engine. A gasket is used between the intake manifold and the cylinder head. No gasket is used between the exhaust manifold and cylinder head or between exhaust manifold and exhaust pipe (fig. 1K-7). Refer to Chapter 1B—Engines for replacement procedure.

Eight-Cylinder Engine

Refer to Chapter 1B—Engines for replacement procedure.

HEAT VALVE

Four- and six-cylinder engines are not equipped with heat valves.

Eight-Cylinder Engine

A thermostatically controlled heat valve mounted between the right exhaust manifold and exhaust pipe directs exhaust heat to the intake manifold for rapid fuel vaporization during engine warmup. When the counterweight is in the horizontal position, the valve is in the heat **On** position, directing exhaust heat through the intake manifold crossover passage (fig. 1K-8). The exhaust heat crosses through the intake manifold and discharges into the left exhaust manifold until the engine attains normal operating temperature. At this time, the heated bimetallic spring loses its tension, the counterweight moves downward and the valve moves to the heat **Off** position. This allows the exhaust heat to discharge completely through the right exhaust pipe.

Examine the manifold heat valve for freedom of movement and lubricate every 30,000 miles (48 000 km) with Jeep Heat Valve Lubricant, or equivalent.

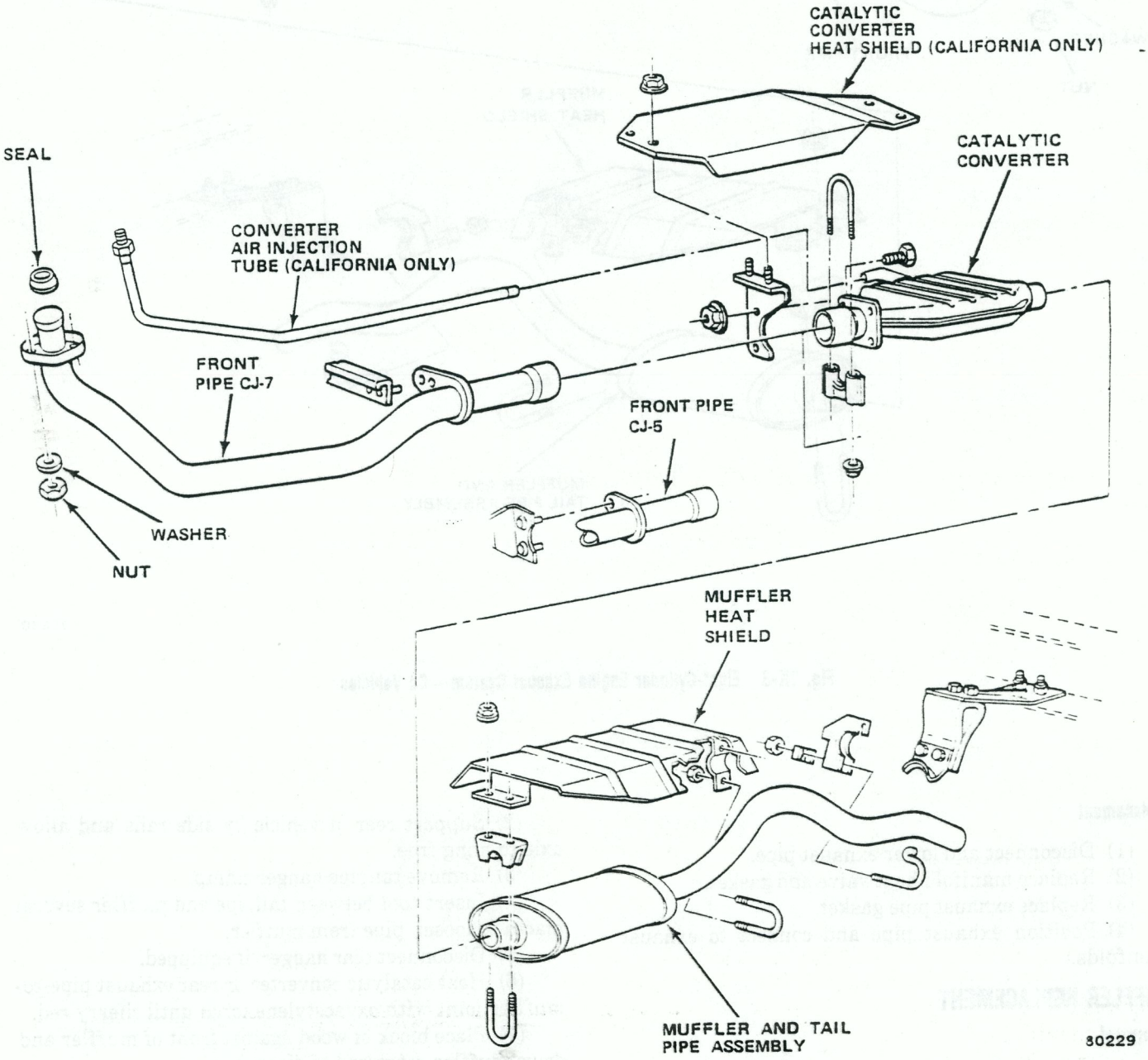


Fig. 1K-2 Six-Cylinder Engine Exhaust System—CJ Vehicles

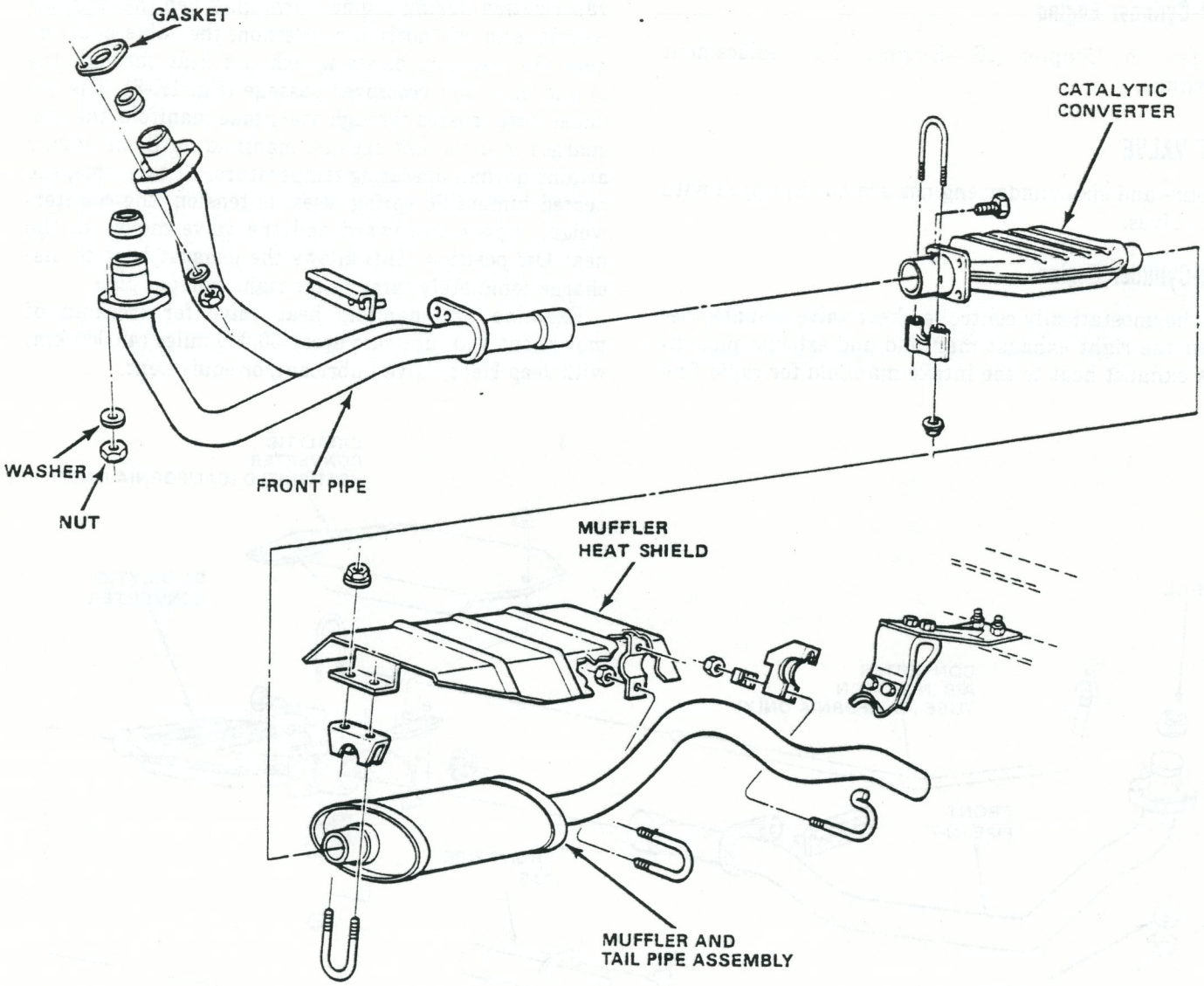


Fig. 1K-3 Eight-Cylinder Engine Exhaust System—CJ Vehicles

Replacement

(1) Disconnect and lower exhaust pipe.
(2) Replace manifold heat valve and gasket.
(3) Replace exhaust pipe gasket.
(4) Position exhaust pipe and connect to exhaust manifolds.

MUFFLER REPLACEMENT

Removal

(1) Remove front and rear muffler clamps.
(2) Support rear of vehicle by side rails and allow axle to hang free.
(3) Remove tailpipe hanger clamp.
(4) Insert tool between tailpipe and muffler several places to loosen pipe from muffler.
(5) Disconnect rear hanger, if equipped.
(6) Heat catalytic converter or rear exhaust pipe-to-muffler joint with oxyacetylene torch until cherry red.
(7) Place block of wood against front of muffler and drive muffler rearward to disengage.
(8) Drive muffler off tailpipe.

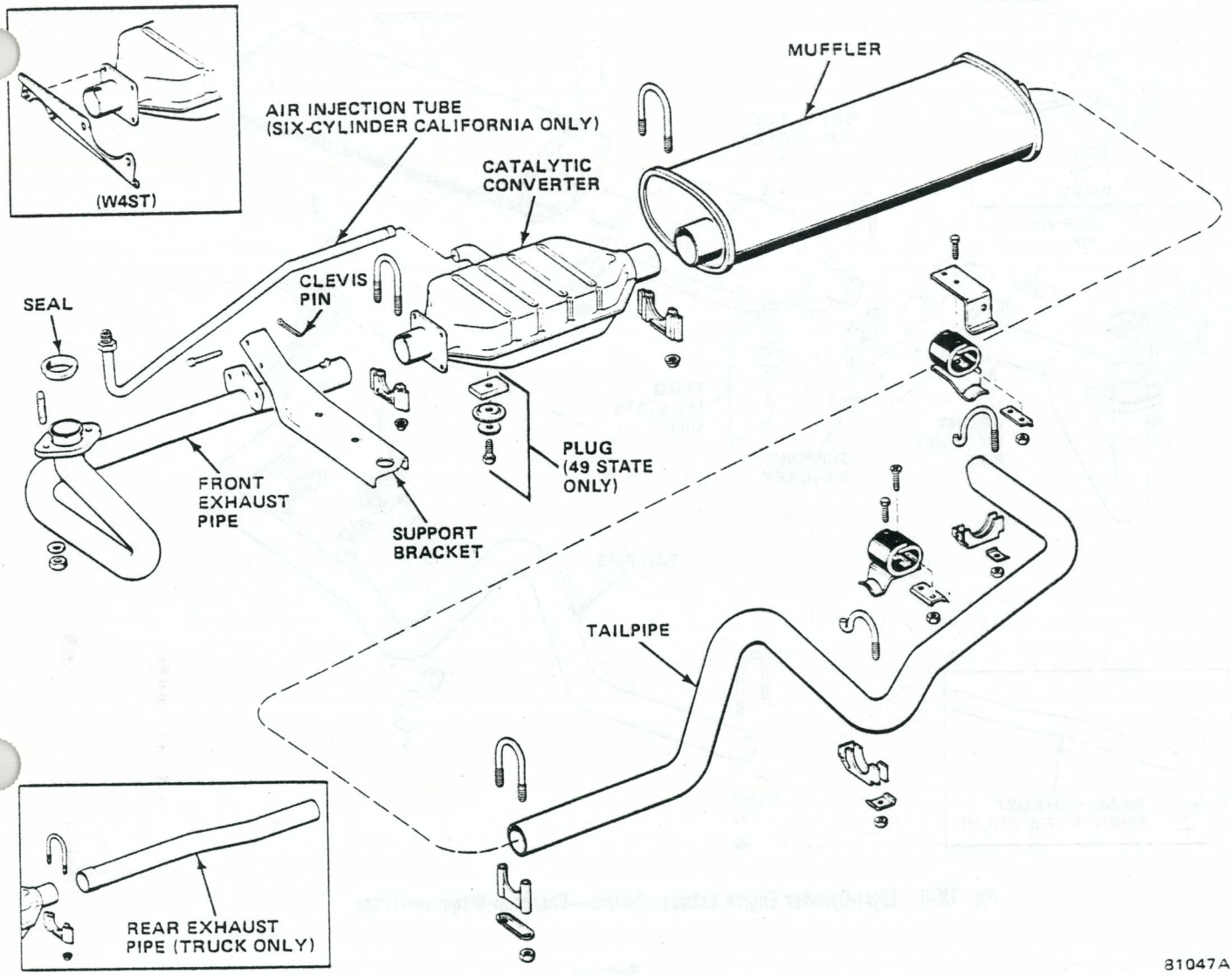


Fig. 1K-4 Six-Cylinder Engine Exhaust System—Cherokee-Wagoneer-Truck

Installation

(1) Attach muffler to tailpipe. Ensure locator on tailpipe aligns with slot in muffler.

(2) Attach catalytic converter or rear exhaust pipe to muffler. Ensure pipe has sufficient clearance from floorpan.

(3) Install clamps and hangers.

(4) Start engine and inspect for exhaust leaks and contact with body panels.

PIPE REPLACEMENT

Front Exhaust Pipe

Removal

(1) Disconnect exhaust pipe from manifold.

(2) Disconnect mounting bracket and/or clamp.

(3) Heat exhaust pipe-to-converter joint with oxyacetylene torch until cherry red. Twist exhaust pipe back and forth to disengage.

Installation

(1) Connect exhaust pipe to converter.

(2) Clean mating surface(s) at manifold(s). Attach exhaust pipe to manifold(s) but do not tighten. Use replacement gasket(s) if necessary.

(3) Align exhaust pipe. Tighten clamp or mounting bracket at rear of exhaust pipe. Tighten flange(s) on manifold(s).

Tailpipe

When replacing a tailpipe, support the vehicle with frame rails.

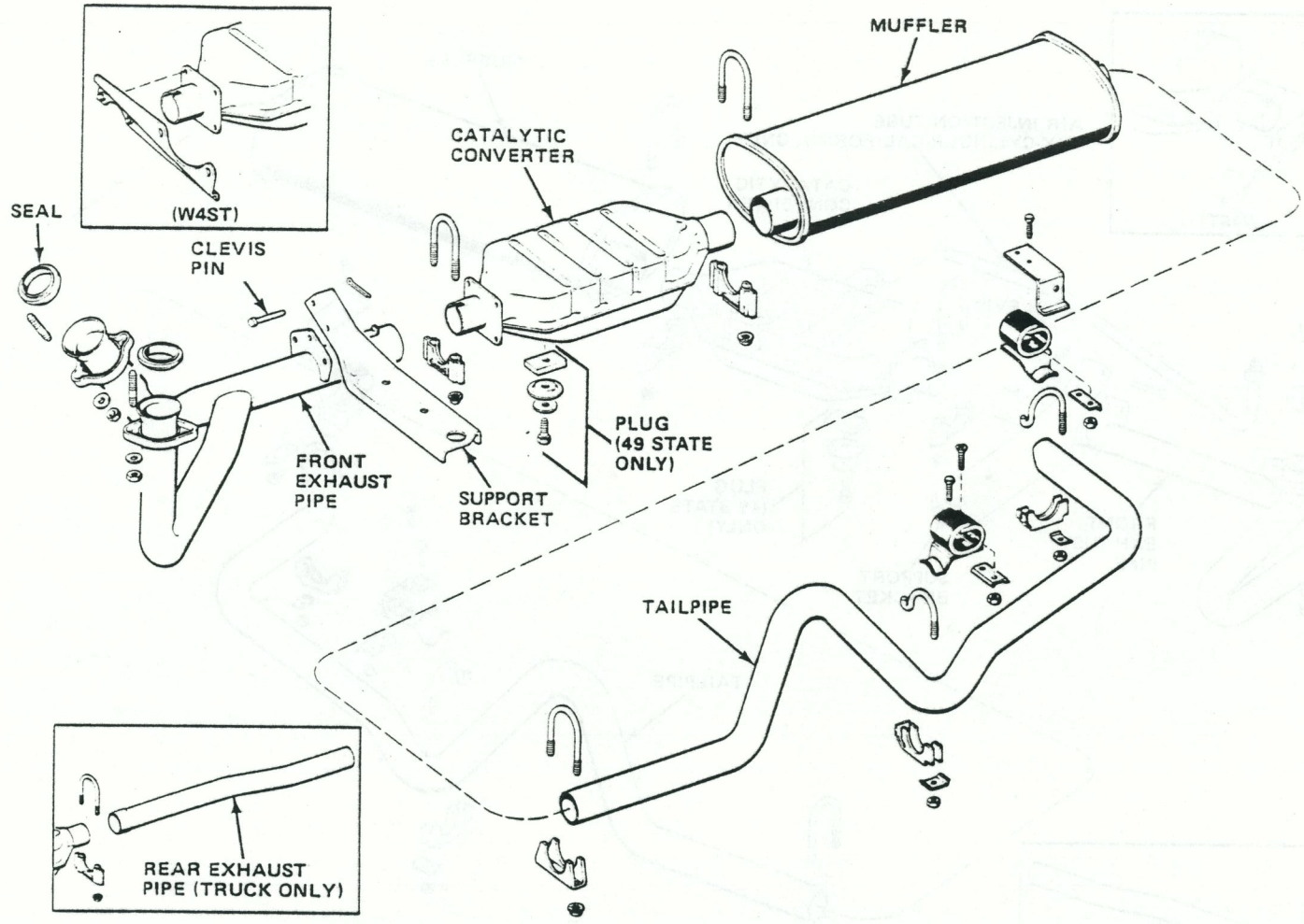
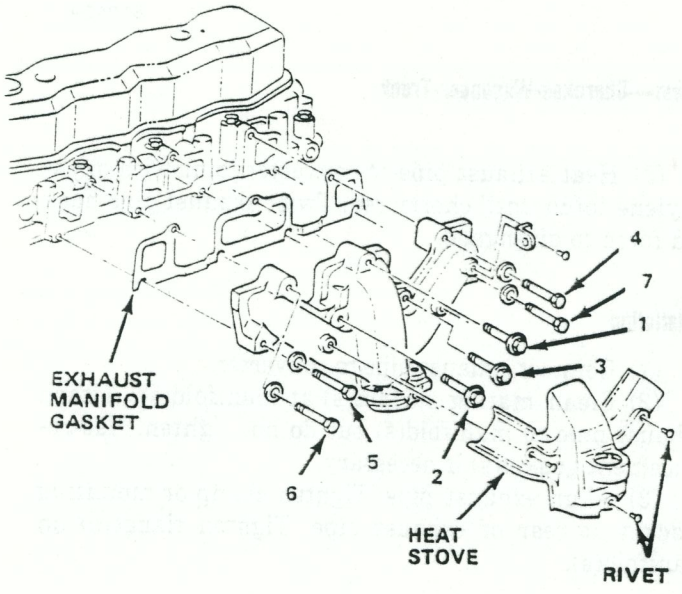


Fig. 1K-5 Eight-Cylinder Engine Exhaust System—Cherokee-Wagoneer-Truck



Removal

To remove a tail pipe attached to the muffler, cut the pipe close to the muffler. Collapse the part remaining in the muffler and remove.

Installation

To install a tailpipe, disconnect the mounting bracket and lower the front of the muffler. Install the tail pipe. Position the mounting bracket and tighten.

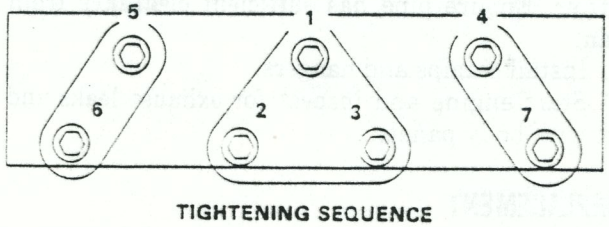


Fig. 1K-6 Exhaust Manifold—Four-Cylinder Engine

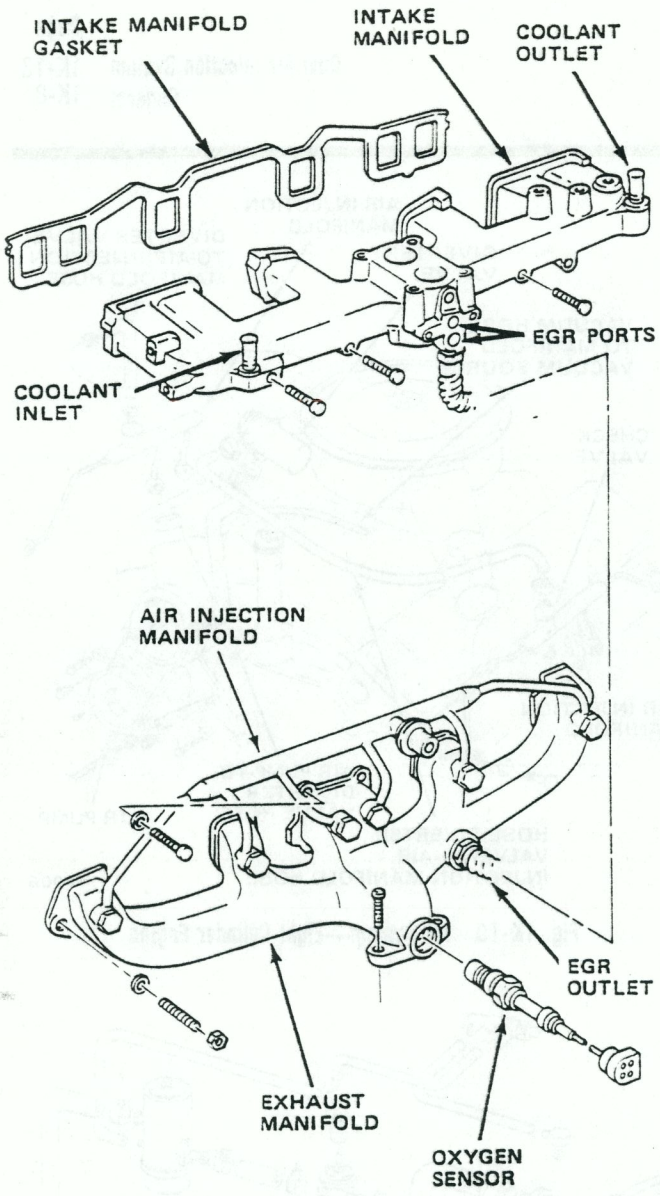


Fig. 1K-7A Manifold Assembly—Six-Cylinder Engine

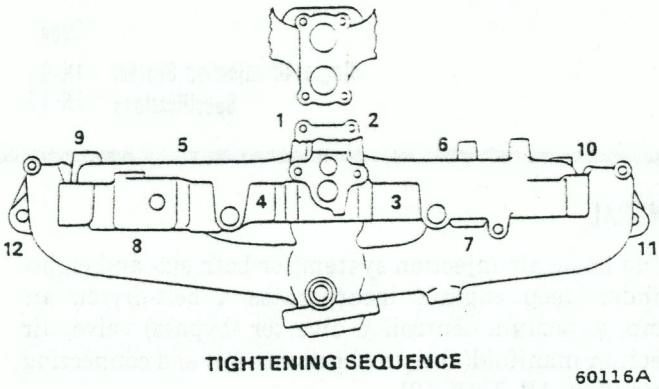


Fig. 1K-7B Manifold Assembly—Six-Cylinder Engine

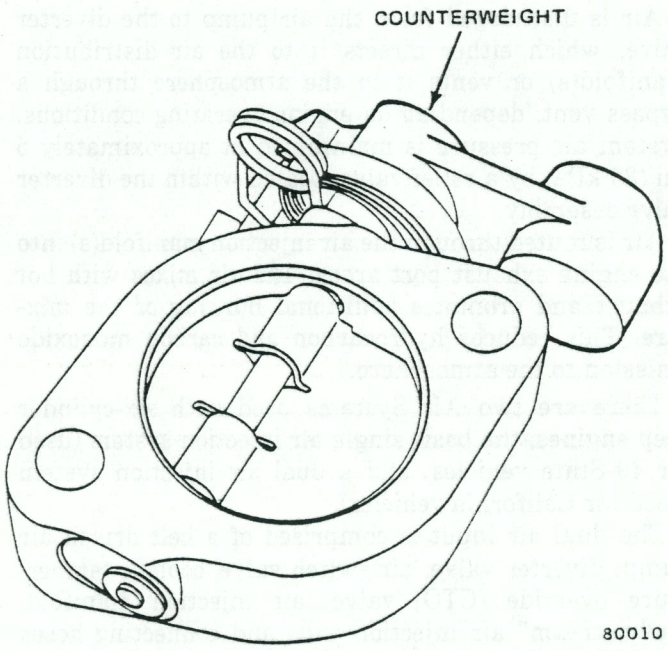


Fig. 1K-8 Exhaust Manifold Heat Valve in Heat On Position—Eight-Cylinder Engine

SPECIFICATIONS

Torque Specifications

Service Set-To Torque Values should be used when assembling components. Service In-Use Recheck Torque Values should be used for checking a pre-tightened item.

	USA (ft.-lbs)		Metric (N-m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Exhaust Manifold Screws Four-Cylinder Engine	37	34-40	50	47-53
Exhaust and Intake Manifold Screws and Nuts Six-Cylinder Engine	23	18-28	31	24-38
Exhaust Manifold Screws — Eight-Cylinder Engine				
Center (2)	25	20-30	34	27-41
Outer (4)	15	12-18	20	20-34
Exhaust Pipe-to-Manifold Nuts	20	27	15-25	20-34

All torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

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AIR INJECTION SYSTEMS

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Single Air Injection System	1K-9	Dual Air Injection System	1K-12
Specifications	1K-13	General	1K-8

GENERAL

The basic air injection system for both six- and eight-cylinder Jeep engines incorporates a belt-driven air pump, a vacuum controlled diverter (bypass) valve, air injection manifold(s) with check valve(s) and connecting hoses (figs. 1K-9, 1K-10).

NOTE: *Four-cylinder Jeep engines are not equipped with an air injection system.*

Air is discharged from the air pump to the diverter valve, which either directs it to the air distribution manifold(s) or vents it to the atmosphere through a bypass vent, depending on engine operating conditions. System air pressure is maintained at approximately 5 psi (35 kPa) by a relief valve located within the diverter valve assembly.

Air is routed through the air injection manifold(s) into the engine exhaust port areas. The air mixes with hot exhaust and promotes additional burning of the mixture. This reduces hydrocarbon and carbon monoxide emission to the atmosphere.

There are two Air Systems used with six-cylinder Jeep engines, the basic single air injection system (used for 49-State vehicles) and a dual air injection system (used for California vehicles).

The dual air input is comprised of a belt driven air pump, diverter valve, air switch valve, coolant temperature override (CTO) valve, air injection manifold, "downstream" air injection tube and connecting hoses (fig. 1K-11). The two air inputs into the exhaust system are:

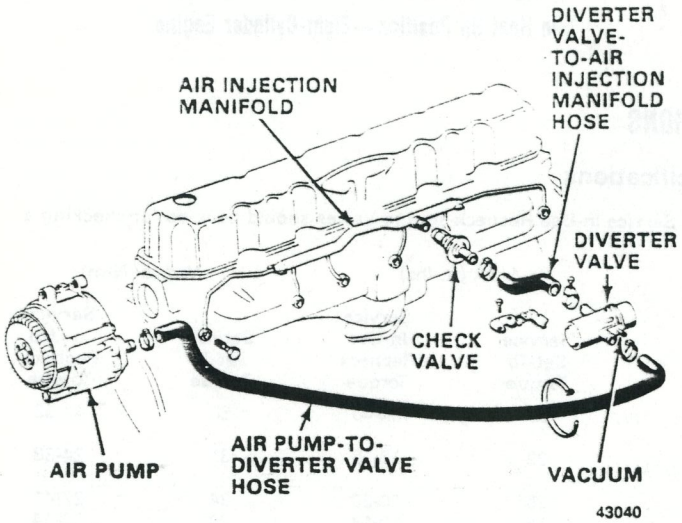

Fig. 1K-9 Air System—Six-Cylinder Engine (49-State)

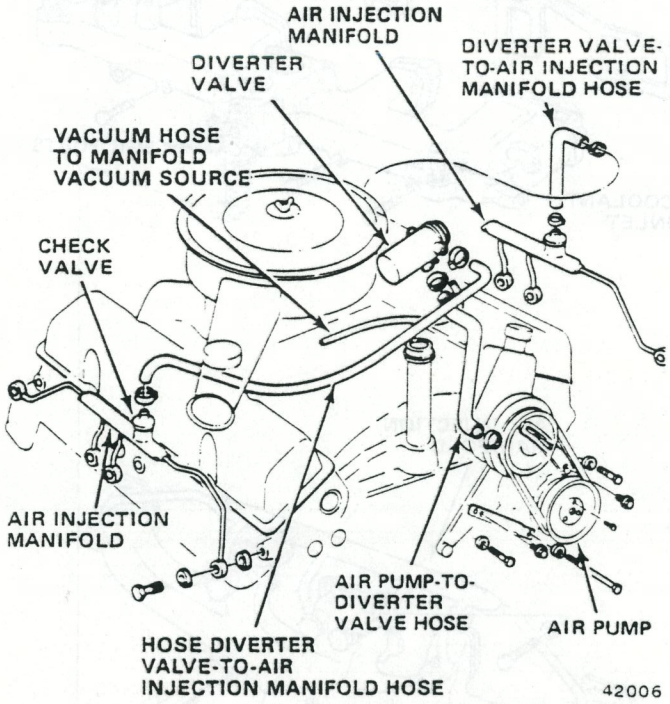

Fig. 1K-10 Air System—Eight-Cylinder Engine

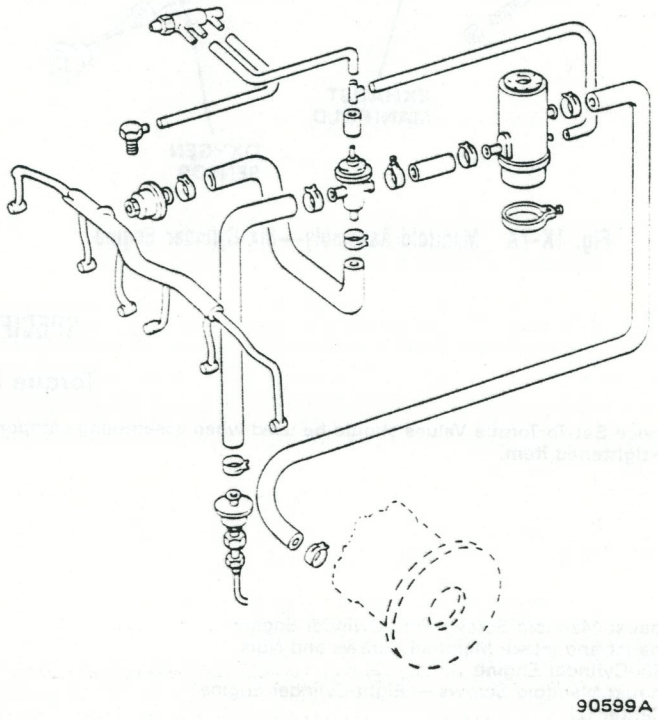

Fig. 1K-11 Air System—Six-Cylinder Engine (Calif.)

- upstream air injection is via the air injection manifold attached to the exhaust manifold.
- downstream air injection is to the dual bed (COC and TWC) converter.

SINGLE AIR INJECTION SYSTEM

Air Pump

The same air pump is used for both six- and eight-cylinder engines. The major components of the air pump are enclosed in a die-cast aluminum housing. A filter fan assembly, rotor shaft and drive hub are visible on the pump exterior (fig. 1K-12).

The pump is designed for long life and is serviceable only by replacement. Do not remove the rear housing cover for any reason. The internal components of the pump are not serviceable.

The aluminum housing has cavities for air intake, compression and exhaust and a bore for enclosing the front bearing. The housing also includes cast metering areas that reduce the noise of intake and compression. Mounting bosses are located on the housing exterior.

NOTE: *The pressure relief valve is located within the diverter valve assembly. If defective, replace the diverter valve assembly.*

The front bearing supports the rotor shaft. The bearing is secured in position by plastic injected around grooves in the housing and outer bearing race.

The rear cover supports the vane pivot pin, rear inner bearing race and exhaust tube. Dowel pins pressed into the housing correctly position the end cover, which is fastened by four screws.

The rotor positions and drives the two vanes. A stamped steel liner supports the carbon shoes and shoe springs that seal the vanes and rotor. The two plastic vanes are molded to hubs that support the bearings, which rotate on the pivot pin. The pulley drive hub is pressed onto the rotor shaft, and threaded holes in the hub provide for attachment of the pulley.

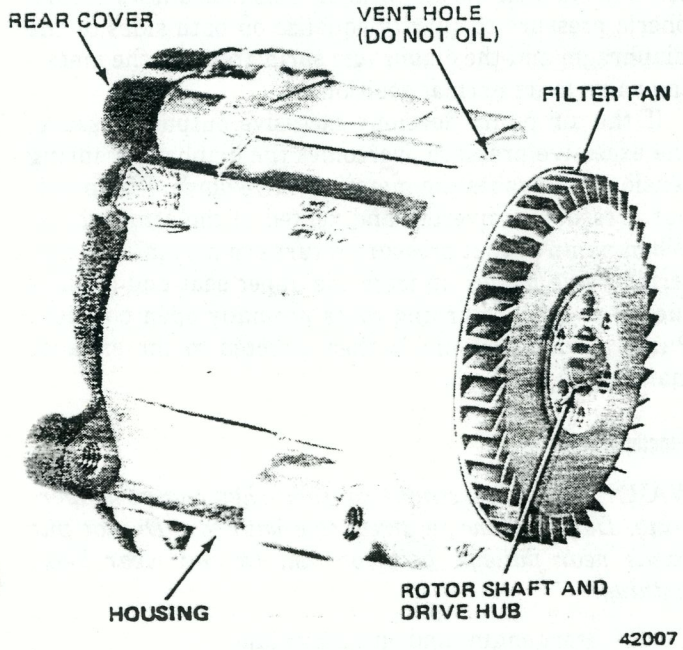

Fig. 1K-12 Air Pump

Operation

The pump vanes are located 180° apart and rotate around the pivot pin, which is located on the centerline of the pump housing. The rotor that drives the vanes rotates off the centerline of the pump housing. This creates changes in the distance between the outside of the rotor and the inner wall of the pump housing during rotor rotation. As the leading vane moves past the intake opening, it is moving from a small area to a large area. This creates a partial vacuum that forces air to enter the pump. As the vanes and rotor continue to rotate, the trailing vane passes the intake and traps the air between the vanes. The vanes and rotor move the air into a smaller area to compress it. Compression continues until the leading vane passes the exhaust opening. There the compressed air passes out of the pump to be either distributed or vented.

Noise Diagnosis

The air pump is not completely noiseless. Under normal conditions, noise will rise in pitch as the engine speed increases. Allow for normal break-in wear of the pump prior to replacement for excessive noise.

A chirping or squeaking noise normally originates from vane rub in the housing bore and is noticeable at low speed intermittently. Vane chirping is often eliminated at increased pump speeds or with additional wear in time. A chirping noise may also be caused by the drive belt slipping on the pulley of a seized pump.

Bearing noise, **a rolling sound noticeable at all speeds,** is easily distinguished from vane chirping. It does not necessarily indicate bearing failure. If bearing noise reaches an objectionable level at certain speeds, the pump may have to be replaced.

Failure of a rear bearing is identified by **a continuous knocking noise** and replacement of the pump is required.

Service Precautions

The following list of service precautions are for preventing damage to the air pump.

- Do not attempt to prevent the pulley from rotating by inserting tools into the centrifugal filter fan.
- Do not operate an engine with the pump belt removed or disconnected except for noise diagnosis.
- Do not attempt to lubricate any part of the pump.

- Do not clean the centrifugal filter.
- Do not disassemble the pump or remove the rear cover.
- Do not exceed 20 foot-pounds (27 N•m) torque when tightening the mounting bolts.
- Do not pry on the aluminum housing to adjust the belt tension.
- Do not clamp the pump in a vise.
- Do not permit liquids to enter the pump when steam or water pressure-cleaning the engine.

Removal—Six-Cylinder Engine with V-Belts

(1) Disconnect air pump output hose at back of air pump.
(2) Remove adjustment bolt and remove drive belt.
(3) Remove front mounting bracket.
(4) Remove adjustment bracket from cylinder head.
(5) Slide pump from pivot stud.

Installation—Six-Cylinder Engine with V-Belts

(1) Slide pump onto pivot stud.
(2) Install front mounting bracket.
(3) Install adjustment bracket and install adjustment screw.

CAUTION: *Adjust the belt tension by hand only.*

(4) Install drive belt and adjust to specified tension. Tighten pivot stud nut.
(5) Connect air pump output hose to back of pump.

Removal—Six-Cylinder Engine with Serpentine Belt

(1) Release belt tension by loosening alternator adjustment and pivot bolts.
(2) Disconnect air pump output hose from back of pump.
(3) Remove air pump mounting bolts/nuts and air pump.

Installation—Six-Cylinder Engine with Serpentine Belt

(1) Position air pump and secure with mounting bolts/nuts.
(2) Connect output hose to back of pump.
(3) Tighten belt to specified tension. Refer to Chapter 1C—Cooling Systems for tension specification.

Removal—Eight-Cylinder Engine

(1) Disconnect air pump output hose at pump.
(2) Loosen mount bracket-to-pump attaching screw and bolt. Remove drive belt.
(3) Remove pivot screw and brace screws.
(4) Remove pump.

Installation—Eight-Cylinder Engine

(1) Position pump at mounting location and install pivot and brace attaching screws. Do not tighten.

CAUTION: *Adjust the belt tension by hand only.*

(2) Install drive belt and adjust to specified tension.
(3) Tighten mounting screws and adjusting strap screw with 20 foot-pounds (27 N•m) torque.

Diverter (Bypass) Valve

A diverter valve is used with all air injection applications. The valves for six- and eight-cylinder engines differ only in the number of outlets. The six-cylinder engine diverter valve has one outlet. The eight-cylinder engine diverter valve has two outlets. A high flow diverter valve is used on some applications where greater air flow is required for emission control.

The valve momentarily diverts air pump output from the exhaust manifold(s) and vents it to the atmosphere during rapid deceleration. The valve also functions as a pressure release valve for excessive air pump output. An internal silencer is also incorporated in the diverter valve housing to muffle the airflow.

Operation

In a rapid deceleration situation, high intake manifold vacuum is applied to the diaphragm in the diverter valve. When the vacuum is 20 in. Hg (68 kPa) or more, the spring tension of the diaphragm is overcome. This moves the metering valve down against its upper seat and away from its lower seat. This diverts and vents air pump output pressure to the atmosphere (fig. 1K-13). Air pump output is diverted only momentarily because of a vent hole in the diaphragm. This hole allows atmospheric pressure to quickly equalize on both sides of the diaphragm and the diaphragm spring returns the metering valve to its normal position.

If the air pump develops excessive output pressure, the excessive pressure overcomes the diaphragm spring tension and pushes the metering valve down. Pump output pressure is diverted and vented to the atmosphere. When pump output pressure returns to normal, the metering valve moves up from the upper seat and against the lower seat, returning to its normally open position. Pump output pressure is then directed to the exhaust manifold(s).

Functional Test

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(1) Start engine and operate at idle.
(2) Examine diverter valve vent. Little or no air should flow from vent.

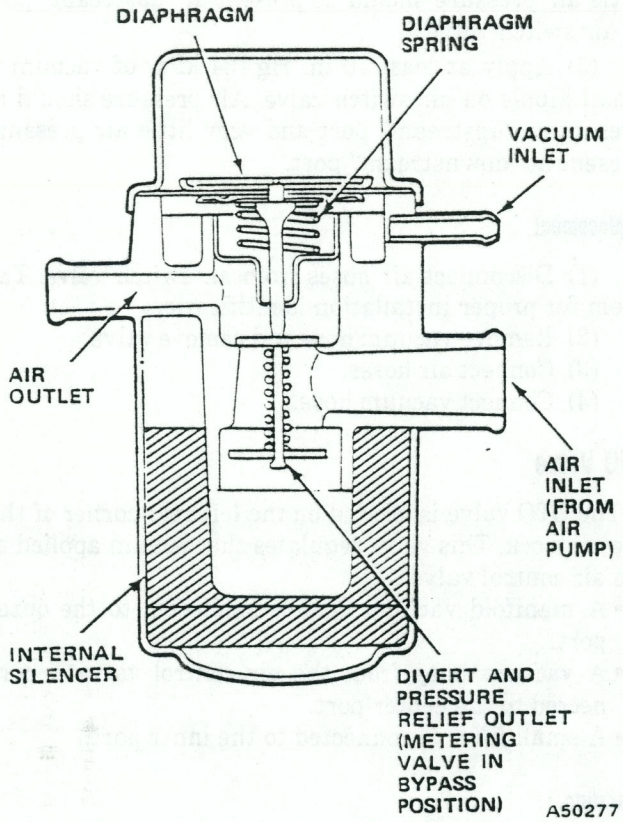

Fig. 1K-13 Diverter Valve—Typical

(3) Accelerate engine to 2000-3000 rpm and rapidly close throttle. A strong flow of air should pass from diverter valve vent for approximately three seconds. If air does not flow or if engine backfire occurs, ensure vacuum hose has vacuum and there is no air leak.

NOTE: *The diverter valve diverts and vents air pump output when a manifold vacuum of 20 in. Hg (68 kPa) or more is applied to the diaphragm. The diverter valve also operates when pump output exceeds 5 psi (35 kPa). Some applications require 8 psi (55 kPa).*

(4) Slowly accelerate engine. Between 2500 and 3500 rpm air should begin to flow from diverter valve vent.

Replacement

The diverter valve is not serviceable and must be replaced if defective. The valve is either attached to a bracket or suspended by the hoses between the air pump and air injection manifold(s). Removal involves disconnecting the air hoses, vacuum hose and bracket clamp, if used. Installation entails connecting the air hoses, vacuum hose and bracket clamp, if used.

Air Injection Manifolds

Air injection manifolds are constructed of cold-rolled steel with zinc plating. They distribute air via the diverter valve from the air pump to each of the exhaust manifold inlet ports.

A check valve, incorporating a stainless steel spring plunger and an asbestos seat, is integral with the air injection manifold. Its function is to prevent the reverse flow of exhaust gas to the pump during pump or belt failure, or diverter valve bypass operation. Reverse exhaust gas flow would damage the air pump and connecting hoses.

The distribution tubes of the air injection manifold are connected directly to the exhaust manifold. The hollow attaching fittings route airflow into the exhaust manifold inlet ports.

Check Valve Functional Test

To test the air injection manifold check valve for proper operation, disconnect the air supply hose at the injection manifold. With the engine operating above idle speed, listen and feel for exhaust leakage from the check valve. A slight leak is normal.

Removal—Six-Cylinder Engine

(1) Disconnect air delivery hose at check valve.

(2) Remove distribution tube fittings from exhaust manifold inlet ports.

NOTE: *Some resistance to turning may be encountered because of carbon build-up on the threads.*

(3) Remove air injection manifold.

Installation—Six-Cylinder Engine

(1) Connect air injection manifold with fittings to exhaust manifold. Tighten fittings with 20 foot-pounds (27 N•m) torque.

(2) Connect air delivery hose.

Removal—Eight-Cylinder Engine

(1) Disconnect air delivery hose at check valve.

(2) Remove distribution tube fittings from exhaust manifold inlet ports.

NOTE: *Some resistance to turning may be encountered because of carbon build-up on the threads.*

(3) Remove air injection manifold.

(4) Remove sealing gaskets from air injection manifold.

NOTE: *Duplicate the procedure for the other air injection manifold.*

Installation—Eight-Cylinder Engine

(1) Install air injection manifold using replacement sealing gasket on either side of each inlet port.

(2) Install distribution tube fittings and injection manifold on exhaust manifold. Tighten fittings with 38 foot-pounds (52 N•m) torque.

(3) Connect air delivery hose to check valve.

NOTE: *Duplicate the procedure for the other air injection manifold.*

DUAL AIR INJECTION SYSTEM

The additional components used with the dual air injection system are:

- air switch valve,
- coolant temperature override (CTO) valve,
- downstream air injection tube.

NOTE: *The dual air injection system is interrelated with the feedback system and must be diagnosed in conjunction with the feedback system.*

Air Switch Valve

The air switch valve is located between the diverter valve and the air injection manifold. The air control valve is controlled by vacuum regulated by the CTO valve.

The air switch valve directs system air pressure either "upstream" (into the air injection manifold attached to the exhaust manifold) when vacuum is applied to it or "downstream" (directly into the dual bed monolithic-type converter) when vacuum is not applied to it.

The air mixes with the hot exhaust when it enters the "upstream" input and causes a further burning of the mixture. This reduces hydrocarbons (HC) and carbon monoxide (CO) emission to the atmosphere.

During "downstream" operation, the additional air reacts with hydrocarbons (HC) and carbon monoxide (CO) in the catalytic converter (rear half) to create carbon dioxide (CO_2) and water vapor and reduce undesirable emission into the atmosphere.

Functional Test

(1) Disconnect two output hoses from air switch valve. Note which hose was connected to "downstream" port and which hose to "upstream" port.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(2) Start engine.

(3) Disconnect vacuum hose from small valve nipple.

NOTE: *Vacuum should be present at the vacuum hose when the coolant temperature is lower than 160° F (71° C) (approximately) and should not be present if the coolant temperature is above 160° F (71° C) (approximately). If the coolant temperature is lower than 160° F (71° C), and vacuum is not present, inspect the hose for air leaks. If no leaks are found, replace the CTO valve.*

(4) Air pressure should be present at air switch valve port that connects to "downstream" hose. Very little air pressure should be present at "upstream" port of air switch valve.

(5) Apply at least 10 in. Hg (34 kPa) of vacuum to small nipple on air switch valve. Air pressure should be present at "upstream" port and very little air pressure present at "downstream" port.

Replacement

(1) Disconnect air hoses from air switch valve. Tag them for proper installation identification.

(2) Remove vacuum hose and remove valve.

(3) Connect air hoses.

(4) Connect vacuum hose.

CTO Valve

The CTO valve is located on the left rear corner of the engine block. This valve regulates the vacuum applied to the air control valve.

- A manifold vacuum hose is connected to the outer port.
- A vacuum hose from the air control valve is connected to the center port.
- A small filter is connected to the inner port.

Operation

Manifold vacuum should be present at the air switch valve when the coolant temperature is lower than 160° F (71° C) (approximately) and should not be present if the coolant temperature is above 160° F (71° C) (approximately). If the coolant temperature is lower than 160° F (71° C) and vacuum is not present, inspect the hose for air leaks and proper routing. Repair as necessary. If no fault is found, replace the valve.

Replacement

WARNING: *Serious burns can result if hot coolant is not drained before removing the valve from the block.*

(1) Drain coolant from radiator.

(2) Disconnect vacuum hoses.

(3) Use open-end wrench to remove valve from block.

(4) Install replacement valve in block.

(5) Connect vacuum hoses.

(6) Install coolant and purge air from cooling system. Refer to Chapter 1C—Cooling Systems.

Downstream Air Injection Tube Replacement

(1) Disconnect air delivery hose at check valve.

NOTE: *Remove check valve if it is to be reused.*

(2) Remove clamp connecting "downstream" air injection tube to catalytic converter nipple.

NOTE: *It may be necessary to heat the joint for removal.*

(3) Attach injection tube to catalytic converter nipple.

(4) Install check valve, if removed, and tighten with 25 foot-pounds (34 N•m) torque minimum.

(5) Connect air delivery hose to check valve.

(6) Install clamp to secure "downstream" air injection tube to catalytic converter nipple. Tighten clamp with 3 to 4 foot-pounds (4 to 5 N•m) torque.

SPECIFICATIONS

Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-tightened item.

	USA (ft.-lbs)		Metric (N-m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Air Pump Mounting Screws	20	15-22	27	20-30
Air Injection Manifold Fittings				
Six-Cylinder Engine	20	15-22	27	20-27
Eight-Cylinder Engine	38	30-45	52	41-61

All Torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

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CATALYTIC CONVERTER SYSTEMS

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GENERAL

All CJ vehicles with four-cylinder engines utilize a pellet-type catalytic converter to reduce undesirable exhaust gas emissions. Vehicles designated 49-State use a conventional oxidizing catalytic (COC) converter and vehicles designated for sale in California use a three-way catalytic (TWC) converter. There is no scheduled maintenance required for either type converter.

A COC pellet-type catalytic converter is used with all six- and eight-cylinder engine exhaust systems except those used with CJ, Cherokee and Wagoneer vehicles with six-cylinder engines manufactured for sale in California. These vehicles use a dual bed (COC and TWC) monolithic-type converter with "downstream" air injection.

CAUTION: *The use of leaded fuel destroys catalytic converters.*

All Jeep vehicles are designed for unleaded fuel and are equipped with a fuel filler neck restrictor that prevents the insertion of the larger leaded fuel-filler hose nozzle.

CONVENTIONAL OXIDIZING CATALYTIC (COC) PELLET-TYPE CONVERTER

The pellet-type conventional oxidizing (COC) converter contains beads of alumina coated with platinum and palladium catalyzing agents. Thousands of pellets are contained in a steel canister. A plug is provided in the converter to permit replacement of the pellets should they become ineffective.

This type converter promotes the oxidation of incompletely burned fuel (HC) and carbon monoxide (CO). The chemical process involved changes HC and CO into harmless carbon dioxide (CO_2) and water (H_2O) vapor before the exhaust gas is emitted into the atmosphere. The catalysts that cause the chemical changes are platinum and palladium.

With pellet-type COC converters, all exhaust gases flow through the catalytic converter.

The temperature inside a converter is somewhat higher than the temperature of the exhaust gases when they are exhausted from the engine. Insulation in the pellet-type converter keeps the outside skin of the converter at approximately the same temperature as the muffler. Because of its larger mass, the converter stays hot much longer than the muffler.

The steel catalytic converter body is designed to last the life of the vehicle. Excessive heat can result in bulging or other distortion, but excessive heat will not be the fault of the converter. A carburetor, air pump or ignition problem that permits unburned fuel to enter the converter will usually cause overheating. If a converter is heat-damaged, the carburetor, air pump, or ignition problem should be corrected at the same time the converter is replaced. All other components of the exhaust system should also be inspected for heat damage.

THREE-WAY CATALYTIC (TWC) PELLET-TYPE CONVERTER

This type converter utilizes rhodium in addition to platinum and palladium as oxidizing agents. Rhodium is a catalyst for oxides of nitrogen (NO_X) and changes it and carbon monoxide (CO) into nitrogen (N_2) and carbon dioxide (CO_2).

Operationally, as the air/fuel mixture is leaned out, the converter efficiency for changing HC and CO is increased but is decreased for changing NO_X. Enrichening the mixture increases converter efficiency for changing NO_X but decreases it for HC and CO. For this reason, to optimize the simultaneous conversion of all three, the carburetor must provide an air/fuel mixture ratio of approximately 14.7:1 (fig. 1K-14). This is the primary function of the C4 System that is used in conjunction with the Three-Way Catalytic (TWC) Converter.

DUAL BED (COC AND TWC) MONOLITHIC-TYPE CONVERTER

The dual bed monolithic-type converter used with six-cylinder engines is two converters in one container. The rear half is a conventional oxidizing catalytic (COC) converter. The front half is a three-way catalytic (TWC) converter.

As with the TWC pellet-type converter (above), maintaining high conversion efficiency for this type converter requires that the carburetor provide an air/fuel mixture ratio of approximately 14.7:1 (fig. 1K-14). This is the primary function of the Feedback System used in conjunction with the converter.

CATALYST REPLACEMENT

Dual Bed (COC and TWC) Monolithic-Type Converter

This type converter is not serviceable. The entire unit must be replaced if defective. Remove by disconnecting the air injection tube and detaching converter from the front exhaust pipe and the muffler (or rear exhaust pipe, if equipped). Install replacement converter.

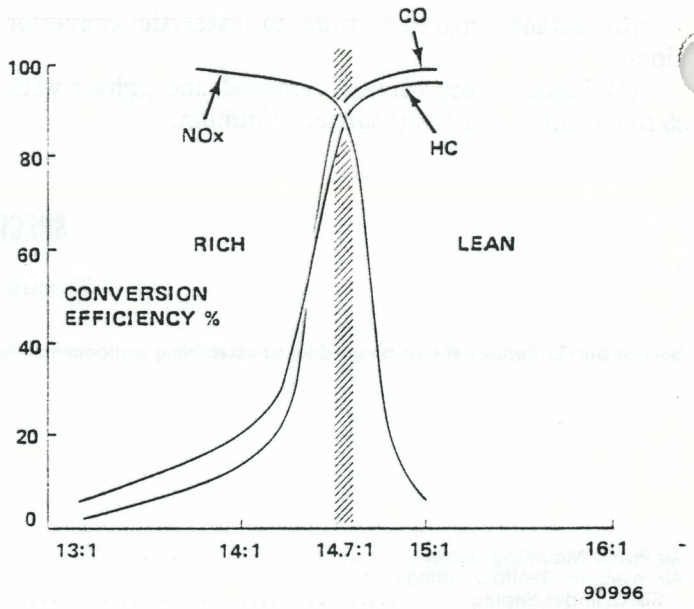

Fig. 1K-14 Optimum Air/Fuel Ratio for Conversion Efficiency

COC Pellet-Type Converter

The pressed-in plug must be removed to replace the pellets. A replacement plug (fig. 1K-15) is required to seal the converter after the pellets have been replaced.

On-vehicle servicing is the only factory approved method of replacing pellets because catalytic converters are difficult to remove from most vehicles, especially after a large number of miles have accumulated, without damaging the converter assembly or exhaust connections.

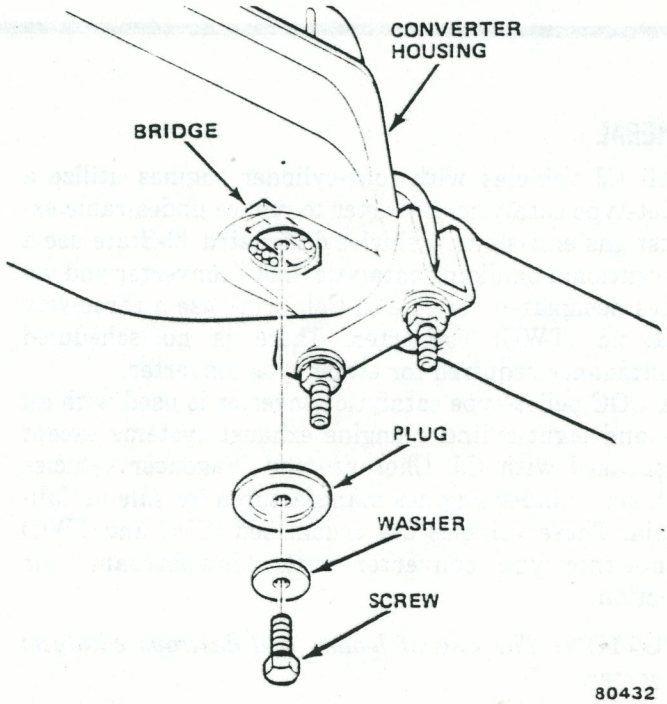

Fig. 1K-15 COC Pellet-Type Converter Plug

The catalyst replacement tool includes an emptying and fill mechanism, a vacuum aspirator and two hand tools used for removal of the converter drain plug. The emptying and fill mechanism clamps directly to the catalytic converter and consists of an air turbine vibrator unit and discharge-fill container. The vibrator induces a rotary motion to the catalytic converter case causing the catalyst pellets to flow out the drain port and into the attached container.

An adapter is included to adapt the exchanger to the newer-type converters, which have an unthreaded (pressed-in) access plug.

(1) Raise vehicle.

(2) Clamp vacuum aspirator (part of Tool J-25077-01) on tailpipe outlet (fig. 1K-16).

(3) Connect air hose (80 psi minimum) to fitting on vacuum aspirator.

NOTE: *Vacuum aspirator must be in operation prior to removing plug to prevent pellets from spilling out on shop floor.*

CAUTION: *Use care to prevent damaging converter housing when removing plug. If the drain-fill hole cannot be sealed with the replacement plug, the converter must be replaced.*

(4) Remove plug from bottom of converter with removal tools provided with Tool Kit J-25077-01.

(5) Clamp container-vibrator unit (using Adapter J-25077-6) on converter (fig. 1K-17).

(6) Remove air hose from vacuum aspirator.

(7) Connect air hose (80 psi or 550 kPa minimum) to fitting on vibrator. Approximately ten minutes is required to empty pellets from converter.

(8) Disconnect air hose, remove container and discard pellets.

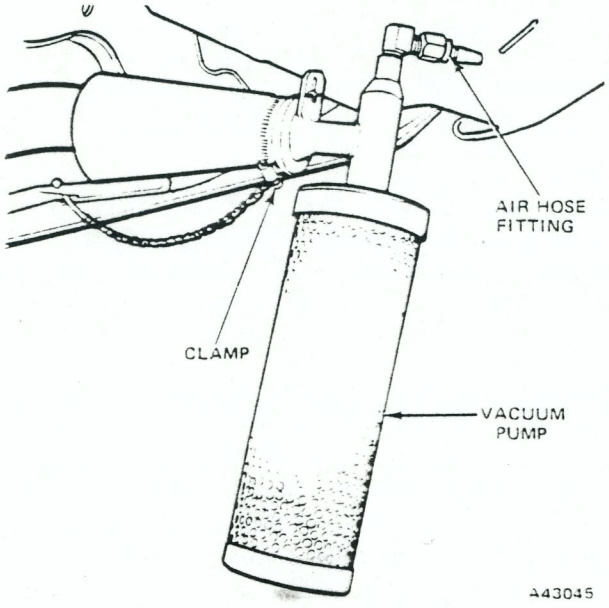

Fig. 1K-16 Vacuum Aspirator

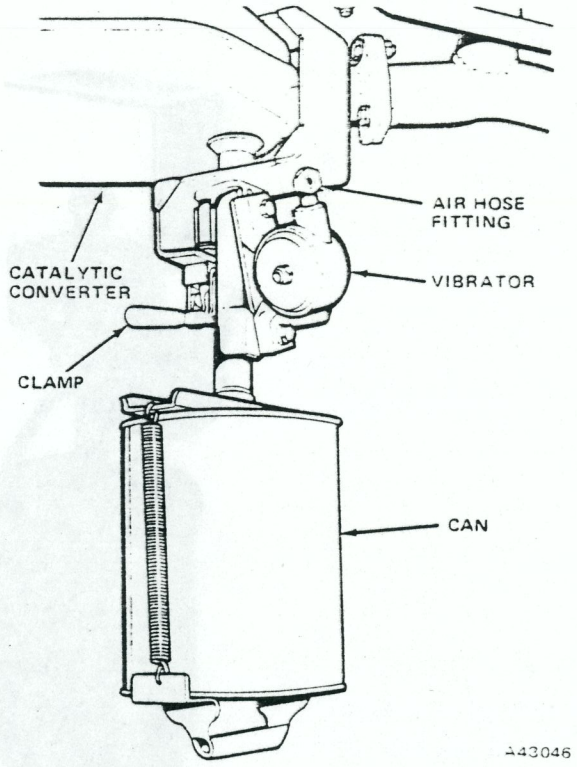

Fig. 1K-17 Container-Unit Vibrator

(9) Fill container with replacement pellets and attach to converter.

(10) Connect air hose (80 psi or 550 kPa minimum) to fitting on vacuum aspirator. Pellets will be forced into converter and packed in place.

NOTE: *If any pellets pass through the converter and into the tailpipe, the converter is defective and must be replaced.*

(11) When full of pellets, remove container-vibrator unit from converter. Maintain air pressure at vacuum aspirator.

(12) Plug converter with replacement plug (fig. 1K-15).

(a) Thread screw into bridge and position bridge inside opening. Remove screw without disturbing bridge position.

(b) Insert screw through washer and plug.

(c) Carefully thread screw into bridge and tighten sufficiently to create an air-tight seal.

(13) Disconnect air hose from fitting on vacuum aspirator. Remove vacuum aspirator from tailpipe. Lower vehicle.

TWC Pellet-Type Converter

The TWC pellet-type converter catalyst is not serviceable. If the converter fails to function, the complete unit must be replaced.

Tools

J-25077
CATALYTIC CONVERTER
CATALYST CHANGER

70452

POWER PLANT INSTRUMENTATION 1L

SECTION INDEX

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GENERAL INFORMATION

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GENERAL

This chapter is divided into three sections. The first section, General Information, contains descriptions of all instrumentation, theory of operation, test procedures and replacement procedures. The second section, Diagnosis and Repair Simplification (DARS) Charts, contains pictorial guides for diagnosing instrumentation malfunctions. The third section, Specifications, contains specifications, instrument cluster illustrations, instrument cluster and printed circuit board schematics and separate schematics for each gauge, meter and lamp circuit.

Power plant instrumentation includes all instrument panel gauges, meters and lamps used to monitor the engine-related systems included in part one of this manual. Refer to Chapter 3C—Instrument Panels and Components for speedometer, odometer, clock, illumination lamps, turn signal indicator lamps and high beam indicator lamp. The instrumentation included in this chapter involves: ammeter, voltmeter, constant voltage regulator (CVR), fuel gauge, oil pressure gauge, tachometer, and coolant temperature gauge (fig. 1L-1 and 1L-2). These devices are all electrically operated.

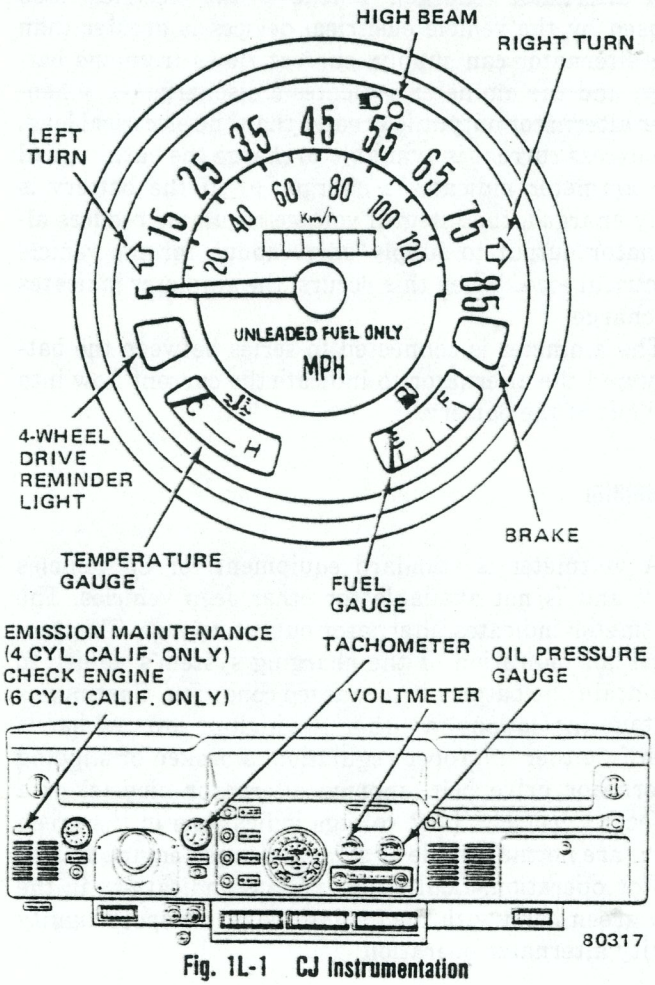


Fig. 1L-1 CJ Instrumentation

OPERATION

Ammeter

Ammeters are standard equipment for Cherokee, Wagoneer and Truck vehicles. They are not available for CJ vehicles.

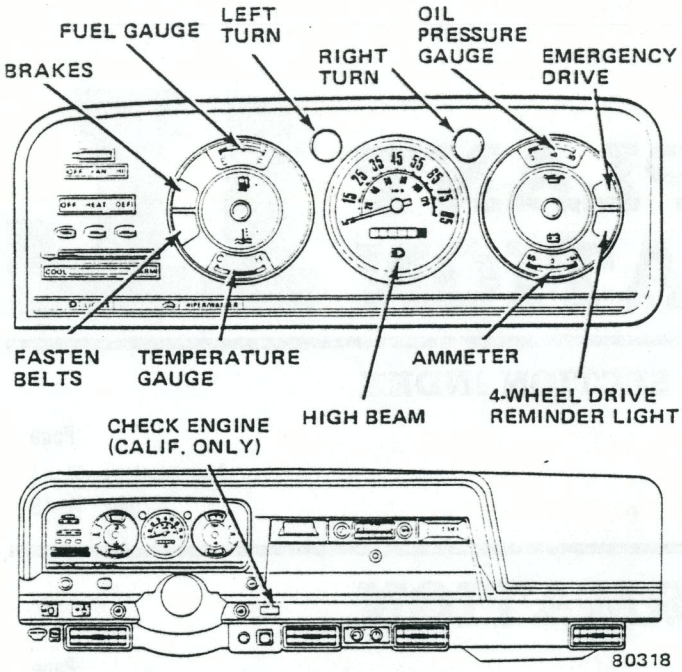


Fig. 1L-2 Cherokee-Wagoneer-Truck Instrumentation

An ammeter is an instrument used to indicate the amount of current flowing from the battery (discharge) and alternator (charge). Whenever the electrical load caused by the vehicle electrical devices is greater than the alternator can supply, current flows from the battery, and the ammeter indicates a discharge (-). Whenever alternator output is greater than the electrical load, the excess current is available to charge the battery, and the ammeter indicates a charge (+). If the battery is fully charged, the integral voltage regulator reduces alternator output to supply only enough for the vehicle electrical load. When this occurs, the ammeter indicates no charge.

The ammeter is connected in series between the battery and the alternator to indicate the current flow into and out of the battery.

Voltmeter

A voltmeter is standard equipment for CJ vehicles only and is not available for other Jeep vehicles. The voltmeter indicates alternator output voltage. This provides an indication of the charging system's ability to maintain the battery in a charged condition. Continuous voltage indications in either the high or low red bands signify either improper regulation, a broken or slipping alternator drive belt, shorted alternator diode(s) or a defective battery. Low voltage indications in the green band are normal at idle or after prolonged engine starter motor operation. Continuous voltage indications in the low green band with the engine above idle speed signify faulty alternator operation.

Constant Voltage Regulator (CVR)

Several vehicle gauges are designed to operate on low voltage. The constant voltage regulator (CVR) provides approximately 5 volts for this purpose. Battery voltage is supplied to the CVR. The CVR contains a small heating coil and thermostatically operated points. With battery voltage applied to the CVR, the points vibrate at a rate that produces an average of 5 volts for the gauges. The CVR is an integral part of the fuel gauge for CJ vehicles and the coolant temperature gauge for Cherokee, Wagoneer and Truck vehicles. An external circuit is used to apply the CVR voltage to the other gauges.

Fuel Gauge

Fuel gauges for all vehicles operate on regulated voltage provided by the constant voltage regulator (CVR). The fuel gauge system consists of a gauge, a variable-resistance sending unit located in the fuel tank, appropriate wiring and the CVR.

The gauge pointer is attached to a bimetallic coil that responds to temperature changes. A heating coil wrapped around the bimetallic coil provides heat that causes the bimetal to expand. Current flows from the CVR through the sending unit in the fuel tank to the heating coil. The sending unit has high resistance at low fuel level and very low resistance at high fuel level.

Oil Pressure Gauge

An oil pressure gauge is standard equipment for all Jeep vehicles.

CJ Vehicles

The oil pressure gauge system consists of an electromagnetic-type gauge, a variable-resistance sending unit and appropriate wiring. Battery voltage is applied to two coils in the gauge. One coil is connected directly to ground. The other coil is connected to the sending unit. The variable resistance in the sending unit is controlled by the oil pressure. Electromagnetic fields expand around both coils in the gauge. The pointer is influenced greater by the coil having the most current flow and the resulting more intense electromagnetic field.

Cherokee-Wagoneer-Truck

The oil pressure gauge system consists of a gauge, a variable-resistance sending unit, appropriate wiring and the constant voltage regulator (CVR). The gauge pointer is attached to a bimetallic strip that reacts to temperature changes. A heating coil wrapped around the bimetallic coil provides heat that causes the bimetal to expand. Current flows from the CVR through the sending unit attached to the engine to the heating coil.

Tachometer

Tachometers are optional instruments available for CJ vehicles only.

Tachometers are wired in series between the ignition switch terminal and the ignition coil negative terminal. The current flow through the coil is turned on and off by the ignition system and the tachometer integrates the interruptions. The engine rpm is directly proportional to the integrated voltage level.

Coolant Temperature Gauge

A coolant temperature gauge is standard equipment for all vehicles.

All temperature gauges operate on regulated voltage provided by the constant voltage regulator (CVR). The temperature gauge system consists of a gauge, a variable-resistance sending unit, appropriate wiring and the CVR.

The gauge pointer is attached to a bimetallic coil that reacts to temperature changes. A heating coil wrapped around the bimetallic coil provides heat that causes the bimetal to expand. Current flows from the CVR through the sending unit attached to the engine to the heating coil. The sending unit has high resistance at low engine coolant temperature and very low resistance at high engine coolant temperature.

Emission Maintenance Indicator Lamp

The emission maintenance indicator lamp is used only with four-cylinder engine vehicles (CJ) manufactured for sale in California. This lamp is illuminated at 30,000 miles (48 280 km) to indicate required service for the oxygen sensor (C4 System). Refer to Maintenance —Chapter B and Exhaust Systems—1K for additional information

After performing the service, the emission maintenance switch must be reset by turning the reset screw on the switch body. The switch is located under the hood between the upper and lower speedometer cables on the left side of the dash panel. Turn the spring loaded reset screw approximately 1/4 turn counterclockwise to the reset detent position.

Check Engine Indicator Lamp

This lamp is used only with six-cylinder engine vehicles manufactured for sale in California. The lamp is illuminated when the computerized emission control self-diagnostic system detects a fault.

As a bulb and system check, the lamp will illuminate when the ignition is turned to the **ON** position with the engine stopped.

The fuel feedback system trouble code diagnosis is described in Fuel Systems—Chapter 1J.

INSTRUMENTATION DIAGNOSIS

General

Improper operation of electrical gauges or meters can be usually traced to either faulty electrical wiring continuity (including printed circuit boards), improperly calibrated components or high resistance caused by loose or corroded connections.

A common diagnostic procedure is to bypass a suspected component, wire, printed circuit, or connection with a jumper wire. If the gauge or meter functions normally with the jumper installed, the problem usually is within the bypassed printed circuit, wire, connection or component.

Test Equipment

Several gauge tests require the use of Universal Gauge Tester J-24538. This instrument provides a wide range of variable resistance. If the tester is not available, a suitable substitute can be constructed with an accurate ohmmeter and a spare fuel gauge sending unit.

(1) Attach one ohmmeter test probe to sending unit terminal.

(2) Attach other ohmmeter test probe to sending unit ground wire.

(3) Refer to applicable Sending Unit Resistance (Ohms) chart for resistance values that apply to gauge being tested. Charts are included in Specifications. To calibrate, move float arm and mark appropriate resistance values on sending unit case.

(4) Remove ohmmeter probes. Attach jumper wire to sending unit terminal. Tester is now calibrated and ready for use.

Printed Circuit Board Test

The following procedure is used to locate suspected breaks or short circuits in the conducting foil.

(1) Remove instrument cluster from vehicle and remove all bulbs and gauges. Refer to Instrument Cluster Replacement for procedure.

(2) Connect one ohmmeter test probe to applicable pin terminal for circuit to be tested. Trace each circuit from pin terminal to bulb or gauge terminal in circuit with other test probe.

NOTE: *Set ohmmeter on low scale (0 to 10 ohms) and zero meter pointer.*

(3) Test for continuity at each uncoated position in circuit. Ohmmeter should indicate zero ohms at each position.

NOTE: *When circuit tracing, starting at the middle of the circuit will eliminate one half of the circuit.*

(4) Trace circuit leading away from bulb or gauge terminal to ground terminal pin or ground screw.

(5) Connect one ohmmeter probe to ground terminal pin and other probe to cluster metal case. Ohmmeter should indicate zero ohms.

(6) Replace printed circuit board if ohmmeter indicates other than zero ohms on any test.

(7) Test for short circuits between circuits. With probe connected to applicable pin for circuit to be tested, move other probe to all other pin terminals on cluster. Ohmmeter should indicate infinite resistance between circuits.

Ammeter Diagnosis

The accuracy of an ammeter may be determined by comparing indications with those of a test ammeter of known accuracy.

(1) Turn ignition switch off.

(2) Disconnect battery positive cable from terminal on starter motor solenoid.

CAUTION: *Test ammeter must be an actual ammeter, not a voltmeter with a calibrated ammeter scale. Connecting voltmeter in series will destroy its internal circuitry.*

(3) Connect test ammeter in series between solenoid terminal and disconnected cable.

(4) Turn ignition switch to On position. Do not start engine. Turn headlamps on. Turn heater blower motor to high speed.

(5) Compare current flow (amps) indication of test ammeter with that of ammeter in vehicle.

(6) Turn headlamps and heater blower motor off. Start engine and operate at high idle. Compare current flow (amps) indication of test ammeter with that of ammeter in vehicle.

(7) Replace ammeter if current flow (amps) indications of vehicle ammeter and test ammeter vary more than calibration tolerance listed in Specifications.

Voltmeter

(1) Connect test voltmeter of known accuracy across battery terminals.

(2) Turn ignition switch on.

(3) Compare voltage indication of test voltmeter with that of voltmeter in vehicle. Replace voltmeter if voltage indications vary more than calibration tolerance listed in Specifications.

Fuel Gauge Diagnosis

Movement of the fuel in the tank can occur when driving up or down hills, driving on rough surfaces or by rapidly accelerating or braking. Erratic up and down motion of the fuel gauge sending unit float may temporarily cause the fuel gauge pointer to fluctuate and indicate incorrectly. Ensure that these possibilities are considered before suspecting an actual abnormal condition in the fuel level indicating system.

Abnormal conditions all result from variations of four basic malfunctions:

- pointer does not move,
- pointer moves but indicates a fuel level that does not correspond with actual fuel level,
- pointer moves to top of scale and remains there,
- pointer pulsates.

Refer to DARS chart 1 for a systematic method of locating the causes of these abnormal conditions. Charts 2 and 3 provide additional procedures that should be used only as directed in chart 1.

Oil Pressure Gauge Diagnosis

An oil pressure gauge malfunction can result in any one of the following conditions:

- pointer does not move,
- pointer moves but indicates an oil pressure that does not correspond with the actual oil pressure,
- pointer moves to top of scale and remains there,
- pointer pulsates.

Refer to DARS chart 4 or 5 for a systematic method of locating the causes of these abnormal conditions.

Calibration Test

If an oil pressure gauge is suspected of indicating pressure that does not correspond with the actual oil pressure, perform a calibration test before performing electrical diagnosis procedures in DARS chart 4 (CJ) or 5 (Cherokee, Wagoneer and Truck).

(1) Remove sending unit from engine. Install T-fitting in sending unit threaded hole in engine. Connect sending unit to T-fitting.

(2) Connect oil pressure test gauge to T-fitting.

(3) Start engine. Compare pressure indicated on vehicle gauge with that on test gauge. Conduct comparison at idle and at higher engine speeds. If both gauge indications are same (within 10 percent), vehicle gauge is acceptable. If gauge is not within specification, perform gauge test as outlined in DARS chart 4 or 5.

(4) After performing test, remove T-fitting, install sending unit and inspect for oil leaks.

Tachometer Diagnosis

Test the accuracy of a tachometer by comparing with rpm indications of a test tachometer of known accuracy. A service (TACH) terminal is located on the ignition coil connector (six- and eight-cylinder engines) for the test tachometer connection. For four-cylinder engines, a service tachometer (TACH) terminal is located adjacent to the ignition switch (BAT) connector on the distributor cap. Refer to Chapter 1G—Ignition Systems. Tachometers are not adjustable. Replace if defective.

NOTE: *Some test tachometers may not be compatible with the High Energy Ignition (HEI) used with four-cylinder engines. Consult the manufacturer of the test tachometer if problems arise.*

Coolant Temperature Gauge Diagnosis

Before performing a coolant temperature gauge diagnosis, ensure the cooling system is functioning normally. Overheating can be caused by low coolant level, restrictions, loose or broken drive belt(s), defective water pump or incorrect ignition timing. Undercooling can be caused by a stuck thermostat. Consider these possibilities before suspecting an actual malfunction in the coolant temperature indicating system. A coolant temperature gauge malfunction can result in any one of the following conditions:

- pointer does not move,
- pointer moves but indicates a coolant temperature that does not correspond with the actual coolant temperature,
- pointer moves to top of scale and remains there,
- pointer pulsates.

Refer to DARS chart 6 for a systematic method of locating the causes of these abnormal conditions. Charts 2 and 3 provide additional procedures that should be used only as directed in chart 6.

INSTRUMENT CLUSTER REPLACEMENT

CJ Vehicles

Removal

(1) Disconnect battery negative cable.
(2) Disconnect speedometer cable from speedometer.
(3) Remove four attaching nuts and pull cluster from mounting studs.
(4) Note positions of all lamps. Note wire colors for use during installation.
(5) Remove gauge wires and lamps.

Installation

(1) Install gauge wires and lamps in cluster.
(2) Position cluster on mounting studs and install attaching nuts.
(3) Connect speedometer cable.
(4) Connect battery negative cable.
(5) Reset clock, if equipped.

Cherokee-Wagoneer-Truck Vehicles

Removal

(1) Disconnect battery negative cable.
(2) Remove cluster retaining screws.
(3) Disconnect speedometer cable at cluster.
(4) Disconnect cluster terminal pin plug by pulling straight off.
(5) Disconnect four-terminal connector.
(6) Tag ammeter wires for installation identification. Disconnect ammeter wires.
(7) Disconnect blower motor wiring connector.
(8) Disconnect vacuum hoses from heater control.

NOTE: *Tag each hose according to its numbered location to ensure proper connection when installing cluster.*

(9) Remove heater control panel lamps.
(10) Disconnect heater temperature control wire from lever.
(11) Remove cluster assembly.

Installation

(1) Connect wiring harness connectors and install lamps in heater control.
(2) Connect heater temperature control wire to lever.
(3) Connect vacuum hoses to heater control.
(4) Connect cluster wire connectors.
(5) Identify and install ammeter wires at original locations. If wires are reversed, ammeter will indicate in reverse (i.e., discharge instead of charge).
(6) Connect speedometer cable.
(7) Position cluster on instrument panel and install screws.
(8) Connect battery negative cable.
(9) Reset clock, if equipped.

GAUGE REPLACEMENT

Ammeter—Cherokee-Wagoneer-Truck Vehicles

(1) Remove cluster.
(2) Remove printed circuit board and gauge assembly from bezel.
(3) Remove mask from oil pressure gauge and ammeter.

CAUTION: *Use care to prevent scratching paint on mask.*

(4) Remove attaching nuts and remove ammeter.
(5) Install replacement ammeter and tighten nuts.
(6) Install mask and screws.
(7) Install printed circuit board and gauge assembly on bezel.
(8) Install cluster.
(9) Test ammeter for proper operation.

Voltmeter—CJ Vehicles

(1) Disconnect illumination lamp and wire connectors. Note wire locations for installation identification.
(2) Remove retaining nuts and bracket behind instrument panel.
(3) Remove gauge from instrument panel.
(4) Position replacement gauge in instrument panel opening.
(5) Install bracket and nuts.
(6) Connect wires to original locations and install lamp.
(7) Test voltmeter for proper operation.

Fuel Gauge—CJ Vehicles

(1) Remove cluster.
(2) Carefully uncrimp lip of outer bezel. Remove outer bezel, glass and glass retaining bezel.
(3) Remove attaching screws from speedometer housing. Remove speedometer and face plate assembly.
(4) Remove attaching nuts and remove insulator and fuel gauge.

NOTE: *It may be necessary to carefully move lamp guard aside.*

(5) Install replacement fuel gauge, insulator and attaching nuts. Place toothed lockwasher on A-terminal. Ensure gauge is properly centered in face plate opening, then tighten nuts.
(6) Inspect all lamp guards for correct position. Install speedometer and face plate assembly. Install attaching screws and washers.
(7) Examine glass for fingerprints and debris.Clean as necessary.
(8) Install glass, glass retaining bezel and outer bezel. Crimp outer bezel lip four places.
(9) Install cluster.
(10) Check fuel gauge for proper operation.

Fuel Gauge—Cherokee-Wagoneer-Truck Vehicles

(1) Remove cluster.
(2) Remove printed circuit board and gauge assembly from bezel.
(3) Remove mask from fuel gauge and coolant temperature gauge.

CAUTION: *Use care to prevent scratching paint on mask.*

(4) Remove attaching nuts and remove fuel gauge.
(5) Install replacement fuel gauge and tighten nuts.
(6) Install mask and screws.
(7) Install printed circuit board and gauge assembly on bezel.
(8) Install cluster.
(9) Test fuel gauge for proper operation.

Oil Pressure Gauge—CJ Vehicles

(1) Remove illumination lamp and disconnect wire connectors.
(2) Remove retaining nuts and bracket behind instrument panel.
(3) Remove gauge from instrument panel.
(4) Position replacement gauge in instrument panel opening.
(5) Install bracket and nuts.
(6) Connect wires and install lamp.
(7) Test oil pressure gauge for proper operation.

Oil Pressure Gauge—Cherokee-Wagoneer-Truck Vehicles

(1) Remove cluster.
(2) Remove printed circuit board and gauge assembly from bezel.
(3) Remove mask from oil pressure gauge and ammeter.

CAUTION: *Use care to prevent scratching paint on mask.*

(4) Remove attaching nuts and remove oil pressure gauge.
(5) Install replacement oil pressure gauge and tighten nuts.
(6) Install mask and screws.
(7) Install printed circuit board and gauge assembly on bezel.
(8) Install cluster.
(9) Test oil pressure gauge for proper operation.

Tachometer—CJ Vehicles

(1) Disconnect following wires.
(a) Black ground wire.
(b) Orange illumination lamp wire.
(c) Red and red with tracer wires (six-cylinder engines) or three-terminal connector (four-cylinder engines).
(2) Remove screw and retaining cup.
(3) Remove tachometer from instrument panel.

NOTE: *It is possible to start engine with tachometer removed. With jumper wire, connect harness wires together that were originally connected to tachometer.*

(4) Install replacement tachometer, cup and screw.
(5) Connect wire connectors and ground wires.
(6) Test tachometer for proper operation.

Coolant Temperature Gauge—CJ Vehicles

(1) Remove cluster.
(2) Carefully uncrimp lip of outer bezel. Remove outer bezel, glass and glass retaining bezel.
(3) Remove attaching screws from speedometer housing. Remove speedometer and face plate assembly.
(4) Remove attaching nuts and remove insulator and coolant temperature gauge.

NOTE: *It may be necessary to carefully move lamp guard aside.*

(5) Install replacement gauge, insulator and attaching nuts. Place toothed lockwasher on S-terminal. Ensure gauge is properly centered in face plate opening, then tighten nuts.
(6) Inspect all lamp guards for correct position. Install speedometer and face plate assembly. Install attaching screws and washers.
(7) Examine glass for fingerprints and debris. Clean as necessary.
(8) Install glass, glass retaining bezel and outer bezel. Crimp outer bezel four places.
(9) Install cluster.
(10) Test coolant temperature gauge for proper operation.

Coolant Temperature Gauge—Cherokee-Wagoneer-Truck Vehicles

(1) Remove cluster.
(2) Remove printed circuit board and gauge assembly from bezel.
(3) Remove mask from fuel gauge and coolant temperature gauge.

CAUTION: *Use care to prevent scratching paint on mask.*

(4) Remove attaching nuts and remove coolant temperature gauge.
(5) Install replacement gauge and tighten nuts.
(6) Install mask and screws.
(7) Install printed circuit board and gauge assembly on bezel.
(8) Install cluster.
(9) Test coolant temperature gauge for proper operation.

PRINTED CIRCUIT BOARD REPLACEMENT

Only Cherokee, Wagoneer and Truck vehicles are equipped with a printed circuit board. CJ vehicles have conventional wiring for all gauges, meters and cluster illumination lamps.

Removal

(1) Remove instrument cluster.
(2) Remove radio noise suppressor (connector strip if not equipped with radio).
(3) Remove all illumination lamps from cluster. Twist counterclockwise to remove.
(4) Remove printed circuit board and gauge assembly.
(5) Remove retaining nuts from ammeter and oil pressure gauge.
(6) Lift ammeter, oil pressure gauge and plate out of cluster as assembly.
(7) Remove retaining nuts from fuel and coolant temperature gauges. Remove large ground screw from printed circuit board above speedometer.
(8) Remove speedometer, fuel gauge, and coolant temperature gauge as assembly.

Installation

(1) Install printed circuit board. Ensure blue illumination lamp diffusers are correctly positioned. Install ground screw and gauge retaining nuts.
(2) Install ammeter and oil pressure gauge assembly on circuit board. Ensure blue lamp diffuser is correctly positioned. Install retaining nuts. Stamped nuts are used for oil pressure gauge. Plain nuts and lockwashers are used for ammeter.
(3) Examine gauge lenses for fingerprints and debris. Clean as necessary.
(4) Install printed circuit board and gauge assembly on bezel.
(5) Install illumination lamps.
(6) Install radio noise suppressor or connector strip.
(7) Install cluster.
(8) Test all gauges and lamps for proper operation.

CONSTANT VOLTAGE REGULATOR (CVR) REPLACEMENT

CJ Vehicles

The CVR is contained in the fuel gauge housing. If the CVR is defective, replace the fuel gauge.

Cherokee-Wagoneer-Truck Vehicles

The CVR is contained in the coolant temperature gauge housing. If the CVR is defective, replace the coolant temperature gauge.

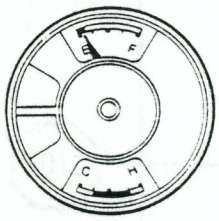
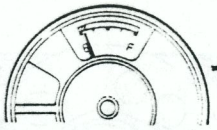
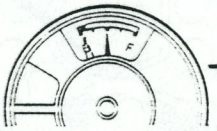
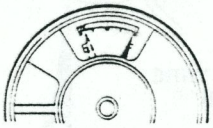
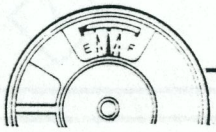
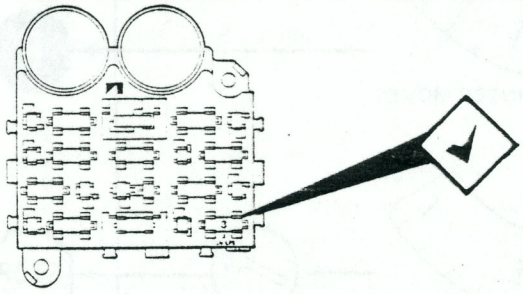
DIAGNOSIS AND REPAIR SIMPLIFICATION (DARS) CHARTS

	Page
Coolant Temperature Gauge Not Functioning Properly	1L-33
Fuel Gauge Not Functioning Properly	1L-9
Fuel Gauge and Coolant Temperature Gauge Both Malfunction	1L-20
Gauge Fuse Blown	1L-18
Oil Pressure Gauge Not Functioning Properly (Cherokee-Wagoneer-Truck Only)	1L-27
Oil Pressure Gauge Not Functioning Properly (CJ)	1L-22

Note: Refer to Chapter A — General Information for details on how to use this DARS chart.

PROBLEM: FUEL GAUGE NOT FUNCTIONING PROPERLY

Chart 1

STEP	SEQUENCE	RESULT
1	● NOTE POSITION OF FUEL GAUGE POINTER ● TURN IGNITION ON AND WAIT 2 MINUTES FOR GAUGE TO WARM UP ● OBSERVE POINTER  POINTER DOES NOT MOVE  POINTER MOVES  POINTER MOVES TO MAXIMUM AND STAYS  POINTER PULSATES MORE THAN WIDTH OF POINTER  REPLACE CVR BEFORE STARTING TEST: ✓ ENGINE MUST BE WARM ✓ FUEL TANK MUST BE NEITHER COMPLETELY FULL NOR COMPLETELY EMPTY	2 20 10 STOP
2	 CHECK 3-AMP FUSE AT FUSE PANEL FUSE BLOWN FUSE NOT BLOWN	GO TO CHART 2 STEP 1 3
3	OBSERVE TEMPERATURE GAUGE TEMPERATURE GAUGE POINTER DOES NOT MOVE TEMPERATURE GAUGE POINTER INDICATES PROPERLY CJ VEHICLES CHEROKEE WAGONEER TRUCK VEHICLES	GO TO CHART 3 STEP 1 4 7

80311A

Chart 1

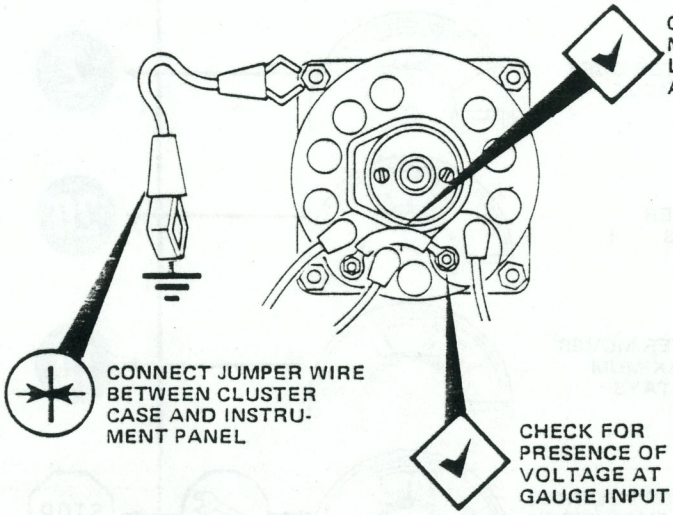
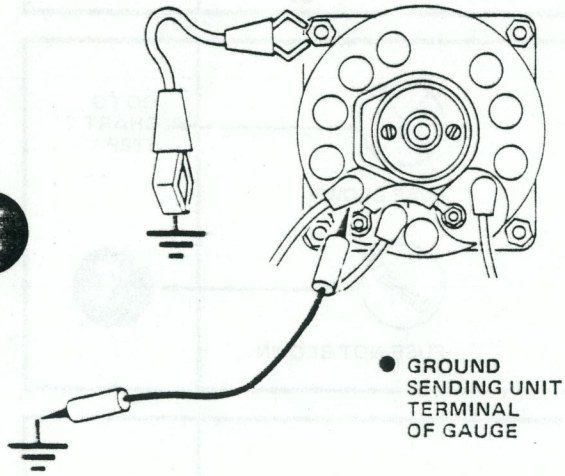
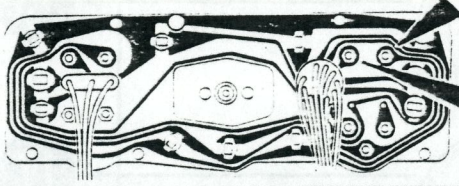
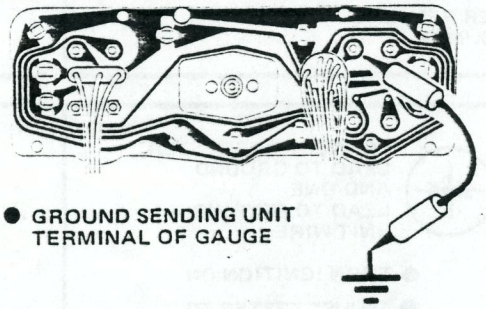
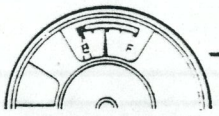
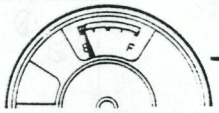
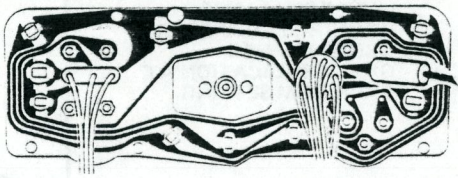
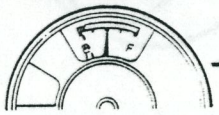
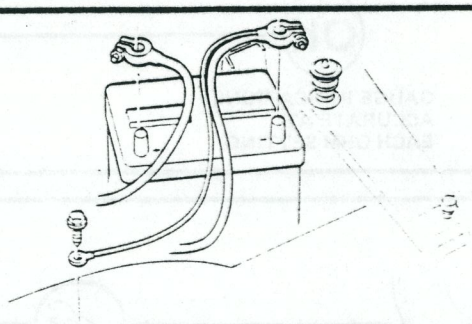
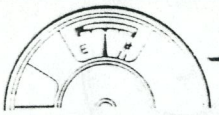
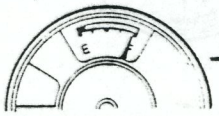
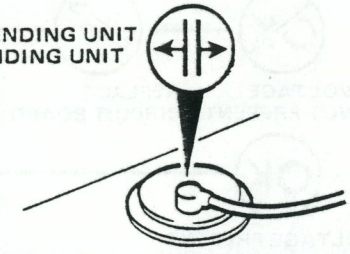
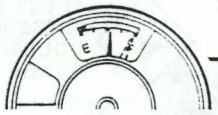
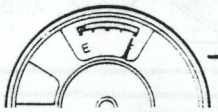
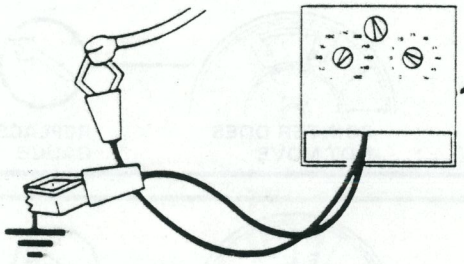
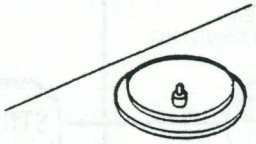
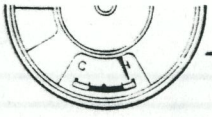
STEP	SEQUENCE	RESULT
4	● REMOVE CLUSTER ● LEAVE INSTRUMENT LEADS ATTACHED  CONNECT JUMPER WIRE BETWEEN CLUSTER CASE AND INSTRUMENT PANEL CHECK GAUGE NUTS FOR LOOSENESS AND CORROSION CHECK FOR PRESENCE OF VOLTAGE AT GAUGE INPUT OK → VOLTAGE NOT PRESENT → LOCATE AND REPAIR FAULT IN JUMPER STRAP → STOP OK → VOLTAGE PRESENT → 5	
5	 ● GROUND SENDING UNIT TERMINAL OF GAUGE POINTER MOVES → 6 POINTER DOES NOT MOVE → REPLACE GAUGE → STOP	
6	LOCATE AND REPAIR OPEN CIRCUIT IN SENDING UNIT WIRE	STOP

Chart 1

STEP	SEQUENCE	RESULT
7	● REMOVE CLUSTER ● DO NOT DISCONNECT INSTRUMENT CLUSTER WIRING CONNECTOR  CHECK FOR PRESENCE OF VOLTAGE AT GAUGE INPUT CHECK GAUGE NUTS FOR LOOSENESS AND CORROSION	OK → VOLTAGE NOT PRESENT → REPLACE CIRCUIT BOARD → STOP OK → VOLTAGE PRESENT → 8
8	 ● GROUND SENDING UNIT TERMINAL OF GAUGE	 POINTER MOVES → 9  POINTER DOES NOT MOVE → REPLACE GAUGE → STOP
9	 ● GROUND FUEL GAUGE PIN TERMINAL ON CIRCUIT BOARD	 POINTER MOVES → REPAIR OPEN CIRCUIT IN SENDING UNIT WIRE → STOP POINTER DOES NOT MOVE → REPLACE CIRCUIT BOARD → STOP
10	CHECK GROUND STRAP ● BROKEN ● MISSING ● CORRODED ● SCREWS LOOSE, MISSING 	OK → GROUND NOT OK → 11 OK → GROUND OK → 12
11	REPAIR GROUND	 POINTER DROPS FROM MAXIMUM → STOP  POINTER REMAINS AT MAXIMUM → 12

80311C

Chart 1

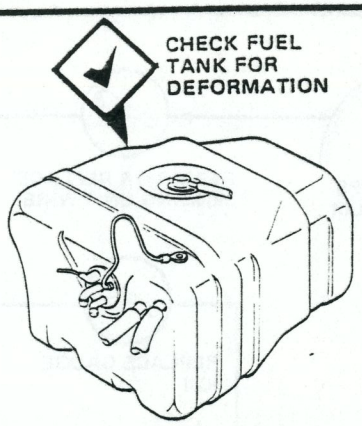
STEP	SEQUENCE	RESULT
12	DISCONNECT SENDING UNIT WIRE FROM SENDING UNIT 	 POINTER DROPS FROM MAXIMUM → 13  POINTER REMAINS AT MAXIMUM → 17
13	 CONNECT ONE TESTER LEAD TO GROUND AND ONE LEAD TO SENDING UNIT WIRE ● TURN IGNITION ON ● ADJUST TESTER TO SELECT OHM VALUES LISTED IN SENDING UNIT RESISTANCE REQUIREMENTS CHART. OBSERVE FUEL GAUGE INDICATION AT EACH OHM SETTING. 	GAUGE INDICATIONS NOT ACCURATE AT EACH OHM SETTING → 14 GAUGE INDICATIONS ACCURATE AT EACH OHM SETTING → 15
14	● OBSERVE TEMPERATURE GAUGE TEMPERATURE GAUGE POINTER IS AT MAXIMUM 	REPAIR CLUSTER GROUND OR REPLACE CVR → STOP
	TEMPERATURE GAUGE POINTER INDICATES NORMALLY	REPLACE FUEL GAUGE → STOP

80311D

Chart 1

STEP | SEQUENCE | RESULT

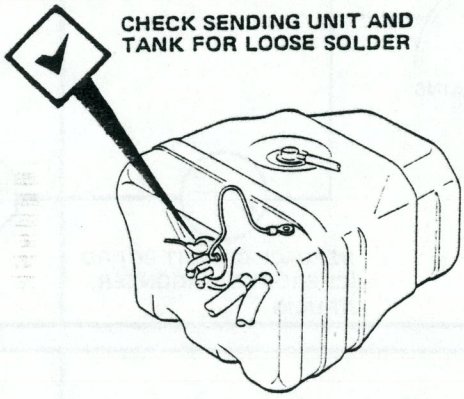
15



OK → FUEL TANK NOT DEFORMED → 16

O.K → FUEL TANK DEFORMED → REPAIR OR REPLACE FUEL TANK → STOP

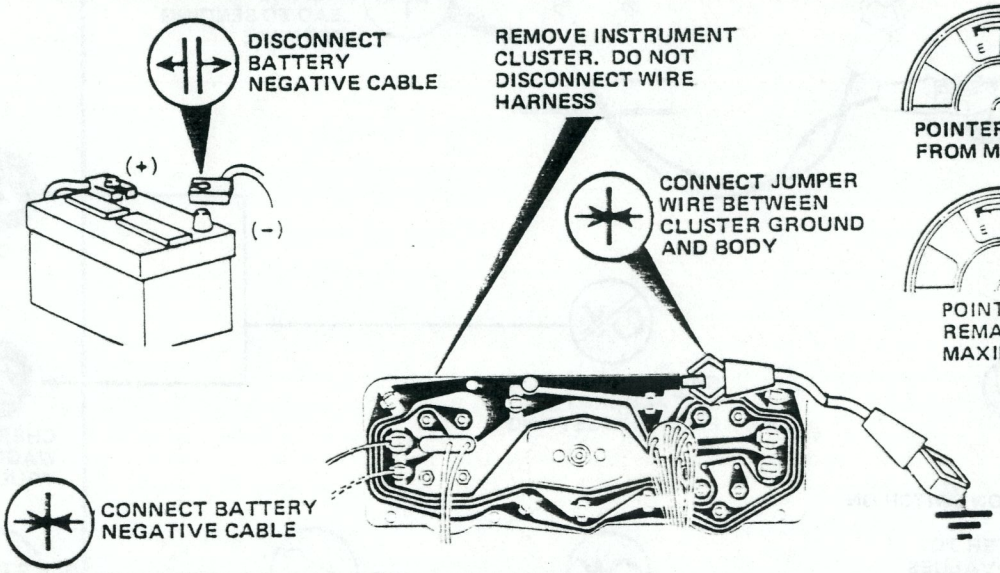
16

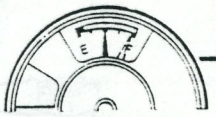


OK → NO LOOSE SOLDER → REPLACE SENDING UNIT → STOP

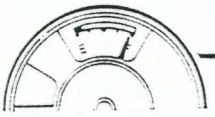
O.K → LOOSE SOLDER PRESENT → REMOVE LOOSE SOLDER → STOP

17





POINTER DROPS FROM MAXIMUM → 18



POINTER REMAINS AT MAXIMUM → 19

18

REPAIR INSTRUMENT GROUND PANEL → STOP

Chart 1

STEP | SEQUENCE | RESULT

19

DISCONNECT SENDING UNIT WIRE FROM CLUSTER

POINTER DROPS FROM MAXIMUM

REPAIR OR REPLACE SENDING UNIT WIRE

STOP

REPLACE GAUGE (CJ)

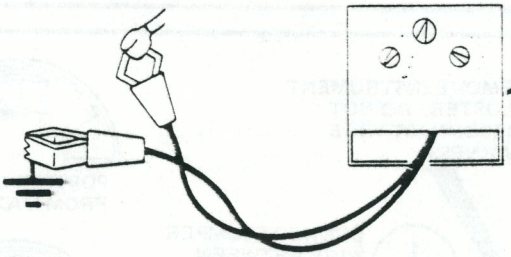
STOP

POINTER REMAINS AT MAXIMUM

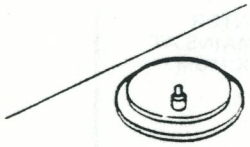
REPLACE CIRCUIT BOARD (CHEROKEE, WAGONEER, TRUCK)

STOP

20



CONNECT ONE TESTER LEAD TO GROUND AND ONE LEAD TO SENDING UNIT WIRE



- TURN IGNITION SWITCH ON
- ADJUST TESTER TO SELECT OHM VALUES LISTED IN SENDING UNIT RESISTANCE CHART. OBSERVE FUEL GAUGE INDICATION AT EACH OHM SETTING.

GAUGE INDICATIONS NOT ACCURATE AT EACH OHM SETTING

21 CJ

22 CHEROKEE WAGONEER TRUCK

GAUGE INDICATIONS ACCURATE AT EACH OHM SETTING

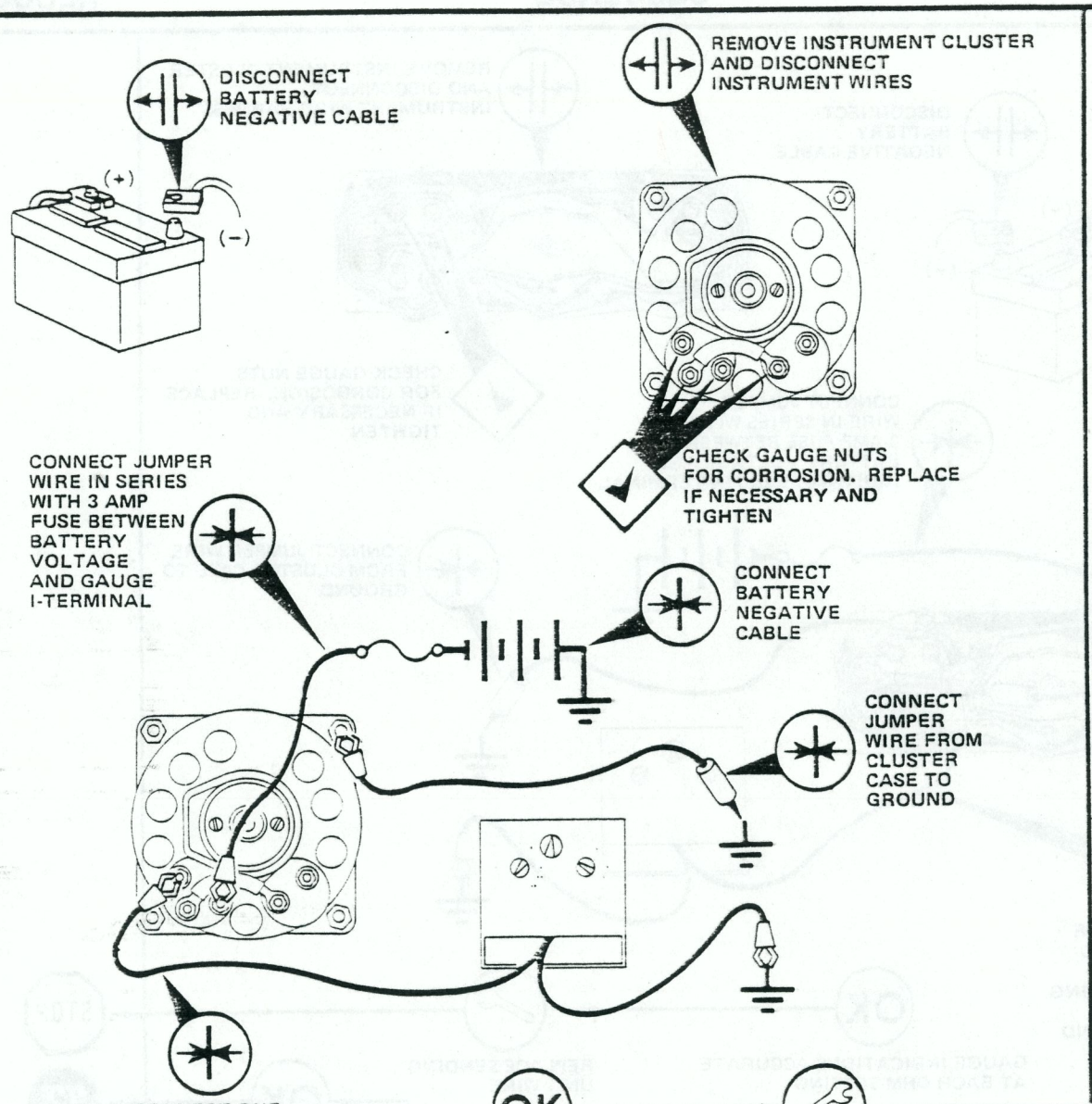
REPLACE SENDING UNIT

STOP

80311F

Chart 1

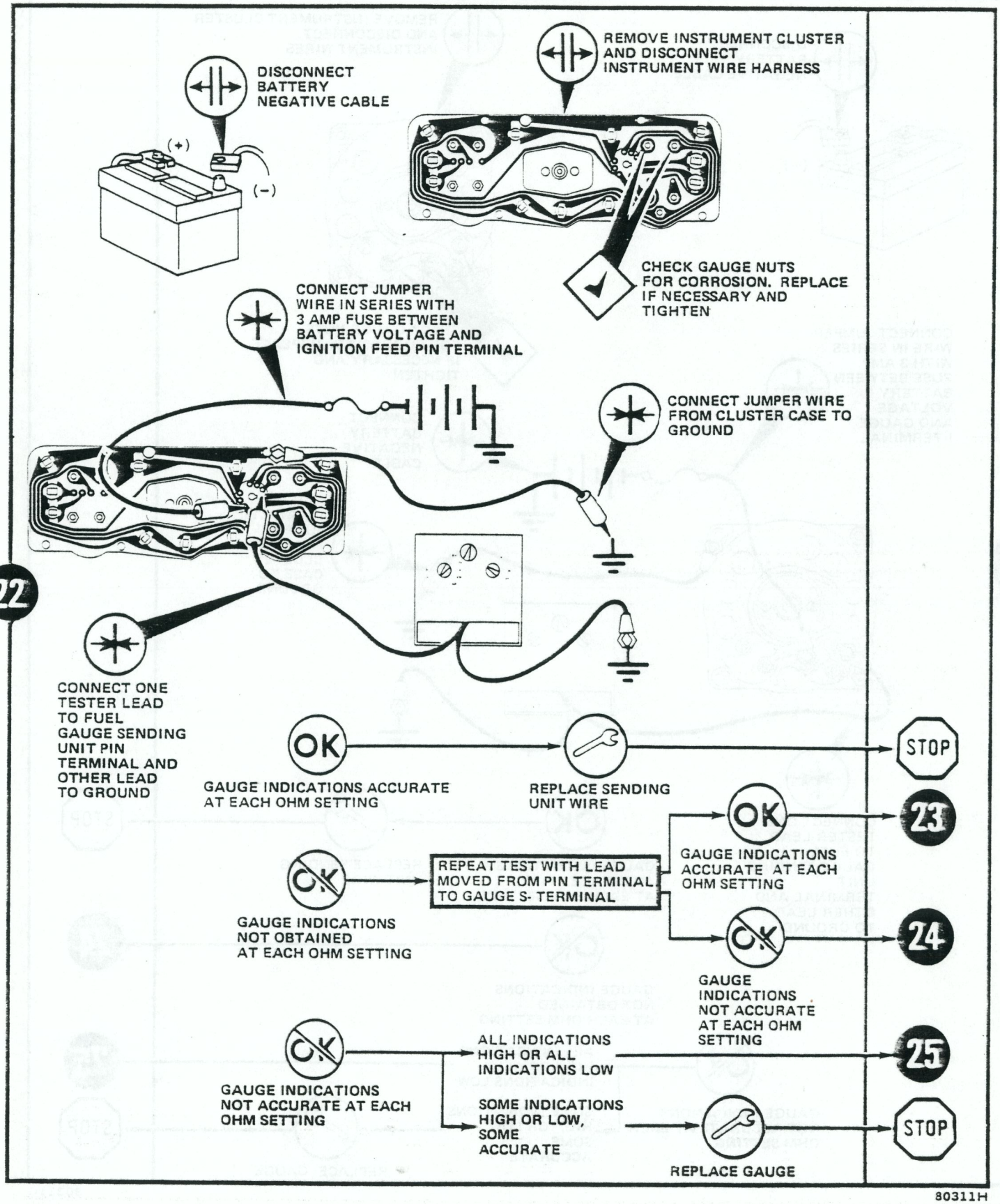
STEP | SEQUENCE | RESULT



80311G

Chart 1

STEP | SEQUENCE | RESULT

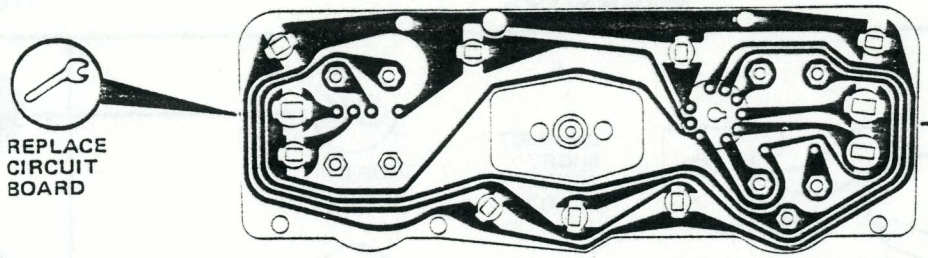


80311H

Chart 1

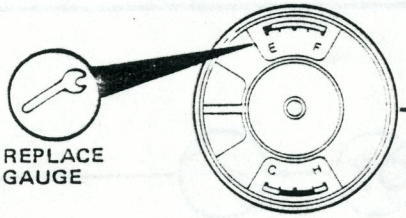
STEP | SEQUENCE | RESULT

23



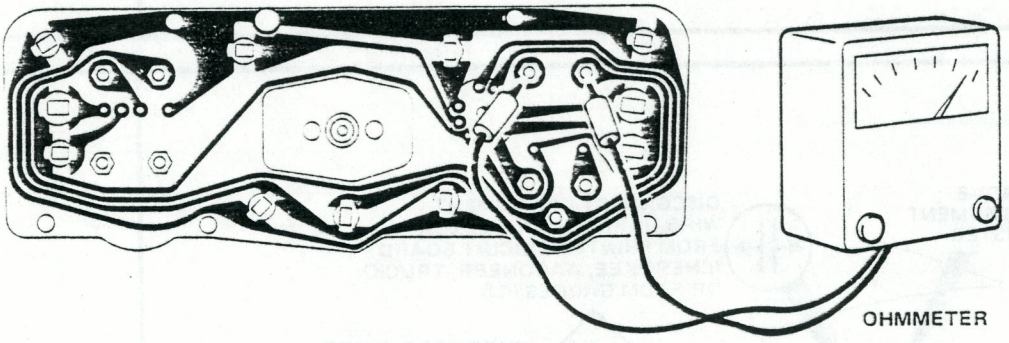
REPLACE CIRCUIT BOARD → STOP

24



REPLACE GAUGE → STOP

25



CONNECT OHMMETER LEADS TO GAUGE INPUT TERMINAL AND GAUGE SENDING UNIT TERMINAL

- COMPARE OHMMETER INDICATIONS WITH VALUES LISTED IN GAUGE RESISTANCE CHART

OK → GAUGE RESISTANCE CORRECT → REPLACE CVR → STOP

OK → GAUGE RESISTANCE INCORRECT → REPLACE GAUGE → STOP

80311J

PROBLEM: GAUGE FUSE BLOWN

Chart 2

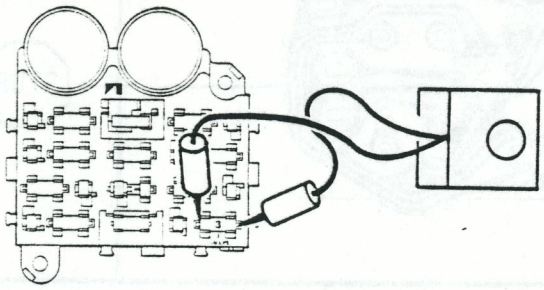
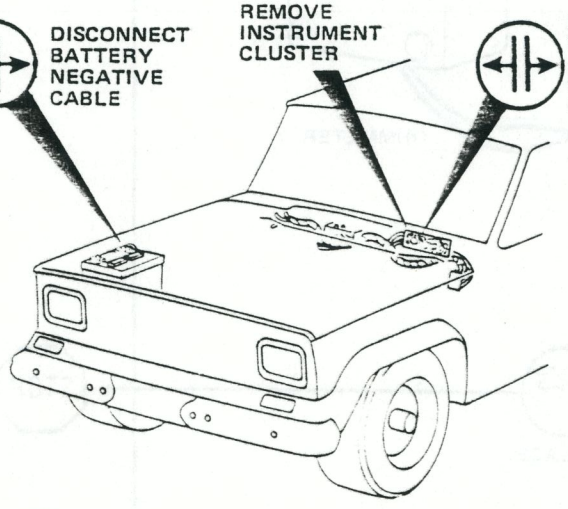
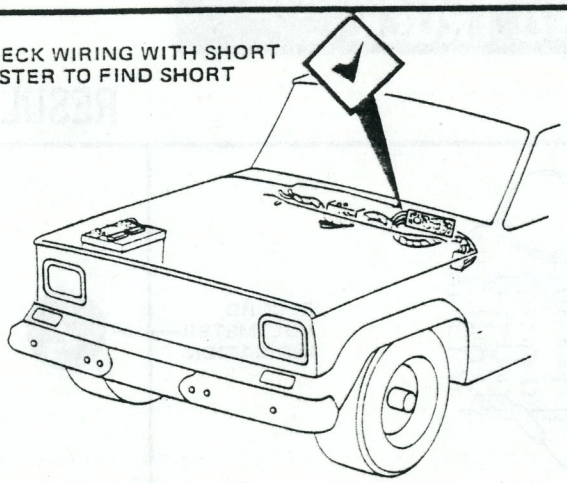
STEP	SEQUENCE	RESULT
1	 CONNECT SHORT TESTER J-8681 → OK: SHORT NOT INDICATED	2
	→ O.K: SHORT INDICATED	3
2	CHECK FOR INTERMITTENT SHORT ● RED IGNITION WIRE TO GAUGES → O.K: SHORT INDICATED → REPAIR AS NECESSARY	STOP
3	 DISCONNECT BATTERY NEGATIVE CABLE REMOVE INSTRUMENT CLUSTER DISCONNECT INSTRUMENT WIRE HARNESS CONNECTOR FROM PRINTED CIRCUIT BOARD (CHEROKEE, WAGONEER, TRUCK) OR FROM GAUGES (CJ) CHECK FOR SHORT AT GAUGE FUSE CONNECT BATTERY NEGATIVE CABLE → O.K: SHORT INDICATED	5
	→ OK: SHORT NOT INDICATED → CHEROKEE WAGONEER TRUCK	6
	→ CJ	7

Chart 2

STEP | SEQUENCE | RESULT

4

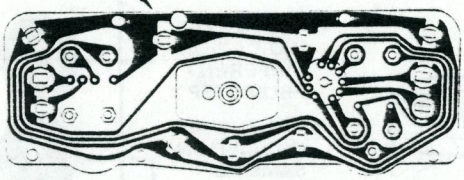
CHECK WIRING WITH SHORT TESTER TO FIND SHORT



REPLACE SHORTED WIRE HARNESS → STOP

5

CHECK CIRCUIT BOARD FOR OBVIOUS DAMAGE

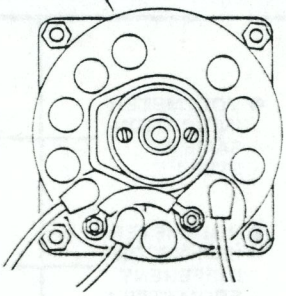


OK — CIRCUIT BOARD NOT DAMAGED → REPLACE CVR → STOP

O.K — CIRCUIT BOARD DAMAGED → DETERMINE CAUSE OF DAMAGE: CVR OR GAUGE FAULTY; REPLACE CIRCUIT BOARD AND FAULTY COMPONENT → STOP

6

CHECK INSTRUMENT CLUSTER AND INDIVIDUAL GAUGES FOR OBVIOUS DAMAGE

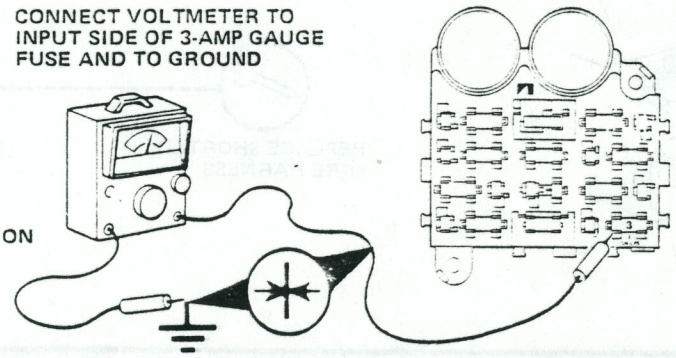
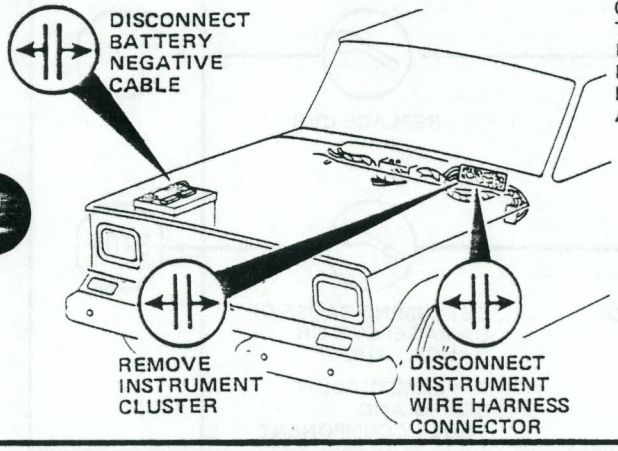
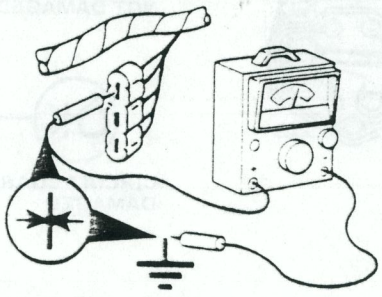
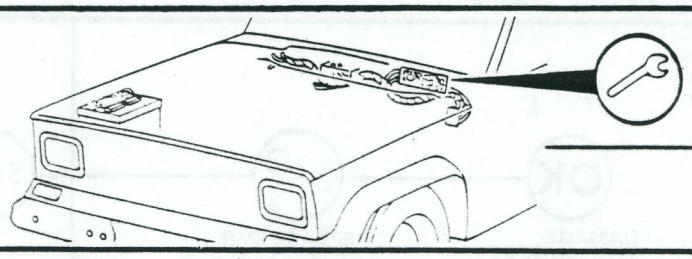
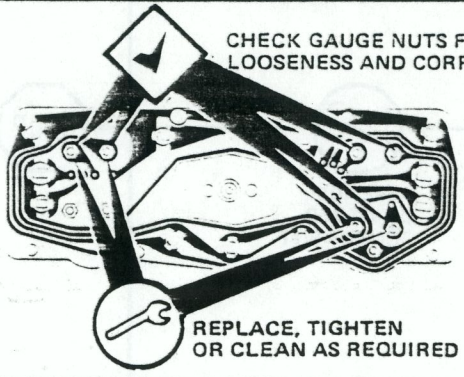


OK — DAMAGE NOT EVIDENT → REPLACE CVR → STOP

O.K — DAMAGE EVIDENT → REPLACE DAMAGED COMPONENT → STOP

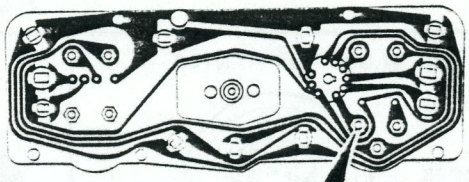
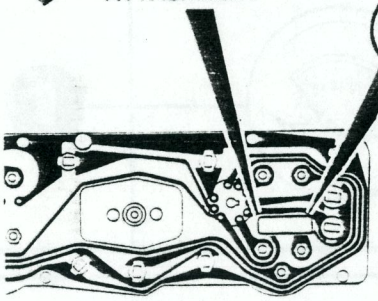
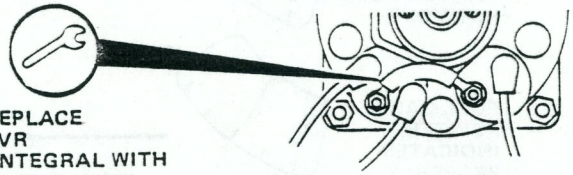
PROBLEM: FUEL GAUGE AND COOLANT TEMPERATURE GAUGE BOTH MALFUNCTION (ALSO OIL PRESSURE GAUGE ON CHEROKEE, WAGONEER AND TRUCK

Chart 3

STEP	SEQUENCE	RESULT
1	TURN IGNITION SWITCH ON CONNECT VOLTMETER TO INPUT SIDE OF 3-AMP GAUGE FUSE AND TO GROUND 	RECORD VOLTMETER INDICATION → 2
2	DISCONNECT BATTERY NEGATIVE CABLE  REMOVE INSTRUMENT CLUSTER DISCONNECT INSTRUMENT WIRE HARNESS CONNECTOR CONNECT VOLTMETER TO IGNITION FEED WIRE FEMALE CONNECTOR IN INSTRUMENT WIRE HARNESS CONNECTOR AND TO GOOD GROUND CONNECT BATTERY NEGATIVE CABLE 	● VOLTMETER INDICATION DIFFERENT FROM STEP 1 → 3 ● VOLTMETER INDICATION SAME AS STEP 1 → 4 CHEROKEE, WAGONEER, TRUCK → 7 CJ → 7
3	REPAIR OR REPLACE INSTRUMENT PANEL WIRE HARNESS 	STOP
4	CHECK GAUGE NUTS FOR LOOSENESS AND CORROSION  REPLACE, TIGHTEN OR CLEAN AS REQUIRED CONNECT JUMPER WIRES AND VOLTMETER ● JUMPER WIRE BETWEEN CLUSTER CASE AND GROUND ● JUMPER WIRE IN SERIES WITH A 3-AMP FUSE BETWEEN BATTERY VOLTAGE SOURCE AND IGNITION FEED PIN TERMINAL ON CLUSTER ● VOLTMETER LEAD TO CVR INPUT TERMINAL ● VOLTMETER LEAD TO GROUND	● VOLTMETER INDICATION SAME AS STEP 1 → 5 ● VOLTMETER INDICATION DIFFERENT FROM STEP 1 → 6

80313A

Chart 3

STEP	SEQUENCE	RESULT
5	 REPLACE CVR (INTEGRAL WITH TEMPERATURE GAUGE)	STOP
6	CHECK RADIO NOISE SUPPRESSOR OR CONNECTOR STRIP FOR PROPER ATTACHMENT  USING SAME TEST SET-UP AS STEP 4, MOVE VOLTMETER CONNECTOR FROM CVR TERMINAL TO RADIO NOISE SUPPRESSOR OR CONNECTOR STRIP OUTPUT TERMINAL	VOLTMETER INDICATION SAME AS STEP 1 → 8 VOLTMETER INDICATION DIFFERENT FROM STEP 1 → 9
7	 REPLACE CVR (INTEGRAL WITH FUEL GAUGE)	STOP
8	REPLACE CIRCUIT BOARD	STOP
9	REPLACE RADIO NOISE SUPPRESSOR OR CONNECTOR STRIP	STOP

80313B

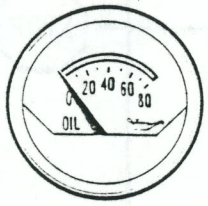
PROBLEM: OIL PRESSURE GAUGE NOT FUNCTIONING PROPERLY (CJ)

Chart 4

STEP | SEQUENCE | RESULT

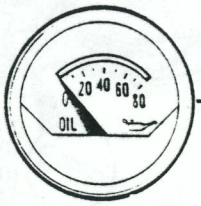
1

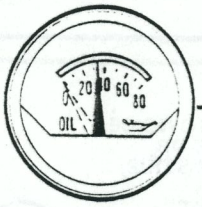
- NOTE POSITION OIL PRESSURE GAUGE POINTER
- START ENGINE
- OBSERVE POINTER

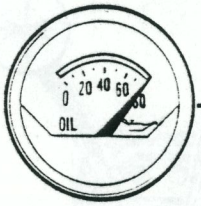


BEFORE STARTING TEST:

- OIL PAN MUST BE FILLED TO SPECIFICATION
- FUEL TANK MUST BE NEITHER COMPLETELY FULL NOR COMPLETELY EMPTY

POINTER DOES NOT MOVE →  → **2**

POINTER MOVES →  → **11**

POINTER MOVES TO MAXIMUM AND STAYS →  → **6**

NOTE: Indicated Oil Pressure Observed from Driver's Seat

2

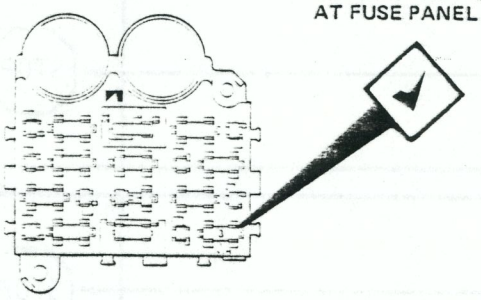
- OBSERVE FUEL GAUGE

FUEL GAUGE POINTER DOES NOT MOVE → → **3**

FUEL GAUGE POINTER INDICATES PROPERLY → → **4**

3

CHECK 3-AMP FUSE AT FUSE PANEL



FUSE BLOWN → GO TO CHART 2 STEP 1

FUSE NOT BLOWN → LOCATE AND REPAIR FAULT IN IGNITION FEED TO INSTRUMENTS → STOP

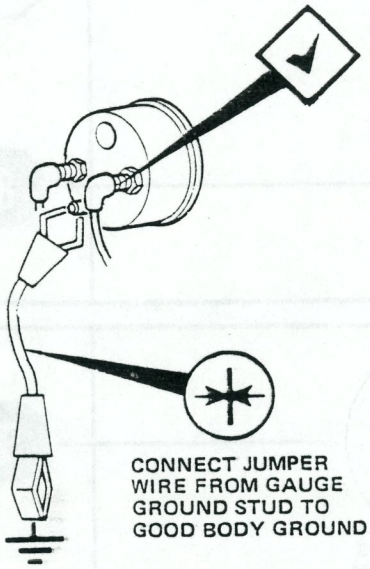
80314A

Chart 4

STEP | SEQUENCE | RESULT

4

- REMOVE OIL PRESSURE GAUGE
- LEAVE GAUGE WIRES CONNECTED



CHECK FOR PRESENCE OF VOLTAGE AT GAUGE I-TERMINAL

TURN IGNITION ON

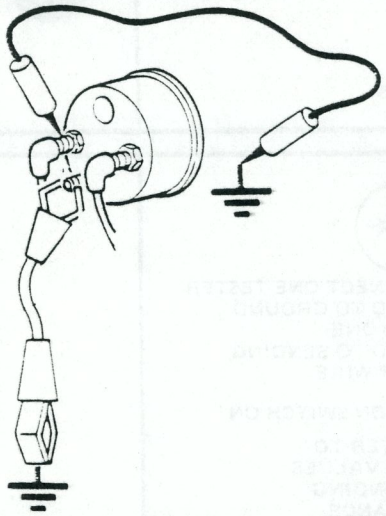
CONNECT JUMPER WIRE FROM GAUGE GROUND STUD TO GOOD BODY GROUND

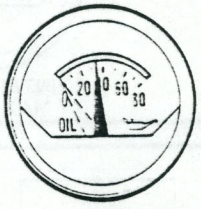
VOLTAGE NOT PRESENT → O.K. → STOP

LOCATE AND REPAIR FAULT IN IGNITION FEED TO OIL PRESSURE GAUGE

VOLTAGE PRESENT → OK → **5**

5





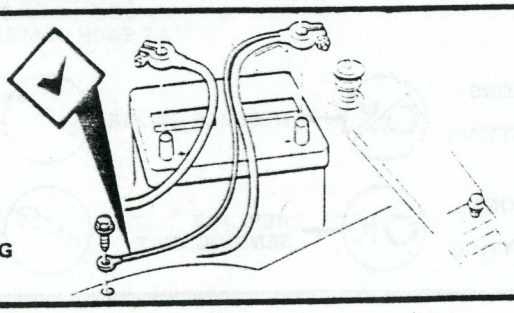
POINTER MOVES → LOCATE AND REPAIR OPEN IN SENDING UNIT CIRCUIT → STOP

POINTER DOES NOT MOVE → REPLACE GAUGE → STOP

6

CHECK GROUND STRAP

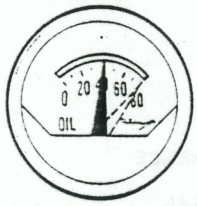
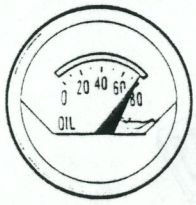
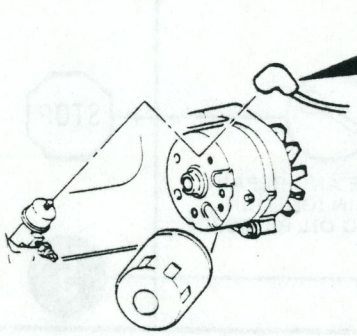
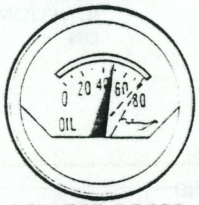
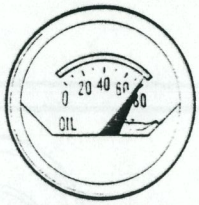
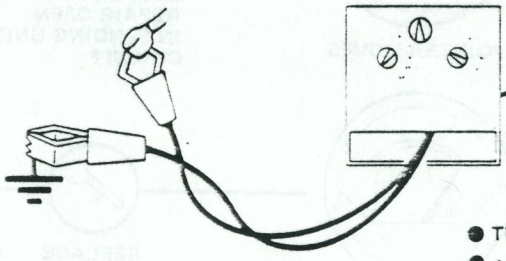
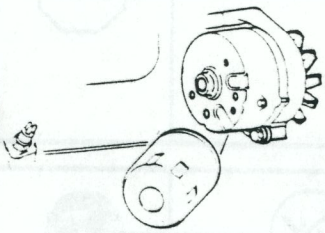
- BROKEN
- MISSING
- CORRODED
- SCREW LOOSE, MISSING



O.K. GROUND NOT OK → **7**

OK GROUND OK → **8**

Chart 4

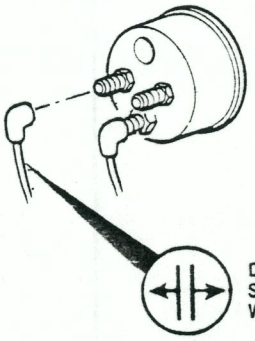
STEP	SEQUENCE	RESULT
7	REPAIR GROUND START ENGINE  POINTER DROPS FROM MAXIMUM	STOP
	 POINTER REMAINS AT MAXIMUM	8
8	 DISCONNECT SENDING UNIT WIRE  POINTER DROPS FROM MAXIMUM	9
	 POINTER REMAINS AT MAXIMUM	10
9	 CONNECT ONE TESTER LEAD TO GROUND AND ONE LEAD TO SENDING UNIT WIRE  ● TURN IGNITION SWITCH ON ● ADJUST TESTER TO SELECT OHM VALUES LISTED IN SENDING UNIT RESISTANCE CHART. OBSERVE GAUGE INDICATION AT EACH OHM SETTING	
	GAUGE INDICATIONS NOT ACCURATE AT EACH OHM SETTING → O.K → REPLACE GAUGE	STOP
	GAUGE INDICATIONS ACCURATE AT EACH OHM SETTING → OK → REPLACE SENDING UNIT	STOP

80314C

Chart 4

STEP | SEQUENCE | RESULT

10

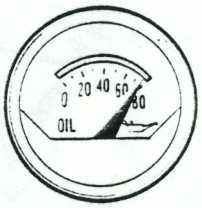


DISCONNECT SENDING UNIT WIRE FROM GAUGE

POINTER DROPS FROM MAXIMUM

REPLACE SENDING UNIT WIRE

STOP

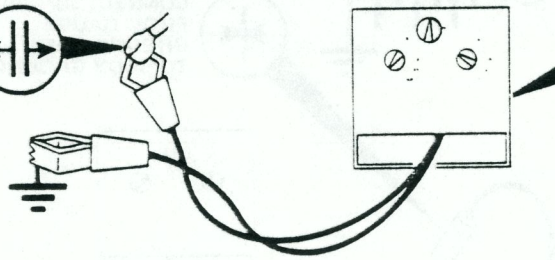


POINTER REMAINS AT MAXIMUM

REPLACE GAUGE

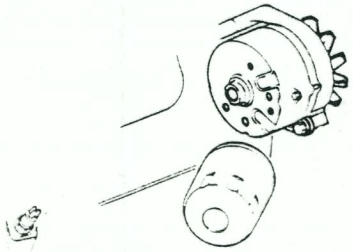
STOP

DISCONNECT SENDING UNIT WIRE



CONNECT ONE TESTER LEAD TO GROUND AND ONE LEAD TO SENDING UNIT WIRE

11



- TURN IGNITION SWITCH ON
- ADJUST TESTER TO SELECT OHM VALUES LISTED IN SENDING UNIT RESISTANCE REQUIREMENTS CHART. OBSERVE GAUGE INDICATION AT EACH OHM SETTING.

OK

GAUGE INDICATIONS NOT ACCURATE AT EACH OHM SETTING

12

OK

GAUGE INDICATIONS ACCURATE AT EACH OHM SETTING

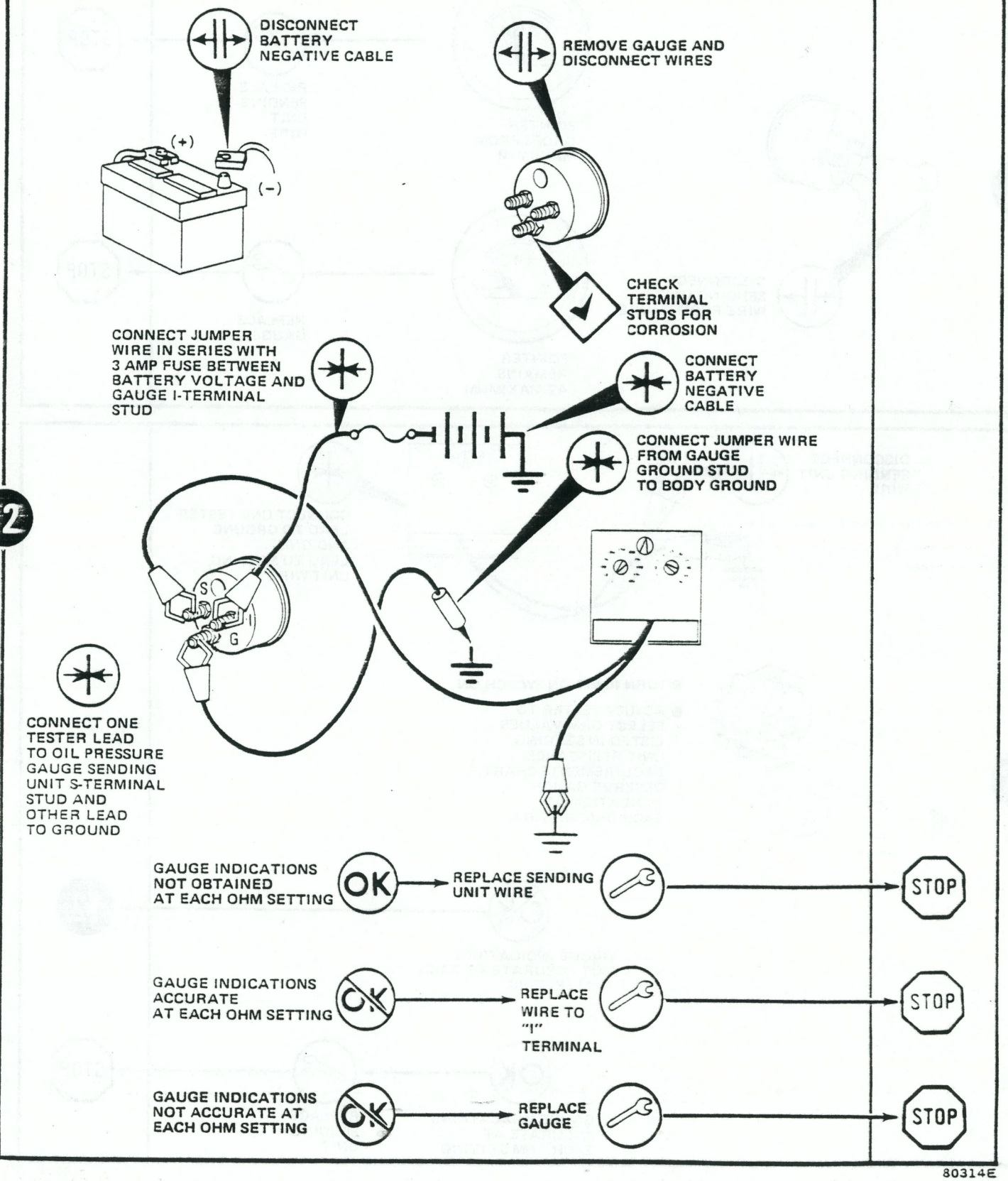
REPLACE SENDING UNIT

STOP

80314D

Chart 4

STEP | SEQUENCE | RESULT



80314E

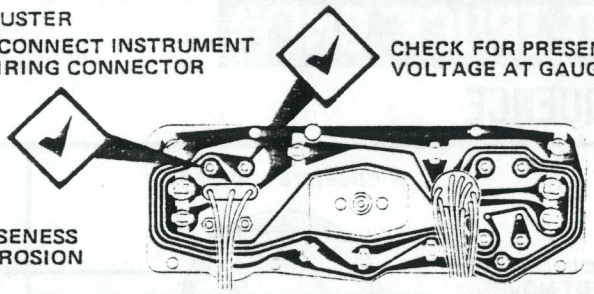
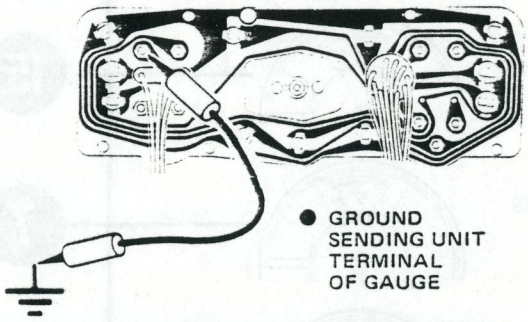
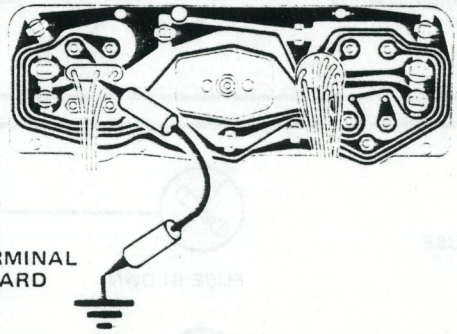
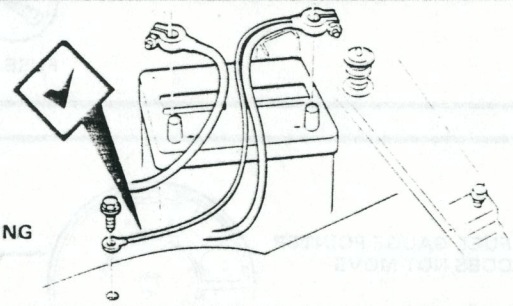
PROBLEM: OIL PRESSURE GAUGE NOT FUNCTIONING PROPERLY (CHEROKEE, WAGONEER AND TRUCK ONLY)

Chart 5

STEP	SEQUENCE	RESULT
1	● NOTE POSITION OF OIL PRESSURE GAUGE POINTER ● START ENGINE AND WAIT 2 MINUTES FOR GAUGE TO WARM UP ● OBSERVE POINTER	
	BEFORE STARTING TEST: OIL PAN MUST BE FILLED TO SPECIFICATION FUEL TANK MUST BE NEITHER COMPLETELY FULL NOR COMPLETELY EMPTY	
	POINTER DOES NOT MOVE	2
	POINTER MOVES	15
	POINTER MOVES TO MAXIMUM AND STAYS	7
	POINTER PULSATES MORE THAN WIDTH OF POINTER	REPLACE CVR → STOP
2	CHECK 3-AMP FUSE AT FUSE PANEL	
	FUSE BLOWN	GO TO CHART 2 STEP 1
	FUSE NOT BLOWN	3
3	● OBSERVE FUEL GAUGE	
	FUEL GAUGE POINTER DOES NOT MOVE	GO TO CHART 3 STEP 1
	FUEL GAUGE POINTER INDICATES PROPERLY	4

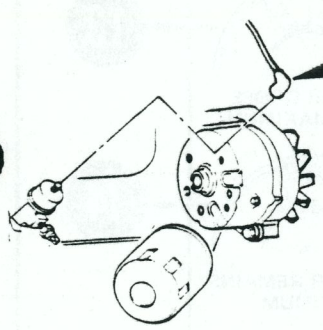
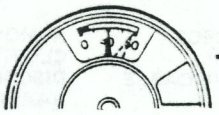
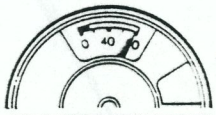
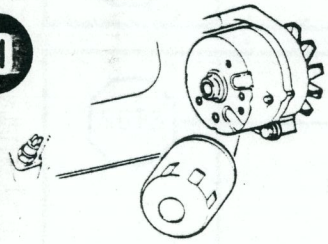
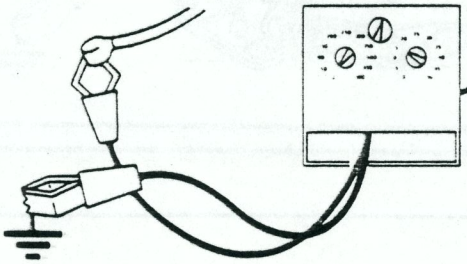
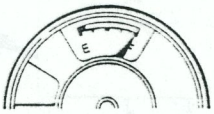
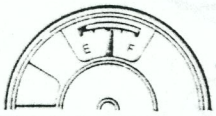
80315A

Chart 5

STEP	SEQUENCE	RESULT
4	● REMOVE CLUSTER ● DO NOT DISCONNECT INSTRUMENT CLUSTER WIRING CONNECTOR ● CHECK GAUGE NUTS FOR LOOSENESS AND CORROSION  CHECK FOR PRESENCE OF VOLTAGE AT GAUGE INPUT OK → VOLTAGE NOT PRESENT → REPLACE CIRCUIT BOARD OK → VOLTAGE PRESENT	STOP 5
5	 ● GROUND SENDING UNIT TERMINAL OF GAUGE POINTER MOVES POINTER DOES NOT MOVE → REPLACE GAUGE	6 STOP
6	 ● GROUND GAUGE PIN TERMINAL ON CIRCUIT BOARD POINTER MOVES → REPAIR OPEN CIRCUIT IN SENDING UNIT WIRE POINTER DOES NOT MOVE → REPLACE CIRCUIT BOARD	STOP STOP
7	CHECK GROUND STRAP ● BROKEN ● MISSING ● CORRODED ● SCREWS LOOSE, MISSING  OK → GROUND NOT OK OK → GROUND OK	8 9
8	REPAIR GROUND POINTER DROPS FROM MAXIMUM POINTER REMAINS AT MAXIMUM	STOP 9

80315B

Chart 5

STEP	SEQUENCE	RESULT
9	 DISCONNECT SENDING UNIT WIRE FROM SENDING UNIT	 POINTER DROPS FROM MAXIMUM → 10  POINTER REMAINS AT MAXIMUM → 12
10	  CONNECT ONE TESTER LEAD TO GROUND AND ONE LEAD TO SENDING UNIT WIRE ● TURN IGNITION SWITCH ON ● ADJUST TESTER TO SELECT OHM VALUES LISTED IN SENDING UNIT RESISTANCE CHART. OBSERVE GAUGE INDICATION AT EACH OHM SETTING.	OK → 11 GAUGE INDICATIONS NOT ACCURATE AT EACH OHM SETTING OK → STOP GAUGE INDICATIONS ACCURATE AT EACH OHM SETTING REPLACE SENDING UNIT
11	● OBSERVE FUEL GAUGE	 FUEL GAUGE POINTER IS AT MAXIMUM → STOP REPAIR CLUSTER GROUND OR REPLACE CVR  FUEL GAUGE POINTER INDICATES NORMALLY → STOP REPLACE OIL PRESSURE GAUGE

80315C

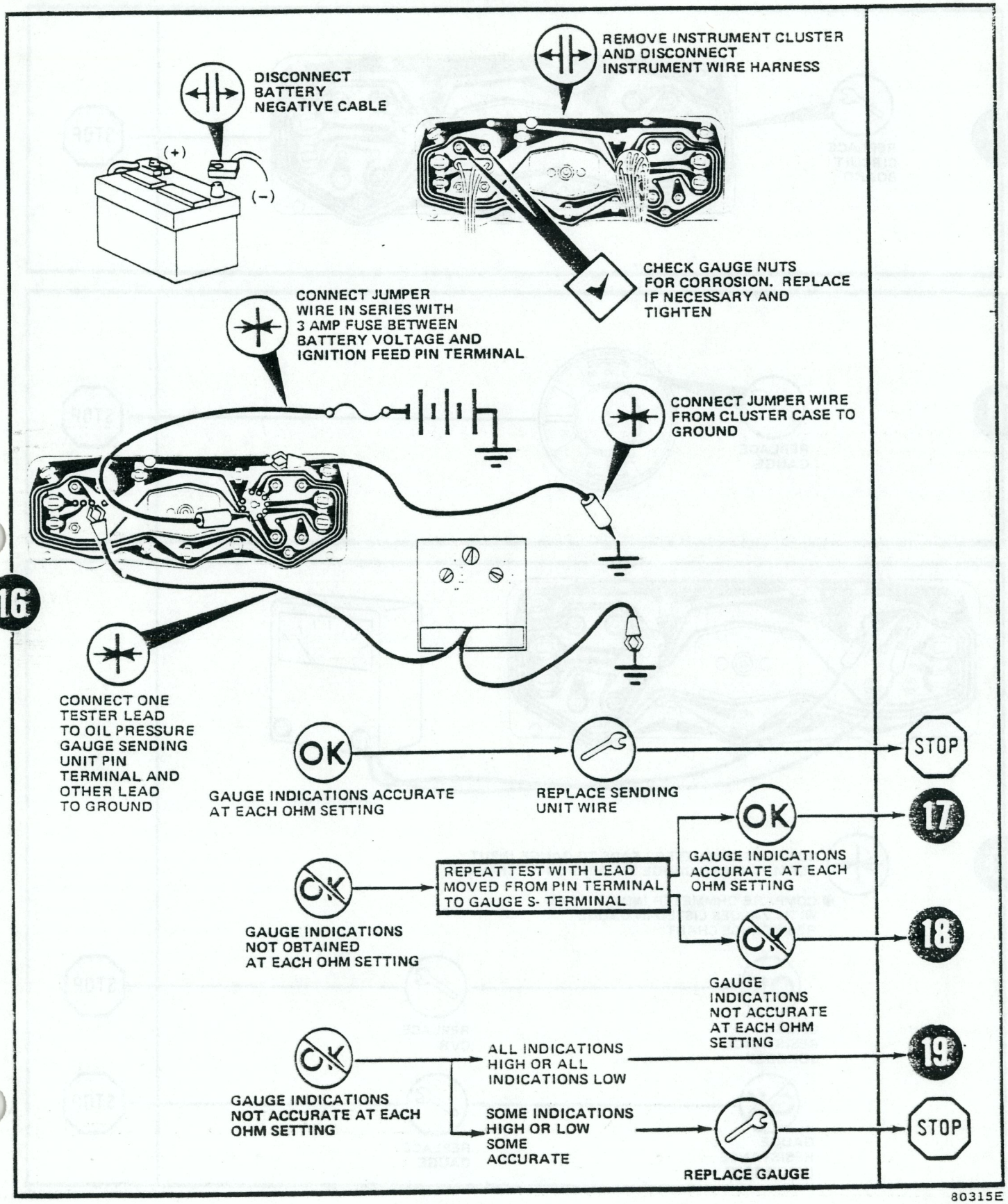
Chart 5

STEP	SEQUENCE	RESULT
12	DISCONNECT BATTERY NEGATIVE CABLE REMOVE INSTRUMENT CLUSTER. DO NOT DISCONNECT WIRE HARNESS CONNECT JUMPER WIRE BETWEEN CLUSTER GROUND AND BODY CONNECT BATTERY NEGATIVE CABLE	POINTER DROPS FROM MAXIMUM → 13 POINTER REMAINS AT MAXIMUM → 14
13	REPAIR INSTRUMENT PANEL GROUND	STOP
14	DISCONNECT SENDING UNIT WIRE FROM CLUSTER	POINTER DROPS FROM MAXIMUM → REPAIR OR REPLACE SENDING UNIT WIRE → STOP POINTER REMAINS AT MAXIMUM → REPLACE CIRCUIT BOARD → STOP
15	DISCONNECT SENDING UNIT WIRE CONNECT ONE TESTER LEAD TO GROUND AND ONE LEAD TO SENDING UNIT WIRE ● TURN IGNITION SWITCH ON ● ADJUST TESTER TO SELECT OHM VALUES LISTED IN SENDING UNIT RESISTANCE CHART. OBSERVE FUEL GAUGE INDICATION AT EACH OHM SETTING.	GAUGE INDICATIONS NOT ACCURATE AT EACH OHM SETTING → OK → 16 GAUGE INDICATIONS ACCURATE AT EACH OHM SETTING → OK → REPLACE SENDING UNIT → STOP

80315D

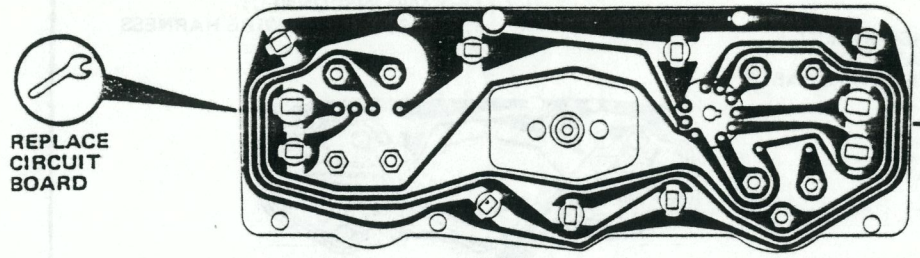
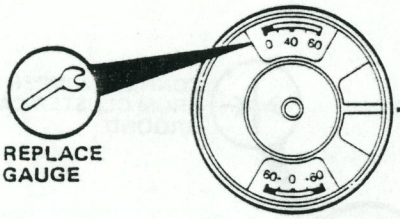
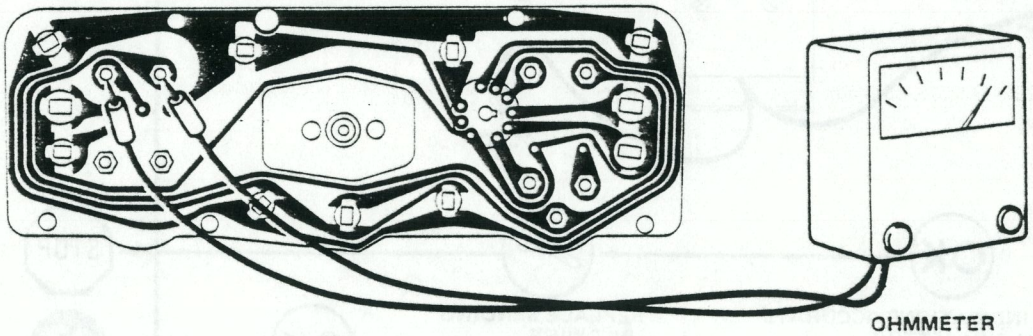
Chart 5

STEP SEQUENCE RESULT



80315E

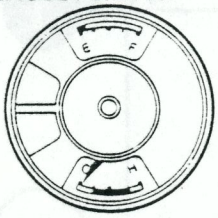
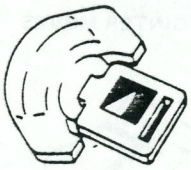
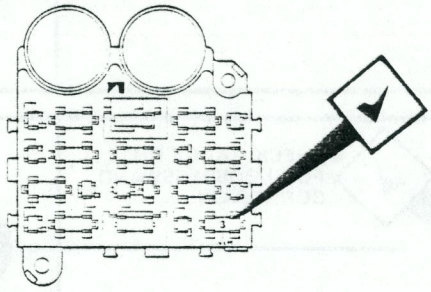
Chart 5

STEP	SEQUENCE	RESULT
17	 REPLACE CIRCUIT BOARD	STOP
18	 REPLACE GAUGE	STOP
19	 OHMMETER CONNECT OHMMETER LEADS TO GAUGE INPUT TERMINAL AND GAUGE SENDING UNIT TERMINAL ● COMPARE OHMMETER INDICATIONS WITH VALUES LISTED IN GAUGE RESISTANCE CHART OK — GAUGE RESISTANCE CORRECT → REPLACE CVR → STOP OK — GAUGE RESISTANCE INCORRECT → REPLACE GAUGE → STOP	

80315F

PROBLEM: COOLANT TEMPERATURE GAUGE NOT FUNCTIONING PROPERLY

Chart 6

STEP	SEQUENCE	RESULT
1	● NOTE POSITION OF COOLANT TEMPERATURE GAUGE POINTER ● TURN IGNITION SWITCH ON AND WAIT 2 MINUTES FOR GAUGE TO WARM UP ● OBSERVE POINTER	
	 	POINTER DOES NOT MOVE → 2
		POINTER MOVES → 17
	BEFORE STARTING TEST: ENGINE MUST BE WARM FUEL TANK MUST BE NEITHER COMPLETELY FULL NOR COMPLETELY EMPTY	POINTER MOVES TO MAXIMUM AND STAYS → 9
		POINTER PULSATES MORE THAN WIDTH OF POINTER → REPLACE CVR → STOP
2	 CHECK 3-AMP FUSE AT FUSE PANEL	FUSE BLOWN → GO TO CHART 2 STEP 1
		FUSE NOT BLOWN → 3
3	● OBSERVE FUEL GAUGE	FUEL GAUGE POINTER DOES NOT MOVE → GO TO CHART 3 STEP 1
		FUEL GAUGE POINTER INDICATES PROPERLY → CJ MODELS → 4
		FUEL GAUGE POINTER INDICATES PROPERLY → CHEROKEE WAGONEER TRUCK MODELS → 6

80316A

Chart 6

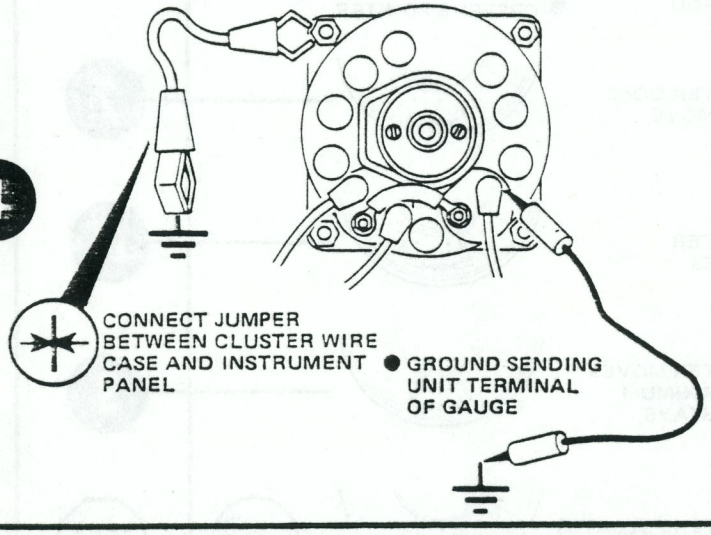
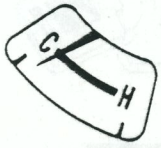
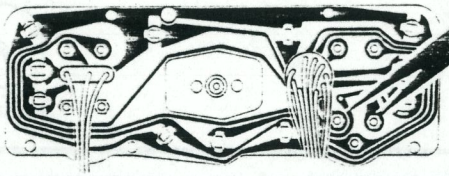
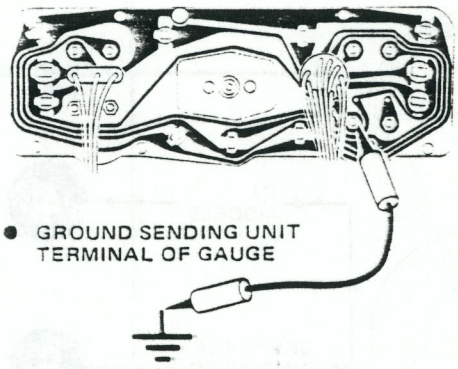
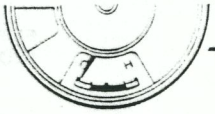
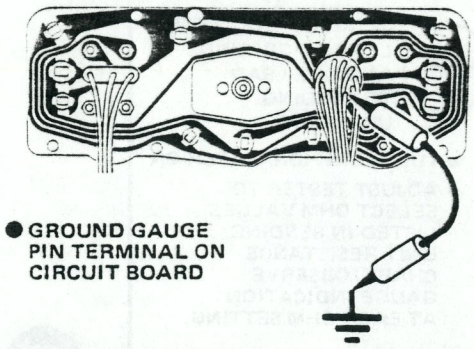
STEP	SEQUENCE	RESULT
4	● REMOVE CLUSTER ● LEAVE INSTRUMENT WIRES ATTACHED  CONNECT JUMPER BETWEEN CLUSTER WIRE CASE AND INSTRUMENT PANEL ● GROUND SENDING UNIT TERMINAL OF GAUGE	 POINTER MOVES → 5  POINTER DOES NOT MOVE → REPLACE GAUGE → STOP
5	LOCATE AND REPAIR OPEN CIRCUIT IN SENDING UNIT WIRE	STOP
6	● REMOVE CLUSTER ● DO NOT DISCONNECT INSTRUMENT CLUSTER WIRING CONNECTOR  ● CHECK GAUGE NUTS FOR LOOSENESS AND CORROSION	7
7	 ● GROUND SENDING UNIT TERMINAL OF GAUGE	 POINTER MOVES → 8  POINTER DOES NOT MOVE → REPLACE GAUGE → STOP

Chart 6

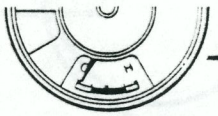
STEP | SEQUENCE | RESULT

8



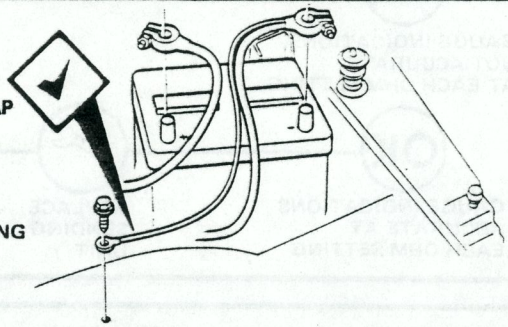
● GROUND GAUGE PIN TERMINAL ON CIRCUIT BOARD

POINTER MOVES → REPAIR OPEN CIRCUIT IN SENDER WIRE → STOP



POINTER DOES NOT MOVE → REPLACE CIRCUIT BOARD → STOP

9



CHECK GROUND STRAP

- BROKEN
- MISSING
- CORRODED
- SCREWS LOOSE, MISSING

OK → GROUND NOT OK → **10**

OK → GROUND OK → **11**

10

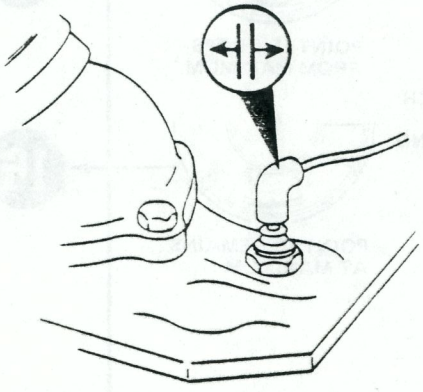
REPAIR GROUND

POINTER DROPS FROM MAXIMUM → STOP

POINTER REMAINS AT MAXIMUM → **11**

11

DISCONNECT SENDING UNIT WIRE FROM SENDING UNIT



POINTER DROPS FROM MAXIMUM → **12**

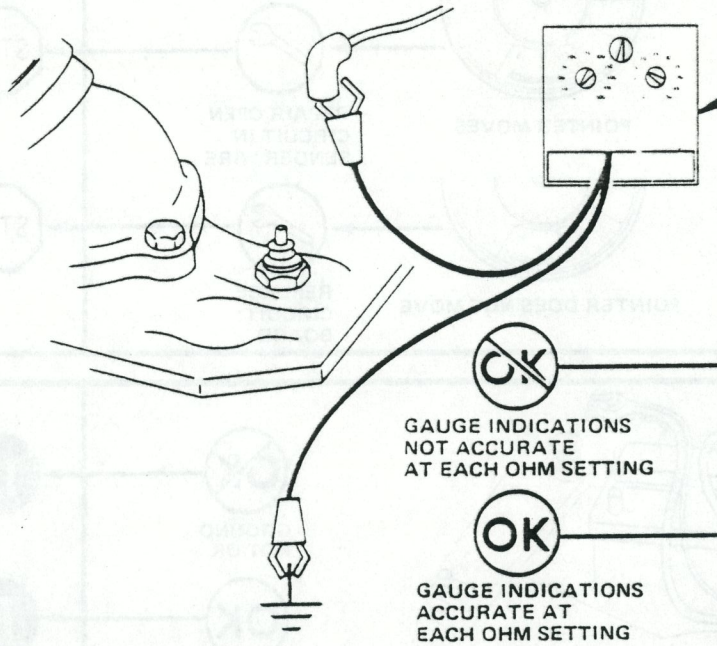
POINTER REMAINS AT MAXIMUM → **14**

80316C

Chart 6

STEP | SEQUENCE | RESULT

12



CONNECT ONE TESTER LEAD TO GROUND AND ONE LEAD TO SENDING UNIT WIRE

- TURN IGNITION SWITCH ON
- ADJUST TESTER TO SELECT OHM VALUES LISTED IN SENDING UNIT RESISTANCE CHART. OBSERVE GAUGE INDICATION AT EACH OHM SETTING.

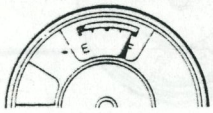
OK → GAUGE INDICATIONS NOT ACCURATE AT EACH OHM SETTING → **13**

OK → GAUGE INDICATIONS ACCURATE AT EACH OHM SETTING → REPLACE SENDING UNIT → STOP

13

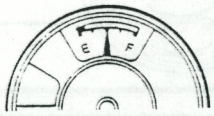
- OBSERVE FUEL GAUGE

FUEL GAUGE POINTER IS AT MAXIMUM



→ REPAIR CLUSTER GROUND OR REPLACE CVR → STOP

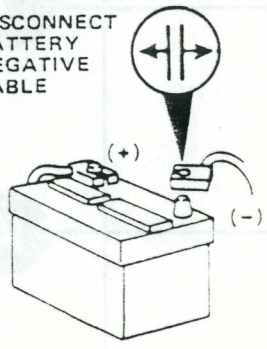
FUEL GAUGE POINTER INDICATES NORMALLY



→ REPLACE TEMPERATURE GAUGE → STOP

14

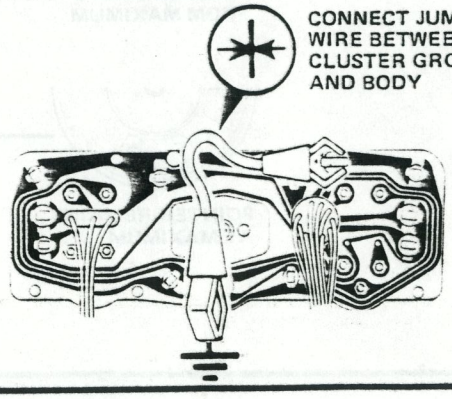
DISCONNECT BATTERY NEGATIVE CABLE



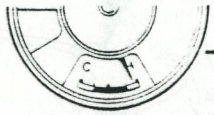
REMOVE INSTRUMENT CLUSTER. DO NOT DISCONNECT WIRE HARNESS

CONNECT BATTERY NEGATIVE CABLE

CONNECT JUMPER WIRE BETWEEN CLUSTER GROUND AND BODY



POINTER DROPS FROM MAXIMUM → **15**



POINTER REMAINS AT MAXIMUM → **16**

80316D

Chart 6

STEP | SEQUENCE | RESULT

15

REPAIR INSTRUMENT PANEL GROUND → STOP

16

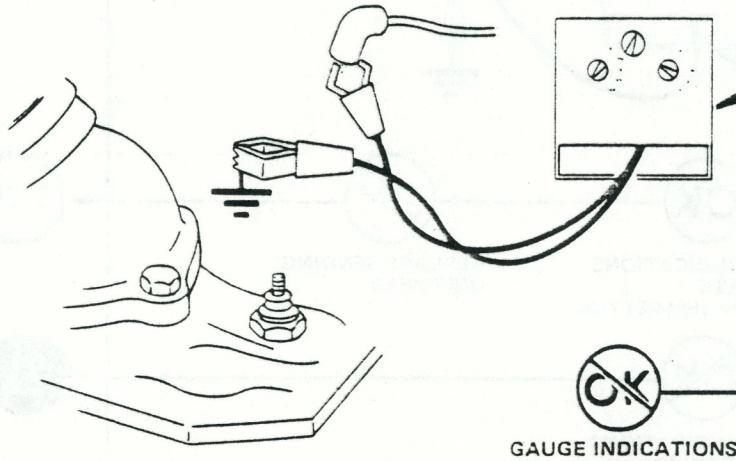
DISCONNECT SENDING UNIT WIRE FROM CLUSTER

POINTER DROPS FROM MAXIMUM → REPAIR OR REPLACE SENDING UNIT WIRE → STOP

POINTER REMAINS AT MAXIMUM → REPLACE GAUGE (CJ) → STOP

POINTER REMAINS AT MAXIMUM → REPLACE CIRCUIT BOARD (CHEROKEE, WAGONEER, TRUCK) → STOP

17



CONNECT ONE TESTER LEAD TO GROUND AND ONE LEAD TO SENDING UNIT WIRE

- TURN IGNITION SWITCH ON
- ADJUST TESTER TO SELECT OHM VALUES LISTED IN SENDING UNIT RESISTANCE CHART. OBSERVE GAUGE INDICATION AT EACH OHM SETTING

O.K. GAUGE INDICATIONS NOT ACCURATE AT EACH OHM SETTING → CJ → **18**

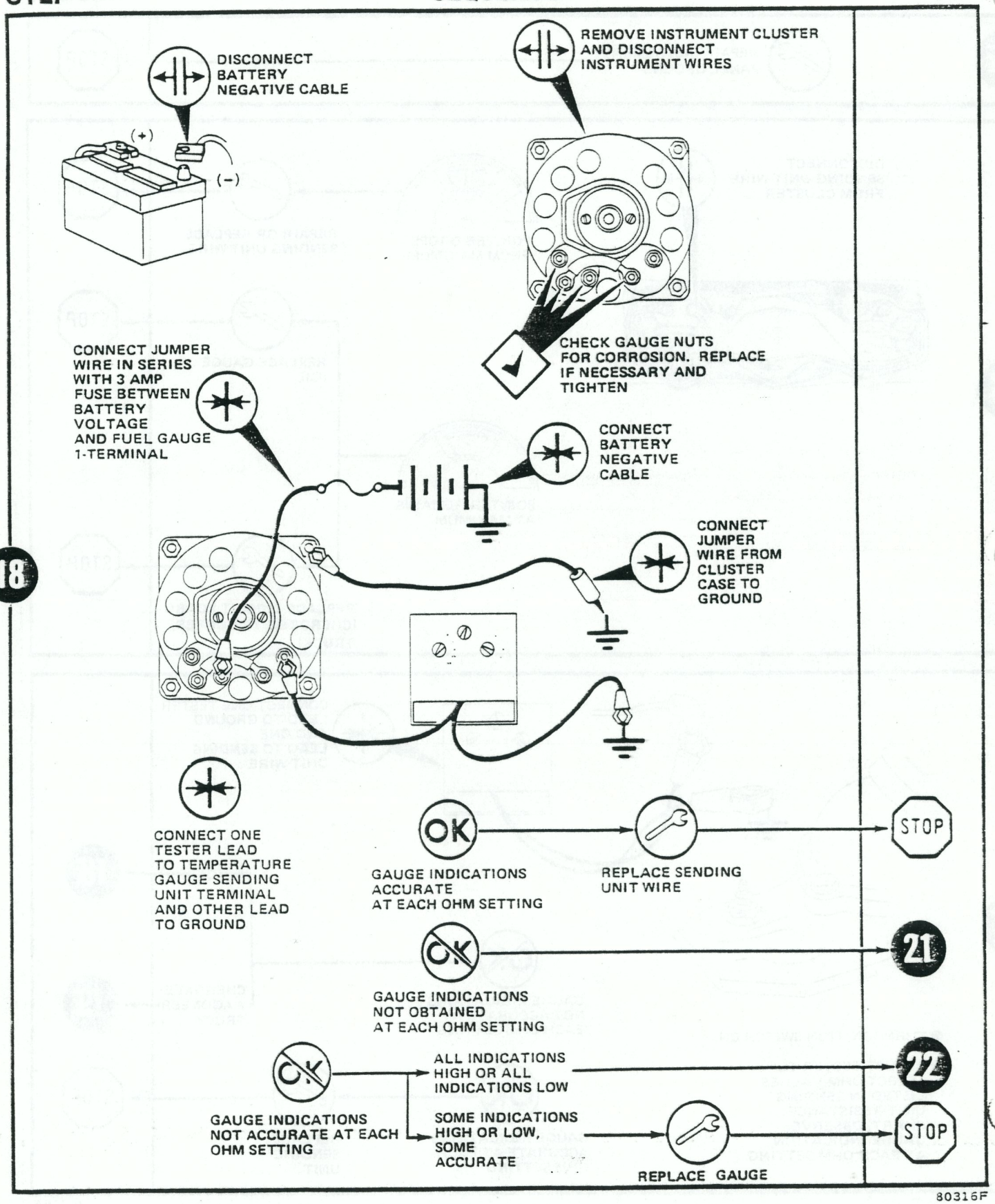
O.K. GAUGE INDICATIONS NOT ACCURATE AT EACH OHM SETTING → CHEROKEE WAGONEER TRUCK → **19**

OK GAUGE INDICATIONS ACCURATE AT EACH OHM SETTING → REPLACE SENDING UNIT → STOP

80316E

Chart 6

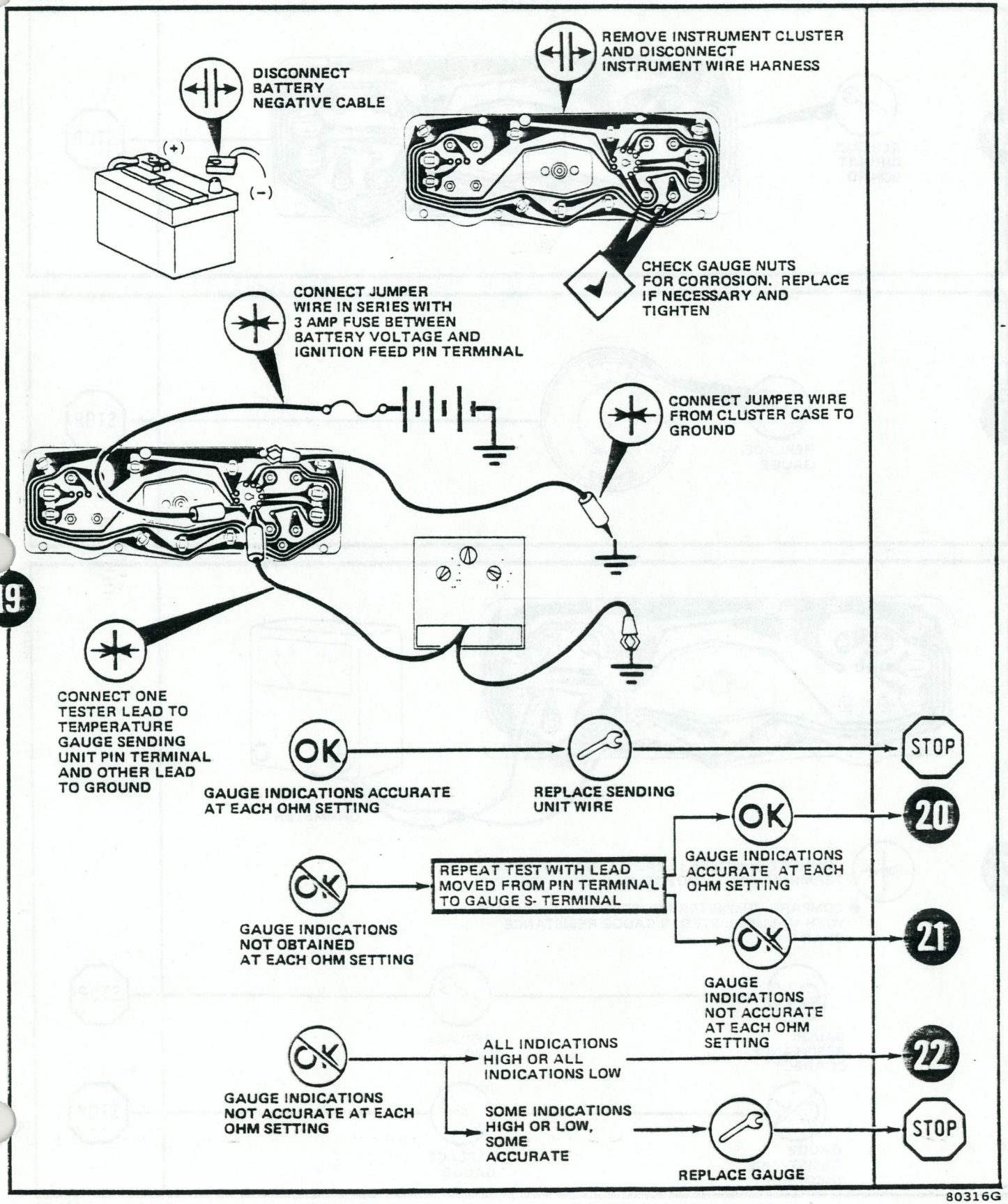
STEP | SEQUENCE | RESULT



80316F

Chart 6

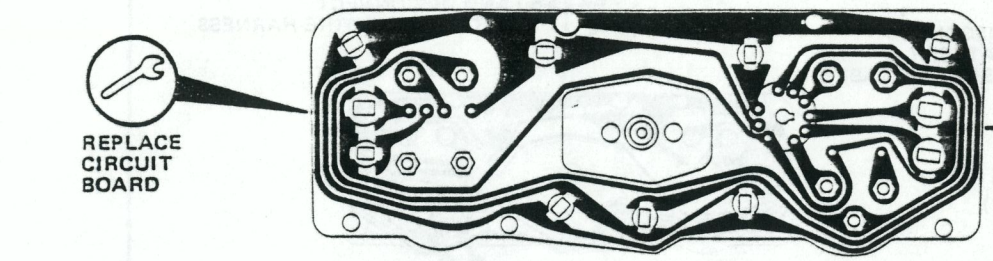
STEP | SEQUENCE | RESULT

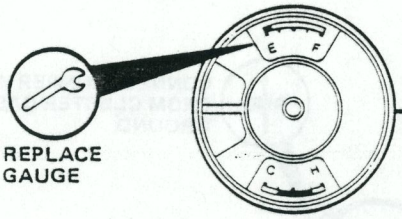


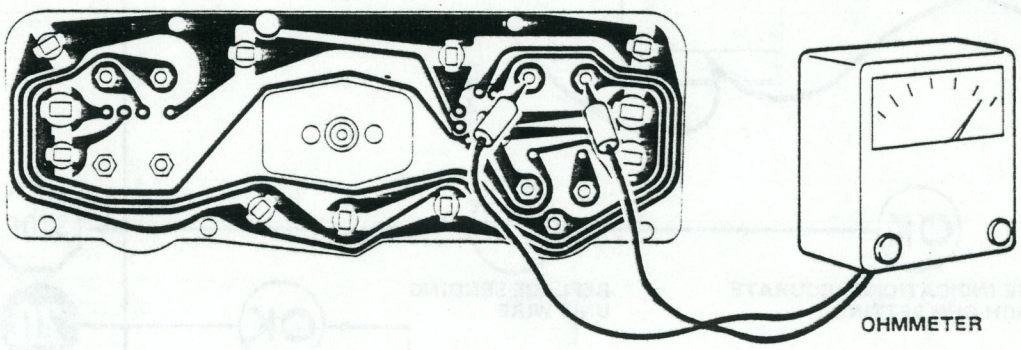
80316G

Chart 6

STEP	SEQUENCE	RESULT
20	REPLACE CIRCUIT BOARD	STOP
21	REPLACE GAUGE	STOP
22	CONNECT OHMMETER LEADS TO GAUGE INPUT TERMINAL AND GAUGE SENDING UNIT TERMINAL ● COMPARE OHMMETER RESISTANCE INDICATIONS WITH VALUES LISTED IN GAUGE RESISTANCE CHART	
	OK — GAUGE RESISTANCE CORRECT	REPLACE CVR — STOP
	OK — GAUGE RESISTANCE INCORRECT	REPLACE GAUGE — STOP







80316H

SPECIFICATIONS

	Page		Page
Schematics—Cherokee-Wagoneer-Truck Vehicles	1L-46	Specifications—Cherokee-Wagoneer-Truck Vehicles	1L-45
Schematics—CJ Vehicles	1L-42	Specifications—CJ Vehicles	1L-41

SPECIFICATIONS—CJ VEHICLES

Fuel Gauge Sending Unit Resistance (Ohms)

E	1/2	F
73	23	10

80670

Fuel Gauge Resistance (Internal)

TEST POINTS	OHMS
S to Ground	68 to 72
S to I	19 to 21
S to A	19 to 21
I to A	ZERO
I to Ground	49 to 51
A to Ground	49 to 51

80671

Oil Pressure Gauge Sending Unit Resistance (Ohms)

PSI	0	20	40	60	80
OHMS	234-246	149-157	100.5-105.5	65-69	32.5-34.5

80672

Coolant Temperature Gauge Resistance (Internal)

S to A	19 to 21 ohms

80673

Coolant Temperature Gauge Sending Unit Resistance (Ohms)

C	BEGINNING OF BAND	END OF BAND	H
73	36	13	9

80674

Tachometer Calibrations (RPM)

ACTUAL	INDICATED
500	380 to 620
1500	1380 to 1620
4500	4330 to 4620

80675

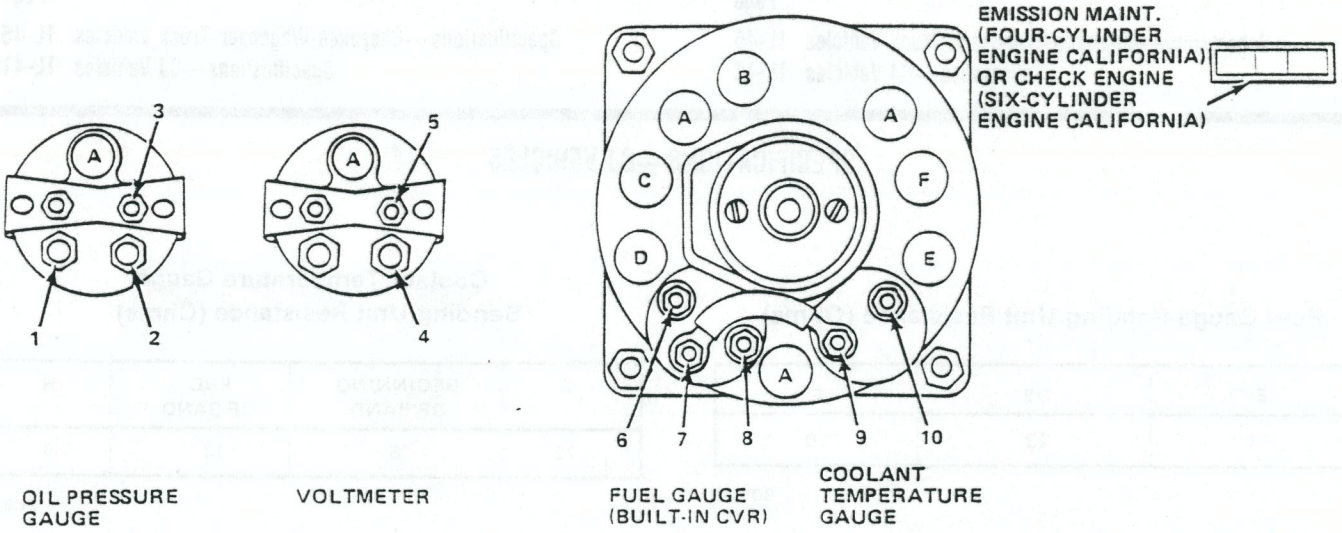
Voltmeter Calibrations (Volts)

ACTUAL	INDICATED
12.4	11.7 to 12.3
14.4	13.8 to 14.2

NOTE: Indicated Voltage Observed from Drivers Seat

80676

SCHEMATICS—CJ VEHICLES



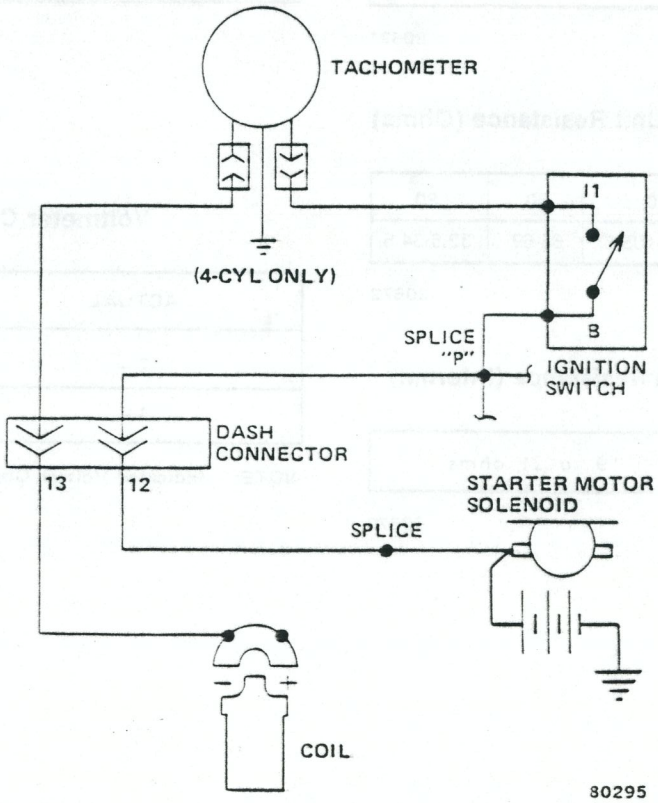
TERMINAL STUDS

1. OIL PRESSURE GAUGE S-TERMINAL
2. OIL PRESSURE GAUGE I-TERMINAL
3. OIL PRESSURE GAUGE GROUND
4. VOLTMETER +-TERMINAL
5. VOLTMETER GROUND
6. FUEL GAUGE S-TERMINAL
7. FUEL GAUGE A-TERMINAL
8. FUEL GAUGE I-TERMINAL
9. COOLANT TEMPERATURE GAUGE S-TERMINAL
10. COOLANT TEMPERATURE GAUGE A-TERMINAL

LAMPS

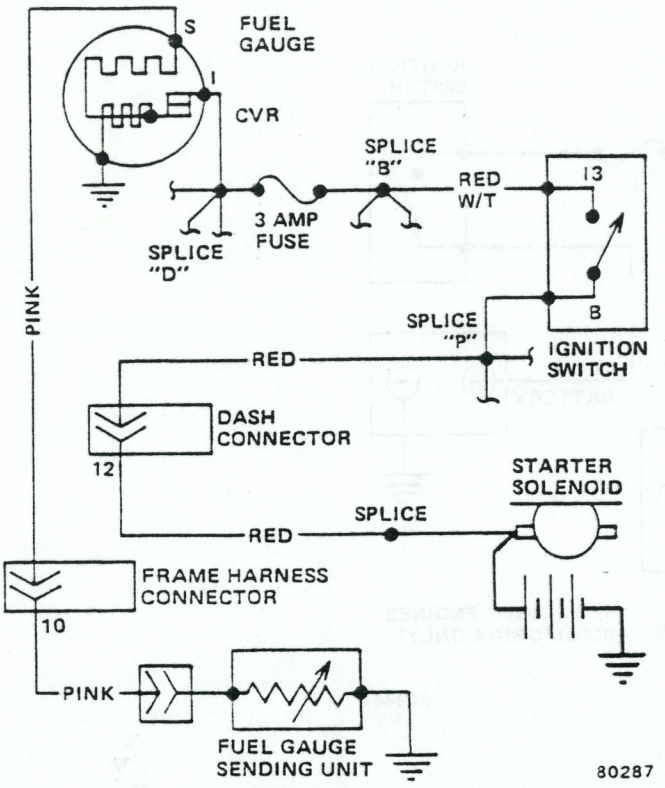
A ILLUMINATION
B HIGH BEAM
C RIGHT TURN
D FOUR-WHEEL DRIVE
E BRAKE
F LEFT TURN

80125

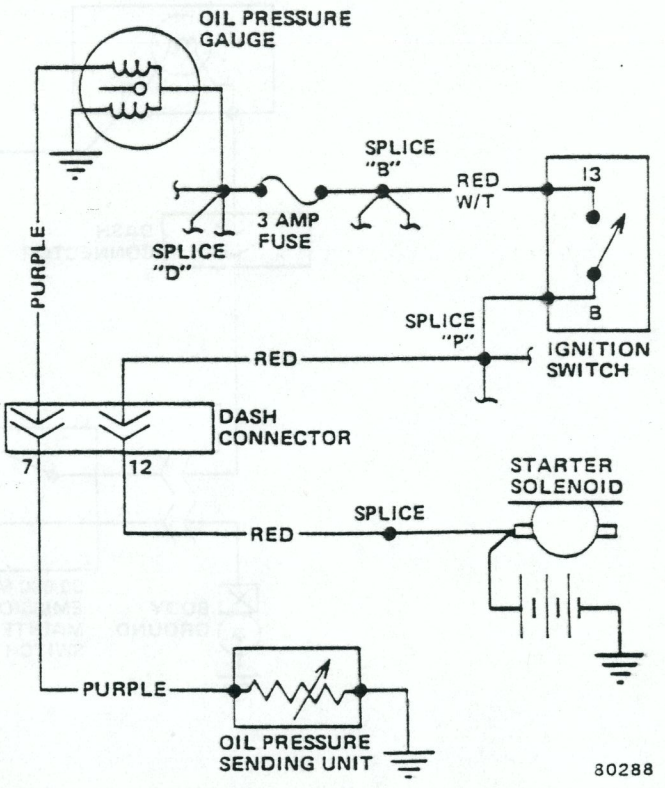


80295

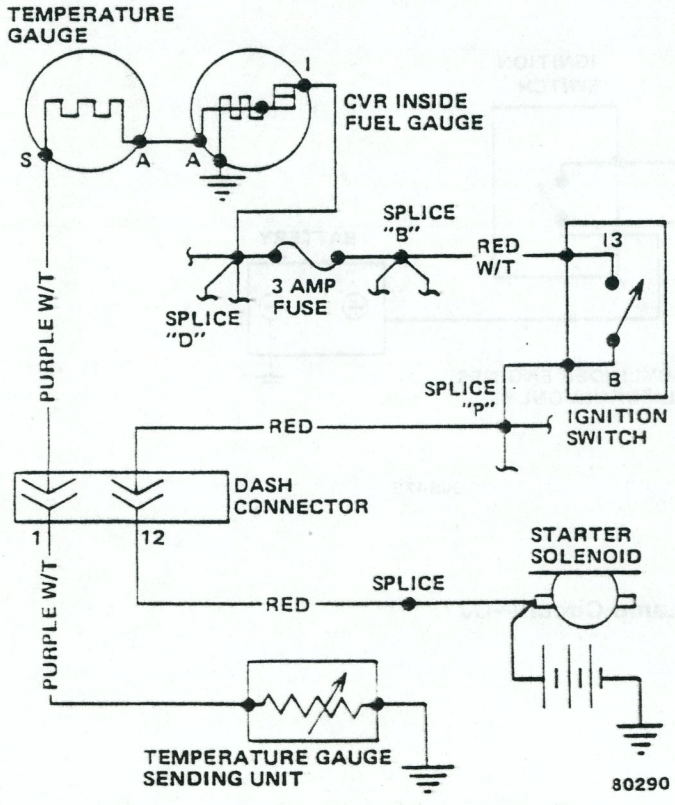
Tachometer Circuit—CJ (Typical)



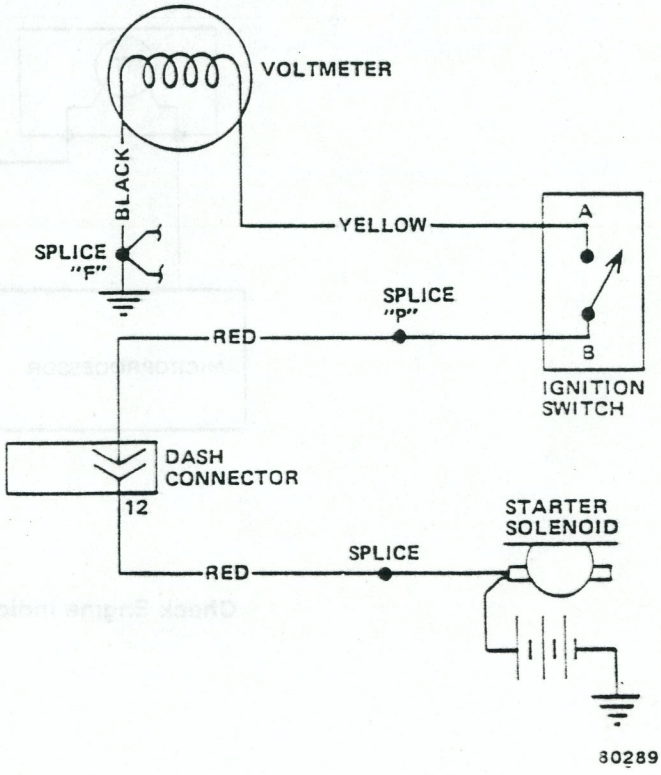
Fuel Gauge Circuit—CJ



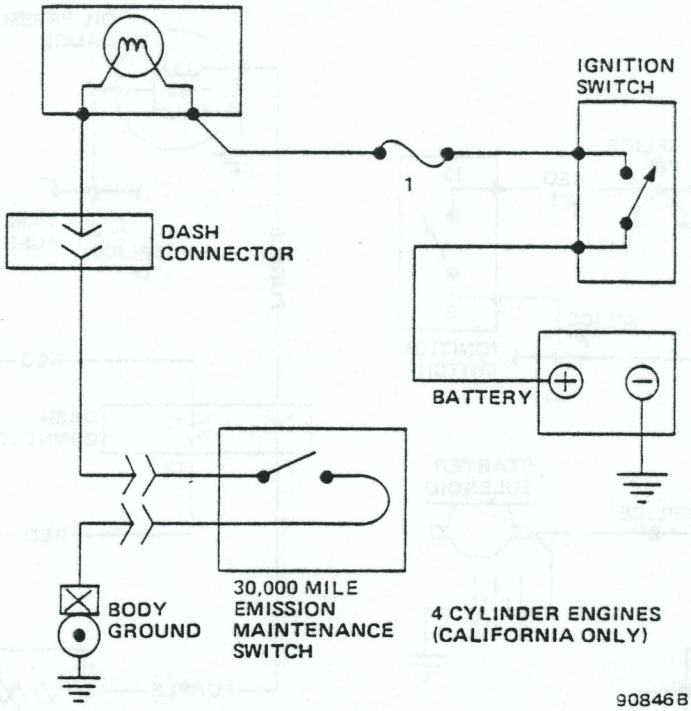
Oil Pressure Gauge Circuit—CJ



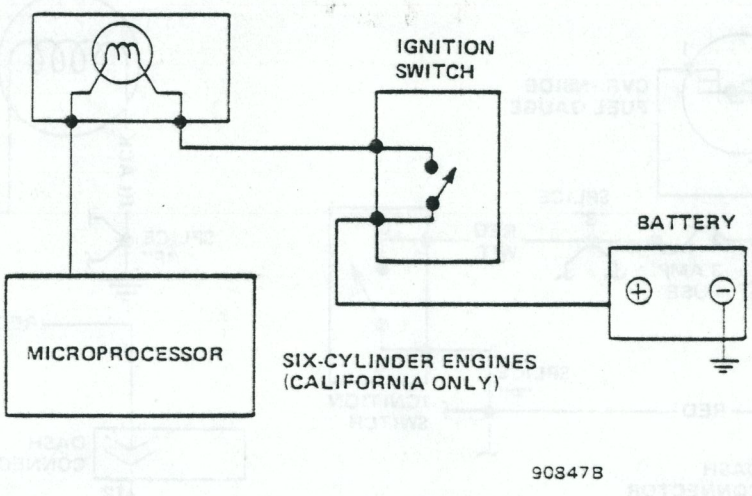
Coolant Temperature Gauge Circuit—CJ



Voltmeter Circuit—CJ



Emission Maintenance Indicator Lamp Circuit—CJ



Check Engine Indicator Lamp Circuit—CJ

SPECIFICATIONS—CHEROKEE-WAGONEER-TRUCK VEHICLES

Ammeter Calibrations

ACTUAL	INDICATED
-60	-48 to -72
0	0± Pointer Width
+60	+48 to +72

80677

Fuel Gauge Sending Unit Resistance (Ohms)

E	1/2	F
61	23	10.3

80670

Fuel Gauge Resistance (Internal)

S to A	19 to 21 ohms

80673

Oil Pressure Gauge Sending Unit Resistance (Ohms)

PSI	0	10	60	80
OHMS	69-77	35-38	13-15	9.5-10.5

80678

Coolant Temperature Gauge Sending Unit Resistance (Ohms)

C	BEGINNING OF BAND	END OF BAND	H
73	36	13	9

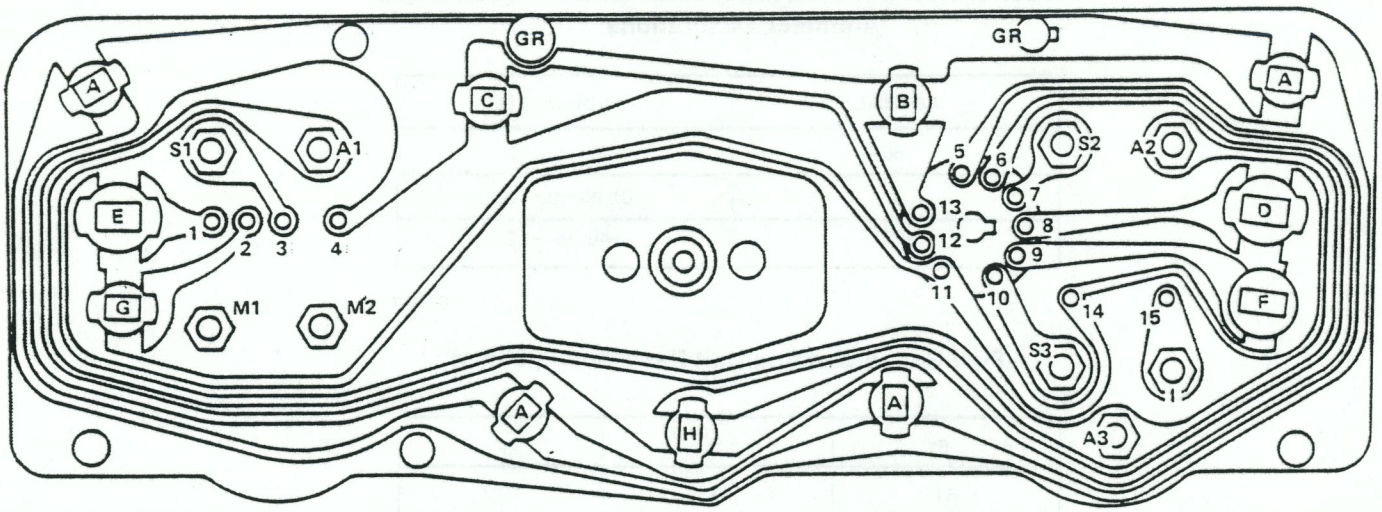
80674

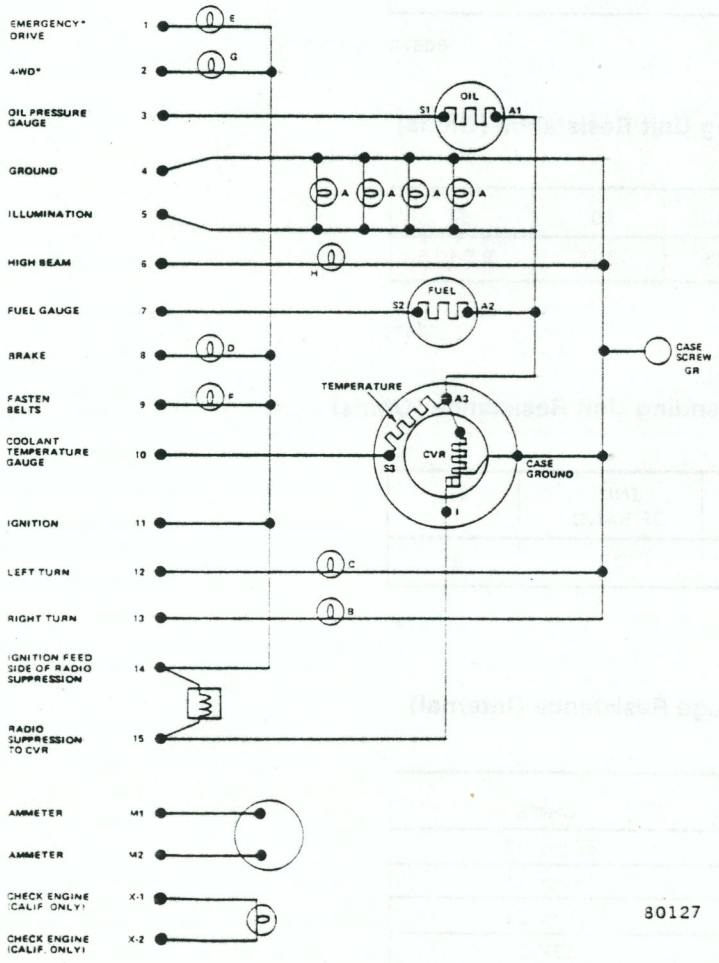
Coolant Temperature Gauge Resistance (Internal)

TEST POINTS	OHMS
S to Ground	68 to 72
S to I	19 to 21
S to A	19 to 21
I to A	ZERO
I to Ground	49 to 51
A to Ground	49 to 51

80671

SCHEMATICS—CHEROKEE-WAGONEER-TRUCK VEHICLES





80127

PIN TERMINALS

1. EMERGENCY DRIVE
2. 4-WHEEL DRIVE.
3. OIL PRESSURE GAUGE
4. GROUND
5. ILLUMINATION
6. HIGH BEAM
7. FUEL GAUGE
8. BRAKE
9. FASTEN BELTS
10. COOLANT TEMPERATURE GAUGE
11. IGNITION
12. LEFT TURN
13. RIGHT TURN
14. IGNITION FEED SIDE OF RADIO SUPPRESSION
15. RADIO SUPPRESSION TO CVR

LAMPS

A ILLUMINATION
B RIGHT TURN INDICATOR
C LEFT TURN INDICATOR
D BRAKE INDICATOR
E EMERGENCY DRIVE INDICATOR* (QUADRA TRAC)
F FASTEN BELT INDICATOR
G 4-WD REMINDER INDICATOR*(MODEL 208)
H HIGH BEAM INDICATOR

OTHER

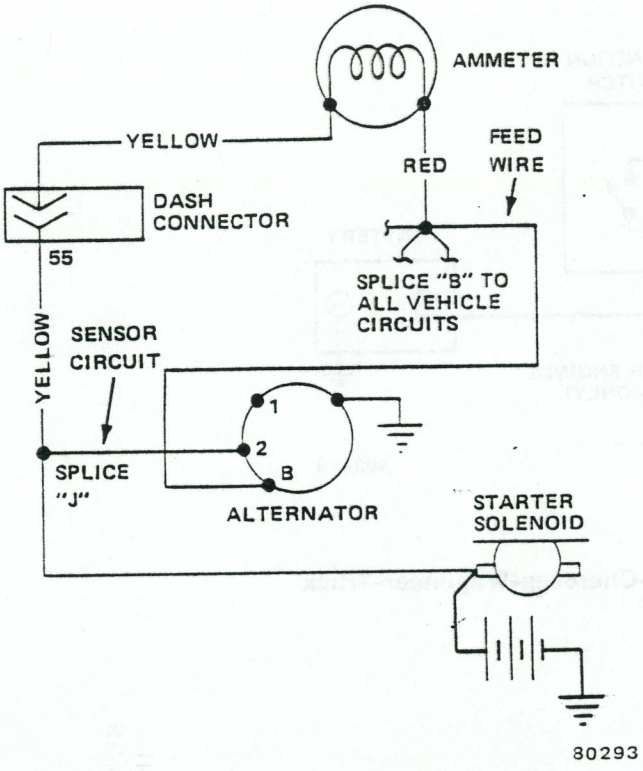
A1 OIL GAUGE A TERMINAL
S1 OIL GAUGE S TERMINAL
A2 FUEL GAUGE A TERMINAL
S2 FUEL GAUGE S TERMINAL
A3 TEMPERATURE GAUGE A TERMINAL
S3 TEMPERATURE GAUGE S TERMINAL
I CVR I TERMINAL (CVR INSIDE TEMPERATURE GAUGE)
M1 AMMETER STUD
M2 AMMETER STUD
GR GROUND SCREW
X-1 CHECK ENGINE LAMP**
X-2 CHECK ENGINE LAMP**

*Light used determined by type of transfer case installed. Lamp is plugged into applicable socket.

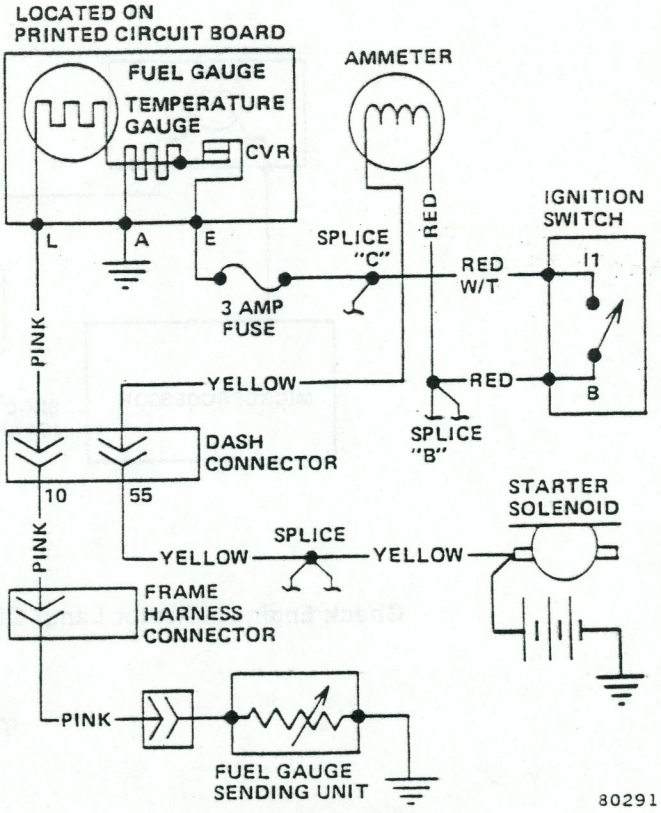
** California six-cylinder engines only

80126

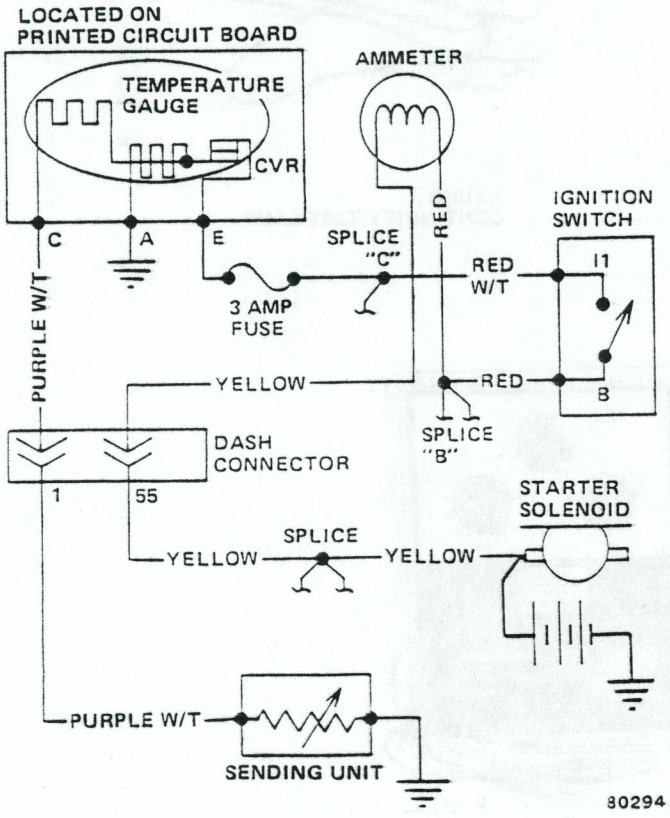
Instrument Printed Circuit Board Cluster and Schematic—Cherokee-Wagoneer-Truck



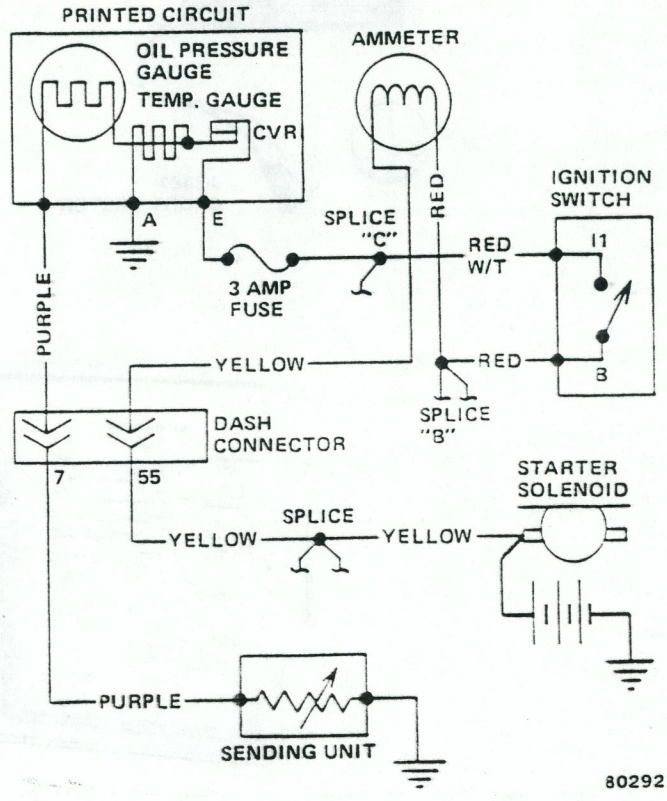
Ammeter Circuit—Cherokee-Wagoneer-Truck



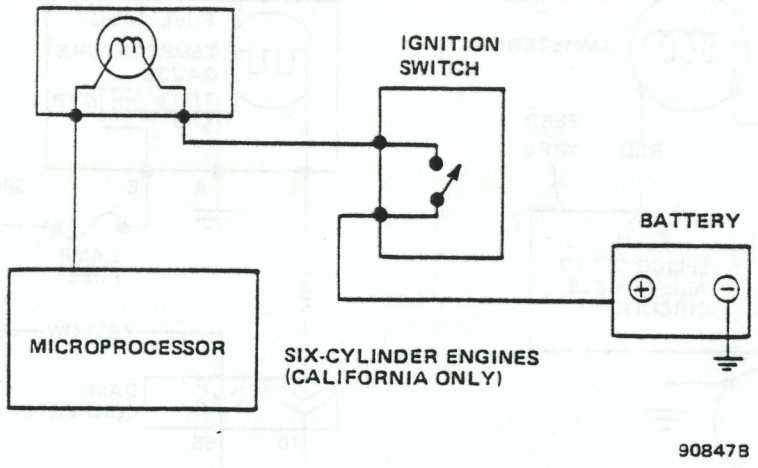
Fuel Gauge Circuit—Cherokee-Wagoneer-Truck



Coolant Temperature Gauge Circuit—Cherokee-Wagoneer-Truck

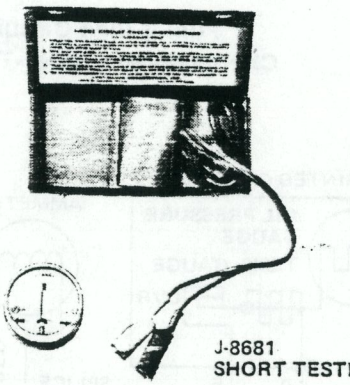


Oil Pressure Gauge Circuit—Cherokee-Wagoneer-Truck

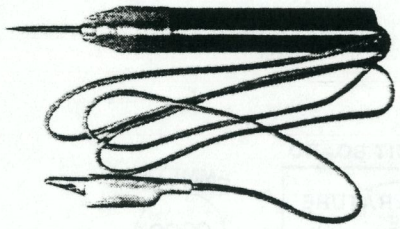


Check Engine Indicator Lamp Circuit—Cherokee-Wagoneer-Truck

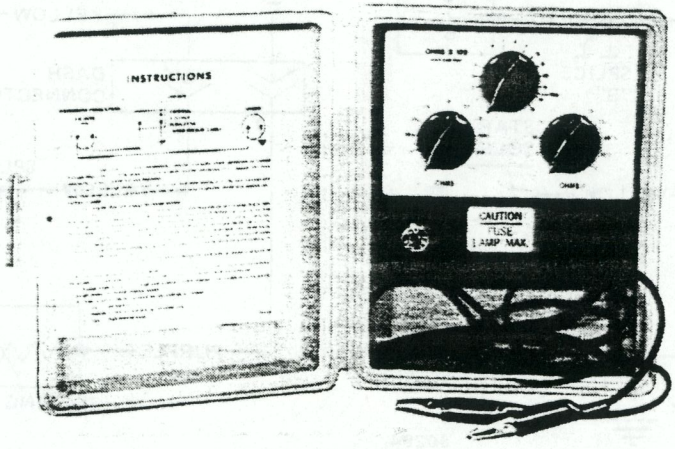
Tools



J-8681
SHORT TESTER



J-21008
CONTINUITY TEST LAMP



J-24538
UNIVERSAL
GAUGE TESTER

PART 2
CHASSIS

CHAPTER INDEX

Clutch 2
Manual Transmission 2
Automatic Transmission 2
Transfer Case 2
Propeller Shaft 2
Axles 2
Brakes 2
Wheels and Tires 2
Steering Columns 2
Manual Steering Gear 2
Power Steering Gear And Pump 2
Steering Linkage 2
Suspension 2

CLUTCH 2A

SECTION INDEX

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Clutch Service—Four-Cylinder CJ Models	2A-9		

GENERAL INFORMATION

	Page		Page
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Clutch Service	2A-2	Service Diagnosis	2A-2
Clutch Linkage	2A-8		

GENERAL

Six- and Eight-Cylinder Models

The clutch assembly used in six- or eight-cylinder CJ, Cherokee and Truck models consists of a single dry-disc driven plate and a spring and lever-type clutch cover (fig. 2A-1). Two clutch cover styles are used. A 10.5-inch (26.7 cm) diameter direct spring pressure cover is used in CJ models with six- or eight-cylinder engines. An 11.0-inch (27.9 cm) diameter semi-centrifugal cover is used on Cherokee and Truck models with an eight-cylinder engine. An 11.0-inch (27.9 cm) diameter direct spring pressure cover is used on six-cylinder Cherokee and Truck models.

Four-Cylinder CJ Models

The clutch assembly used in four-cylinder CJ models consists of a diaphragm-type clutch cover and a single dry-disc driven plate. The cover consists of a one-piece diaphragm spring with integral release fingers (fig. 2A-2). The driven plate consists of a steel hub with four integral cushion springs and the friction material which is riveted to the hub (fig. 2A-3). The clutch cover and driven plate diameter is 9.250 inches (23.5 cm).

Clutch Hydraulic System—Four-Cylinder CJ Models

A hydraulic-clutch operating system is used on CJ models equipped with the 2.5 liter four-cylinder engine (fig. 2A-4). The system consists of a clutch cylinder, a slave cylinder, and an interconnecting hydraulic line. The clutch cylinder is mounted on the dash panel next to the brake master cylinder. The slave cylinder is mounted on the clutch housing. The clutch cylinder is connected directly to the clutch pedal. The slave cylinder is connected to the throwout lever.

Clutch Hydraulic System Operation

When the clutch pedal is pressed down, hydraulic fluid from the clutch cylinder flows into the slave cylinder causing the slave cylinder push rod to extend. Since the push rod is connected to the throwout lever, the lever moves the throwout bearing into contact with the clutch cover release fingers to disengage the clutch.

NOTE: *On four-cylinder CJ models with the clutch hydraulic operating system, the clutch pedal must be fully depressed before complete clutch disengagement will occur.*

Clutch Hydraulic Fluid

The hydraulic fluid that operates the clutch hydraulic mechanism is contained in the clutch cylinder reservoir. When adding fluid to, or refilling the system after service operations, use AMC/Jeep brake fluid, or equivalent, marked SAE J-1703 or DOT 3 only. Do not use any type of mineral or paraffin base oils in the system. These fluids will damage the rubber parts in the clutch and slave cylinders.

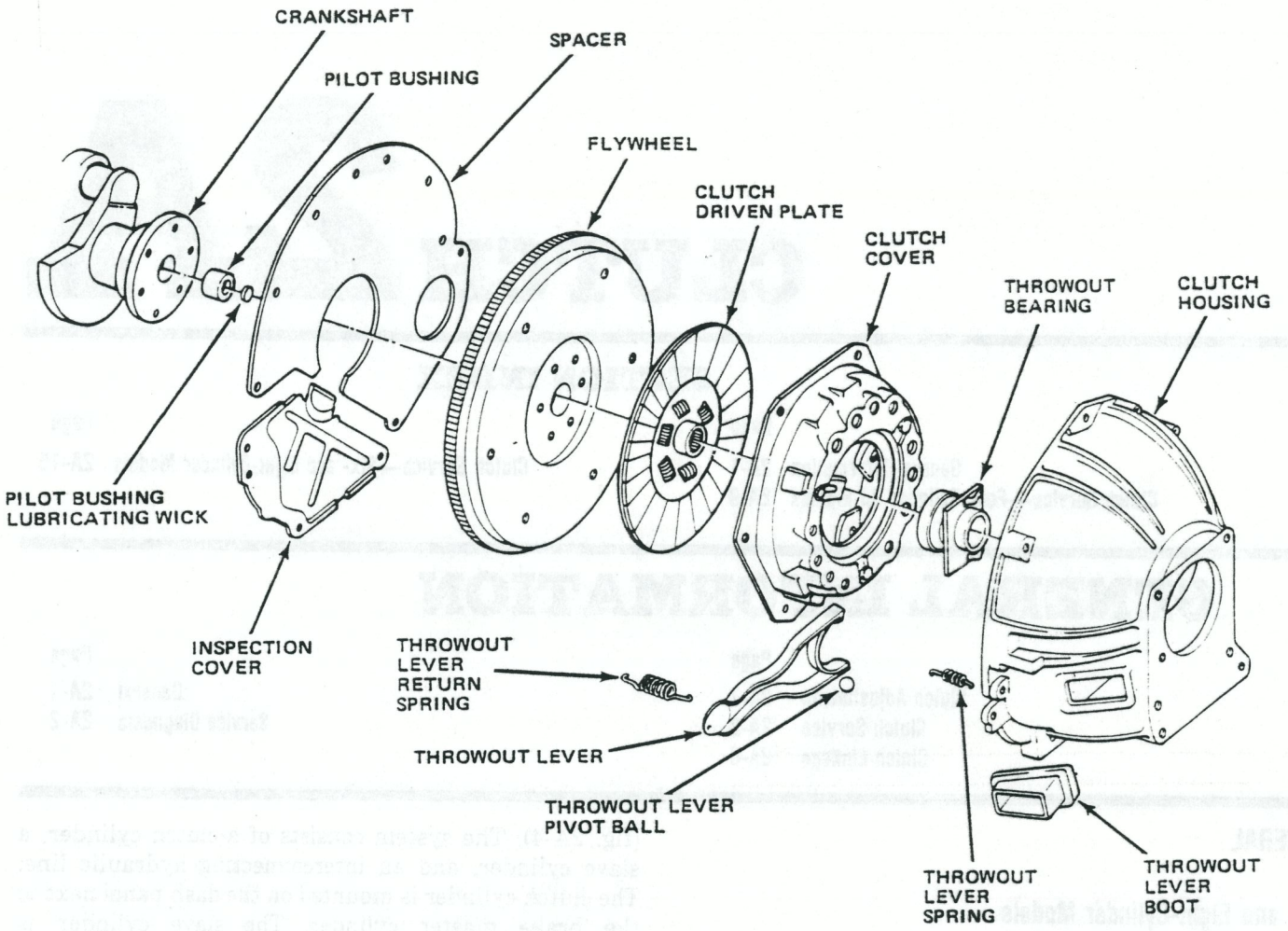

Fig. 2A-1 Clutch Assembly—Six- and Eight-Cylinder Models

Clutch Hydraulic Fluid Level

The desired fluid level is indicated on the side of the clutch cylinder. When refilling the system, fill the cylinder reservoir to the level indicated on the side of the reservoir only. Do not overfill the reservoir.

Throwout Bearing

CJ models equipped with the 2.5 liter four-cylinder engine use a throwout bearing that is similar to the bearing used on six- and eight-cylinder CJ, Cherokee and Truck models. The four-cylinder throwout bearing contact face is slightly crowned. The six- and eight-cylinder throwout bearing contact face is flat. Refer to figure 2A-4 for an illustration of bearing configuration.

CLUTCH SERVICE

On four-cylinder CJ models, the components that form the clutch hydraulic system are fully serviceable. Refer to the Clutch Service—Four-Cylinder CJ Models section for all necessary service procedures.

On all models the clutch cover, driven plate and throwout bearing are serviced as assemblies only. Do not attempt to disassemble any of these components to effect repairs. If any of these components are damaged or severely worn, replace the component as an assembly only.

SERVICE DIAGNOSIS

General

Clutch problems can generally be assigned to one of the following categories defined as:

- Clutch chatter
- Clutch slippage or inadequate clutch pedal free play
- Clutch drag or inadequate clutch release
- Clutch pedal pulsation
- Clutch-related vibration
- Clutch area noises

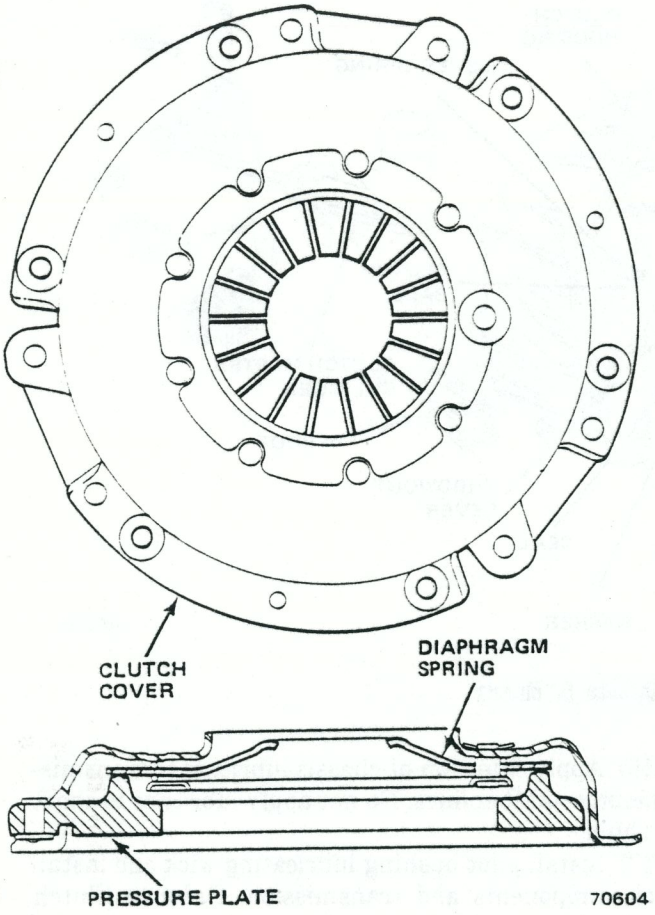

Fig. 2A-2 Clutch Cover—Four-Cylinder CJ Models

Each category is described in common complaint language and followed by simplified diagnosis and repair procedures.

NOTE: *Before performing any of the following diagnosis and repair procedures, adjust pedal free play on vehicles with six- and eight-cylinder engines and be sure the clutch pedal returns to the pedal stop completely. On four-cylinder CJ models, check the hydraulic cylinders and connecting line for damage and leakage.*

Clutch Chatter

Clutch chatter can be described as a shaking or shuddering sensation felt throughout the vehicle. Chatter usually develops when the clutch cover pressure plate makes initial contact with the driven plate and ceases when the clutch is fully engaged (clutch pedal released). Check clutch operation as follows:

WARNING: *The following test requires clutch engagement to the point of vehicle movement. Do not allow anyone to stand at the front or rear of the vehicle during this test.*

(1) Start engine, press clutch pedal to floor and shift transmission into first gear.

(2) Increase engine speed to 1200/1500 rpm and slowly release clutch pedal. When pressure plate makes initial contact with driven plate, note clutch operation. Press clutch pedal to floor and release accelerator pedal.

(3) Shift transmission into reverse and repeat procedure outlined in step (2).

(4) If clutch chatter does not develop in either gear range, increase engine speed to 1700/2200 rpm and repeat steps (2) and (3).

(5) If clutch chatter does not develop after performing tests outlined in steps (1) through (4), problem may be improper operation by owner. If clutch chatter does develop, proceed to next step.

(6) Raise vehicle on hoist.

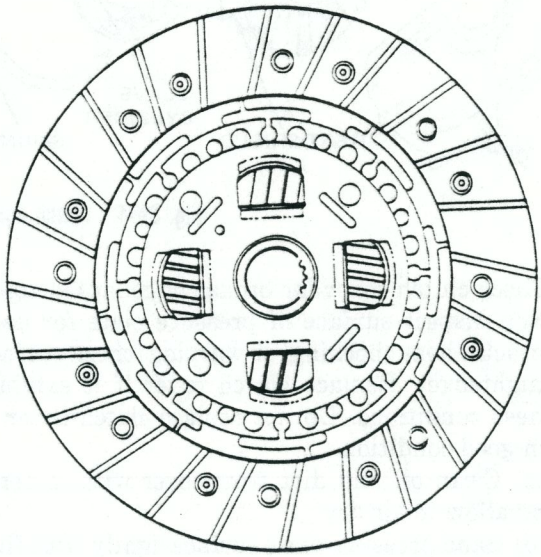

Fig. 2A-3 Clutch Driven Plate—Four-Cylinder CJ Models

(7) Check for loose or broken front or rear engine support cushions. Tighten or replace as necessary. Check for loose clutch housing-to-engine or housing adapter-to-transmission attaching bolts. Tighten as necessary. Refer to torque specifications in this section. Check for binding, worn, bent or broken clutch linkage components. Lubricate or replace as necessary.

(8) If components inspected are in good condition, proceed to next step. If one or more problems were discovered and corrected, lower vehicle and repeat step (1). If chatter is still evident, proceed to next step.

(9) Remove transmission and clutch components as outlined in this chapter.

NOTE: *Whenever the clutch components are removed, also remove the pilot bushing lubricating wick, soak the wick in engine oil and reinstall the wick before assembly.*

(10) Check for oil or grease contamination of driven plate. If contaminated, correct cause of contamination and replace driven plate.

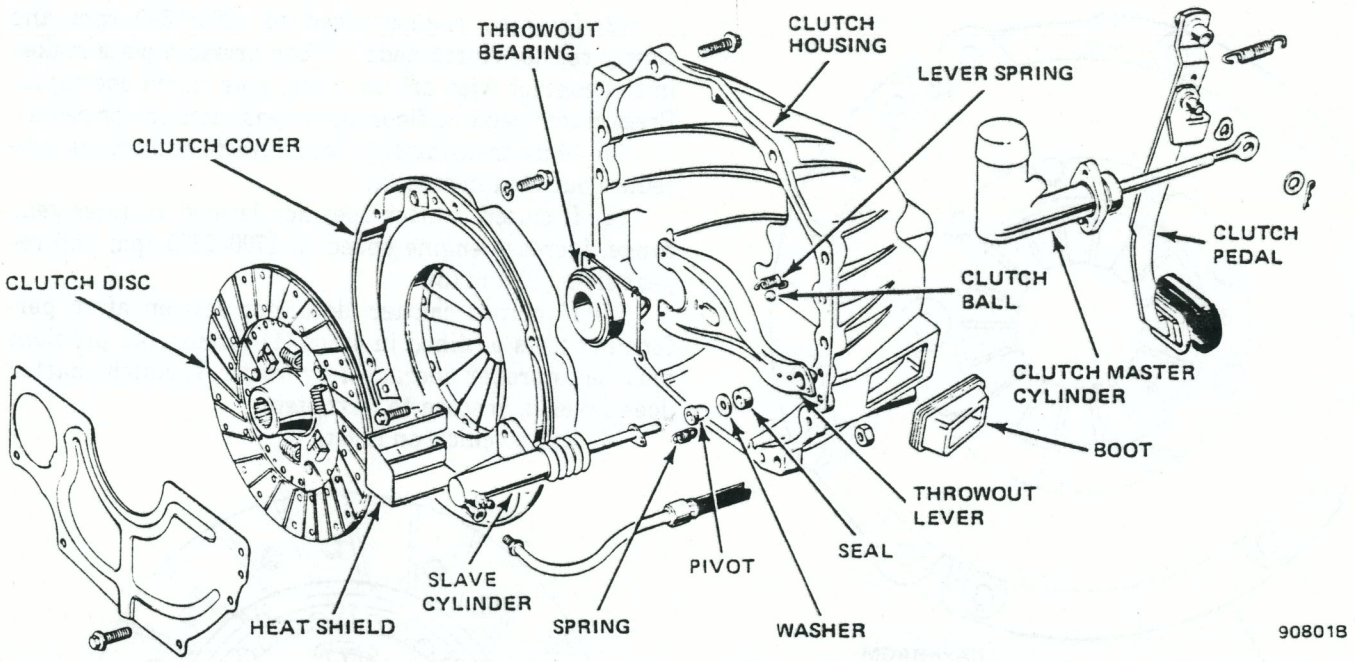

Fig. 2A-4 Clutch Assembly—Four-Cylinder CJ Models

(11) Check clutch cover for broken or collapsed apply springs and inspect surface of pressure plate for deep scoring, cracks, heat checking, or warping (check surface with straightedge). Replace clutch cover if it exhibits any of these conditions. Do not replace clutch cover if cover is in good condition.

(a) Clean oil and dirt from cover with mineral spirits and allow to air dry.

(b) Sand pressure plate surface lightly with fine emery cloth.

(c) Lubricate release lever pivots and check release lever height. Adjust height if necessary.

CAUTION: *Apply lubricant to pivots sparingly. Excessive lubrication could result in grease contamination of the pressure plate and driven plate surfaces.*

(12) Inspect crankshaft pilot bushing. Replace bushing if worn, deeply scored, or discolored.

NOTE: *Soak replacement bushing in engine oil before installation.*

(13) Inspect condition of splines on transmission clutch shaft and in driven plate hub. If splines are worn, galled, chipped or broken, replace clutch shaft or driven plate. Remove corrosion, rust, or burrs from splines using oilstone or fine-tooth file. Install driven plate on clutch shaft. Plate must move freely on shaft.

(14) If all clutch components are in good condition, proceed to next step. If one or more components were determined to be faulty, repair as necessary and proceed to next step.

(15) Check clutch housing alignment as outlined in this chapter. Correct alignment if necessary and proceed to next step.

(16) Apply thin film of chassis lubricant to transmission clutch shaft splines. Do not apply lubricant to shaft pilot hub.

(17) Install pilot bushing lubricating wick and install clutch components and transmission. Refer to Clutch Installation.

NOTE: *Do not replace the throwout bearing unless it is defective or damaged. Refer to Clutch Area Noises.*

Clutch Slippage Or Inadequate Clutch Linkage Free Play

Clutch slippage can be described as a condition in which the engine overspeeds but does not generate any increase in torque supplied to the wheels. Clutch slippage occurs when the driven plate is not gripped firmly between the flywheel and clutch cover pressure plate and rotates or slips between them at high torque. Clutch slippage can occur during initial acceleration or during subsequent shifts. Check clutch operation as follows:

(1) Block wheels and apply parking brake.

(2) Operate engine until it reaches normal operating temperature.

(3) Shift transmission into third gear and increase engine speed to 2000 rpm.

WARNING: *Do not permit anyone to stand in front of the vehicle during this test.*

(4) Slowly release clutch pedal until clutch is fully engaged.

CAUTION: *Do not allow the clutch to be engaged for more than 5 seconds at a time as the clutch components could be damaged.*

(5) If engine stalls within 5 seconds, clutch is not defective. If engine continues to run, proceed to next step.

(6) Raise vehicle on hoist. Check clutch linkage for binding, worn, broken, or bent components. Lubricate or replace as necessary. If all components inspected are in good operating condition, proceed to next step.

(7) If one or more problems were discovered and corrected during inspection in previous step, repeat steps (1) through (4). If clutch slippage is corrected, stop repair. If slippage persists, proceed to next step.

(8) Remove transmission and clutch components. Refer to Clutch Removal.

NOTE: *Whenever the transmission is removed, also remove the pilot bushing lubricating wick, soak the wick in engine oil, and reinstall the wick before assembly.*

(9) Inspect driven plate. If 1/16 inch (2 mm) or less friction material remains above rivet heads, or plate is severely glazed or contaminated with oil or grease, replace driven plate.

NOTE: *If the driven plate is contaminated, determine the cause and make correction before proceeding.*

(10) Inspect clutch cover. If cover is heat-checked, has broken or collapsed springs, or exhibits signs of overheating (e.g., has blue coloration), replace cover. If cover does not exhibit any of these conditions, do not replace it.

(a) Clean oil and dirt from cover using mineral spirits and allow cover to air dry.

(b) Sand pressure plate surface lightly using fine emery cloth.

(c) Lubricate cover release lever pivots and check and adjust release lever height as necessary.

CAUTION: *Apply lubricant to the pivots sparingly. Excessive lubrication could result in grease contamination of the driven plate and pressure plate surfaces.*

(11) Check throwout bearing mounting surface of transmission front bearing cap for galling, deep scores, or roughness. Install throwout bearing on bearing cap and check for smooth fore/aft movement. Replace bearing or bearing cap as necessary if bind occurs. Fill throwout bearing groove with chassis grease and apply thin coat of grease to bearing mounting surface of front bearing cap.

CAUTION: *The throwout bearing has retaining springs which position the bearing on the throwout lever. Check these springs for distortion, loss of tension, or for being bent or broken. Replace the bearing if these springs are damaged. Also, when installing the bearing, be sure the retaining projections on the throwout lever are properly engaged in the retaining holes in the bearing sleeve.*

NOTE: *Do not replace the throwout bearing unless it is actually defective or damaged. Refer to Clutch Area Noises.*

(12) Apply thin film of chassis grease to transmission clutch shaft splines. Do not apply grease to shaft pilot hub.

(13) Install pilot bushing and lubricating wick.

(14) Install clutch components and transmission. Refer to Clutch Installation.

(15) Lower vehicle.

Clutch Drag Or Inadequate Release

Clutch drag can be described as a condition in which the clutch driven plate, and consequently the transmission clutch shaft, does not come to a complete stop after the clutch pedal is depressed (clutch disengaged). Clutch drag can cause gear clash when shifting into reverse or hard or difficult shifting. Check clutch operation as follows.

NOTE: *Occasionally, the clutch driven plate and clutch shaft will require approximately 5 seconds to lose momentum and come to a complete stop after initial clutch disengagement. This is normal and should not be mistaken for clutch drag.*

(1) Start engine, depress clutch pedal fully, and shift transmission into first gear.

(2) Shift transmission into neutral but **do not** release clutch pedal.

(3) Wait 5 to 10 seconds and shift transmission into reverse. If shift is smooth with no gear clash, clutch operation is normal. If shifting into reverse produces gear clash, proceed to next step.

(4) Raise vehicle on hoist. Check clutch linkage for binding, worn, broken or bent components. Lubricate or replace as necessary. If components are in good operating condition, proceed to next step. If one or more problems were discovered and repaired, lower vehicle and repeat steps (1) through (3). If clutch now operates correctly, stop repair. If clutch drag persists, proceed to next step.

(5) Remove transmission and clutch components. Refer to Clutch Removal.

NOTE: *Whenever the transmission is removed, also remove the pilot bushing lubricating wick, soak the wick in engine oil, and reinstall the wick before assembly.*

(6) Observe wear pattern on driven plate. If wear pattern is uneven (e.g., two areas heavily worn on one side, two only partially worn on opposite side), or has opposing wear patterns on front and reverse side, the driven plate is warped and should be replaced.

(7) Inspect clutch cover assembly. If clutch cover assembly has worn, bent, or broken release levers or lever pivots, is heavily scored, or warped, replace clutch

cover assembly. If cover assembly does not exhibit any of these conditions, do not replace it.

(a) Clean oil and dirt from clutch cover with solvent and allow cover to air dry.

(b) Sand pressure plate surface lightly using fine emery cloth.

(c) Lubricate cover release lever pivots with chassis grease.

NOTE: *Apply lubricant to pivots sparingly. Excessive lubricant could result in grease contamination of pressure plate and driven plate surfaces.*

(8) Check and adjust clutch cover release lever height as necessary.

NOTE: *If the release lever height cannot be adjusted, the release lever(s) are bent. Replace the clutch cover.*

(9) Inspect crankshaft pilot bushing for heavy scoring, angular wear pattern, or discoloration. Replace as necessary. Be sure to soak bushing in engine oil before installation.

NOTE: *If the pilot bushing displays an angular-type wear pattern, check and correct clutch housing alignment before proceeding. Refer to Clutch Housing Alignment.*

(10) Inspect condition of splines on transmission clutch shaft and in driven plate hub. If severely worn, galled, or corroded, replace clutch shaft or driven plate. Corrosion, rust, or burrs can be removed from splines using an oilstone or fine-tooth file. Install driven plate on clutch shaft. Driven plate must move freely on shaft.

(11) If components inspected in previous steps are in good condition, proceed to next step. If one or more problems were discovered during inspection procedure, repair as necessary and proceed to next step.

(12) Check clutch housing alignment. Refer to Clutch Housing Alignment. Correct alignment if necessary and proceed to next step.

(13) Apply thin film of chassis grease to transmission clutch shaft splines. Do not apply grease to shaft pilot hub.

(14) Install pilot bushing lubricating wick.

(15) Install transmission and clutch components. Refer to Clutch Installation.

(16) Lower vehicle.

NOTE: *Do not replace the throwout bearing unless actually defective. Refer to Clutch Area Noises.*

Clutch Pedal Pulsation

Clutch pedal pulsation can be described as a rapid up-and-down or pumping-type movement of the pedal that is not accompanied by any noise. In most cases, pedal movement is slight and cannot be observed but can be felt by the driver. However, on occasion, pedal movement will be great enough to be visually observed and cause a noticeable vibration.

Clutch pedal pulsation occurs when the throwout bearing makes initial contact with the clutch cover release levers (clutch partially disengaged), or at any time the bearing is in contact with the release levers. Pulsation is usually caused by incorrect clutch release lever height or clutch housing misalignment. Check clutch operation as follows.

(1) Start engine, slowly depress clutch pedal until throwout bearing makes initial contact with clutch release levers, and check for pulsation.

NOTE: *Some minor pulsation is normal.*

(2) Continue to depress clutch pedal while checking for pulsation until pedal is fully depressed.

(3) If pulsation is not evident or is minor, stop repair. If pulsation is very rapid and can be felt throughout vehicle, refer to Clutch-Related Vibrations. If vehicle displays pulsation symptoms, proceed to next step.

(4) Remove transmission and clutch components. Refer to Clutch Removal.

(5) Remove pilot bushing lubricating wick and soak wick in engine oil.

(6) Inspect clutch cover release levers. If levers are bent or excessively worn, replace clutch cover and proceed to step (8). If release levers are in good condition, clean oil and dirt from clutch cover assembly using mineral spirits, allow assembly to air dry and proceed to next step.

(7) Sand clutch cover pressure plate surface lightly using fine emery cloth.

(8) Lubricate clutch cover release lever pivots lightly with chassis grease.

NOTE: *Apply lubricant to the pivots sparingly. Excessive lubrication could result in grease contamination of the driven plate and pressure plate surface.*

(9) Check and adjust clutch cover release lever height if necessary.

NOTE: *If release lever height cannot be adjusted, the levers are bent and the cover must be replaced.*

(10) Check clutch housing alignment. Refer to Clutch Housing Alignment. Correct alignment if necessary and proceed to next step.

(11) Apply thin film of chassis grease to transmission clutch shaft splines but do not apply grease to shaft pilot hub.

(12) Install pilot bushing lubricating wick.

(13) Install clutch components and transmission. Refer to Clutch Installation.

Clutch Related Vibrations

Clutch related vibrations differ from pedal pulsations in frequency and magnitude. They usually occur at relatively high engine speeds (over 1500 rpm), are not affected by clutch pedal position, and can be felt throughout the vehicle.

Although clutch related vibrations are usually caused by clutch component imbalance, this condition occurs very infrequently because the clutch cover and driven plate are balanced as a unit during assembly. At this time, the cover and plate are installed on the crankshaft/flywheel assembly and given a final fine-tune balance before installation in the vehicle.

Replacement of clutch components to correct vibrations should be performed only after exhausting all other possibilities. Check clutch operation as follows.

(1) Raise vehicle on hoist and check engine front support cushion interlocks for grounding. Repair as necessary. Check other engine components (e.g., exhaust manifold, valve cover, etc.) for grounding on body or frame. If one of these components is grounded, repair and check for vibration. If vibration ceases, stop repair. If vibration continues, lower vehicle and proceed to next step.

(2) Disconnect accessory drive belts one at a time, start engine, and check for vibration. If vibration stops after removal of a drive belt, cause of vibration is related to accessory driven by belt or by belt itself. Repair as necessary. If vibration persists after checking all belts and accessories, proceed to next step.

(3) Raise vehicle on hoist and remove transmission and clutch housing. Refer to Clutch Removal.

(4) Support engine firmly.

(5) Check for loose flywheel mounting bolts. Tighten bolts to 105 foot-pounds (142 N•m) torque if necessary and operate engine. If vibration ceases, stop repair. If vibration is still evident, proceed to next step.

(6) Check flywheel face runout while holding crankshaft end play to zero. If runout is 0.005 inch (0.12 mm) or less, proceed to next step. If runout exceeds 0.005 inch (0.12 mm), replace flywheel and operate engine. If vibration ceases, stop repair. If vibration is still evident, proceed to next step.

(7) Check for damaged crankshaft vibration dampener. If dampener is in good condition, proceed to next step. If dampener is damaged, replace dampener and operate engine. If vibration ceases, stop repair. If vibration is still evident, proceed to next step.

(8) Check clutch cover imbalance as follows:

(a) Remove clutch cover and driven plate from flywheel.

(b) Start and operate engine at speed where vibration occurred.

(c) If vibration ceases, replace clutch cover and recheck operation. If now OK, install clutch housing and transmission. Refer to Clutch Installation.

(9) Lower vehicle.

Clutch Noises

Throwout Bearing Noise

Throwout bearing noises can be described as whirring, grating, or grinding noises that occur when the clutch pedal is depressed (clutch disengaged).

These noises usually continue until the clutch pedal is fully released (clutch engaged) and the bearing is no longer in contact with the clutch cover release levers.

Throwout bearing noise is corrected by replacing the bearing as outlined in this chapter.

NOTE: *The throwout bearing should not be replaced as a matter of course when servicing the clutch cover or driven plate. Replace the bearing only if defective.*

Transmission Clutch Shaft or Countershaft Bearing Noise

Transmission clutch shaft or countershaft bearing noises can be described as whirring, grating, or grinding noises which cease when the clutch pedal is depressed (clutch disengaged) or when the transmission is shifted into gear. These noises are most noticeable when the clutch pedal is fully released and the transmission is in neutral. Correction of these noises will require transmission removal and replacement of the problem bearing(s).

Crankshaft Pilot Bushing Noise

Pilot bushing noises can be described as squealing, howling, or elephant-type trumpeting noises which are most noticeable when the engine is cold. These noises occur during the first few inches of clutch pedal travel as the pedal is being released (partial clutch engagement) with the transmission in gear. It can also occur in very cold weather when the pedal is fully depressed (clutch disengaged) and the engine is started with the transmission in neutral. To correct pilot bushing noise, replace bushing as outlined in this section.

CLUTCH ADJUSTMENTS

Four-Cylinder CJ Models

The clutch hydraulic mechanism is self-adjusting. Free play adjustments are not required nor is there any provision for such an adjustment.

Six- and Eight-Cylinder Models

There are two clutch adjustments required: clutch pedal free play and clutch cover release lever height.

Clutch pedal freeplay should be checked and adjusted at the intervals specified in the Mechanical Maintenance Schedule, Chapter B, or whenever diagnosis indicates adjustment is needed. Refer to Clutch Pedal Free Play Adjustment in this section.

Clutch cover release lever height should be checked and adjusted whenever the cover is removed or replaced during service operations, or whenever diagnosis indicates adjustment is needed. Refer to the Clutch Service—Six- and Eight-Cylinder Models section in this chapter.

Clutch Pedal Free Play Adjustment

(1) Lift clutch pedal upward and against pedal stop (fig. 2A-1).

(2) Raise vehicle.

(3) On Cherokee and Truck models, adjust clutch push rod lower ball pivot assembly in-or-out on push rod (fig. 2A-5) until bellcrank inner lever is parallel to front face of clutch housing. Lever should be slightly forward from vertical.

(4) On all models, loosen release rod adjuster jamnut.

(5) Turn release rod adjuster in or out to obtain specified clutch pedal free play.

(6) Tighten release rod jamnut.

(7) Lower vehicle.

CLUTCH LINKAGE

The suspended-type clutch pedal is connected to the throwout lever through the clutch push rod, bellcrank outer and inner levers, and release rod (figs. 2A-5 and 2A-6). The throwout bearing is mounted on the transmission front bearing cap and acts directly against the clutch cover release levers to engage and disengage the clutch. The bearing is actuated by a throwout lever mounted in the clutch housing. The lever pivots on a steel ball mounted inside the clutch housing.

The bellcrank pivots on ball studs mounted in the inner and outer support brackets (figs. 2A-5 and 2A-6). Idler bushings, installed in each end of the bellcrank provide bearing surfaces for the ball studs.

Clutch Linkage Lubrication

The clutch linkage ball studs are the only linkage components that require periodic lubrication. The studs should be lubricated at the intervals specified in the Mechanical Maintenance Schedule, Chapter B.

Lubrication Procedure

The bellcrank has a lubrication fitting to facilitate ball stud lubrication. Whenever lubrication is necessary, proceed as follows:

(1) Raise vehicle.

(2) Fill lube gun with lithium-base chassis grease.

(3) Connect lube gun nozzle to bellcrank fitting and lubricate ball studs.

(4) Remove lube gun and lower vehicle.

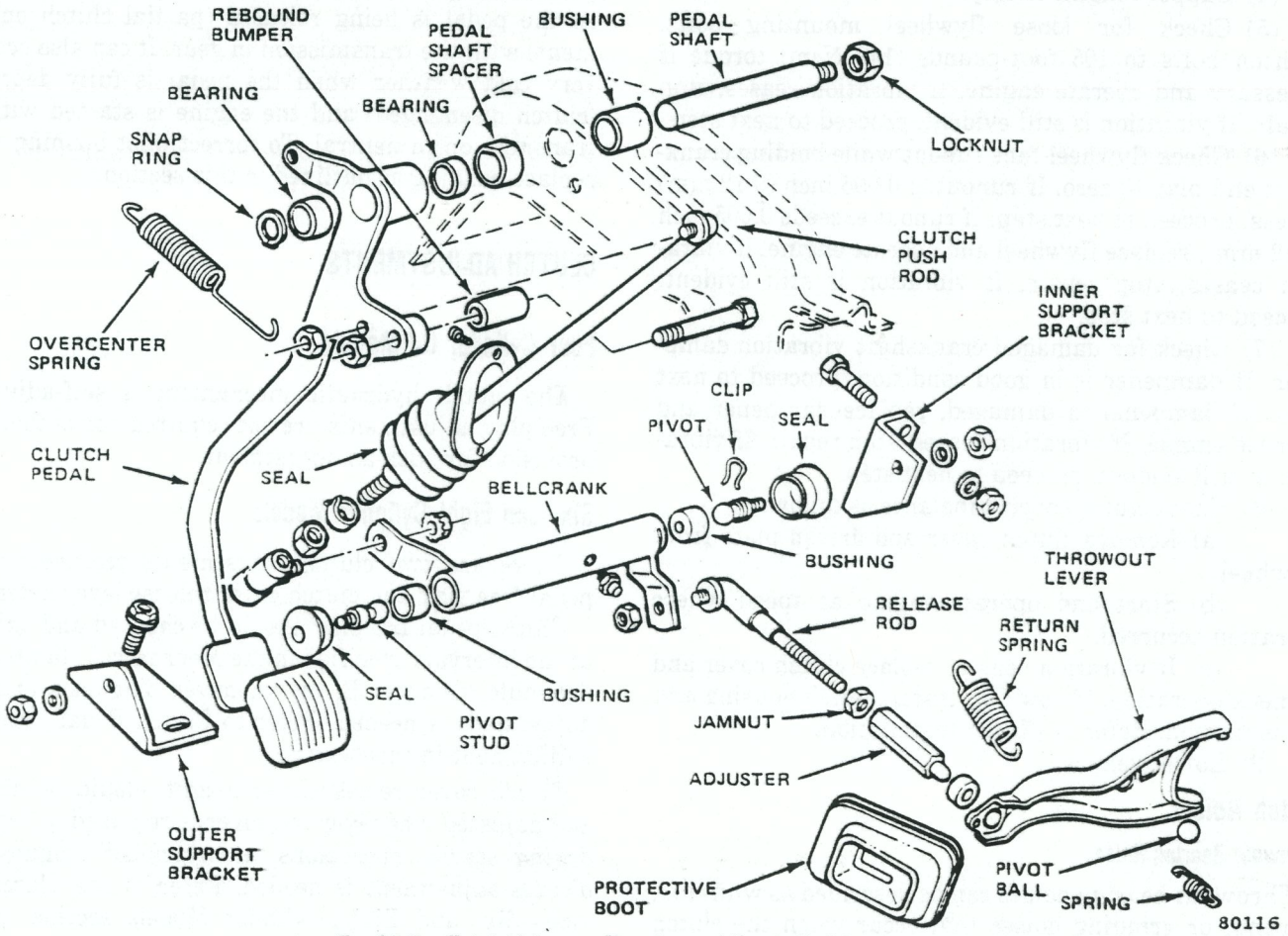

Fig. 2A-5 Clutch Linkage—Cherokee and Truck Models

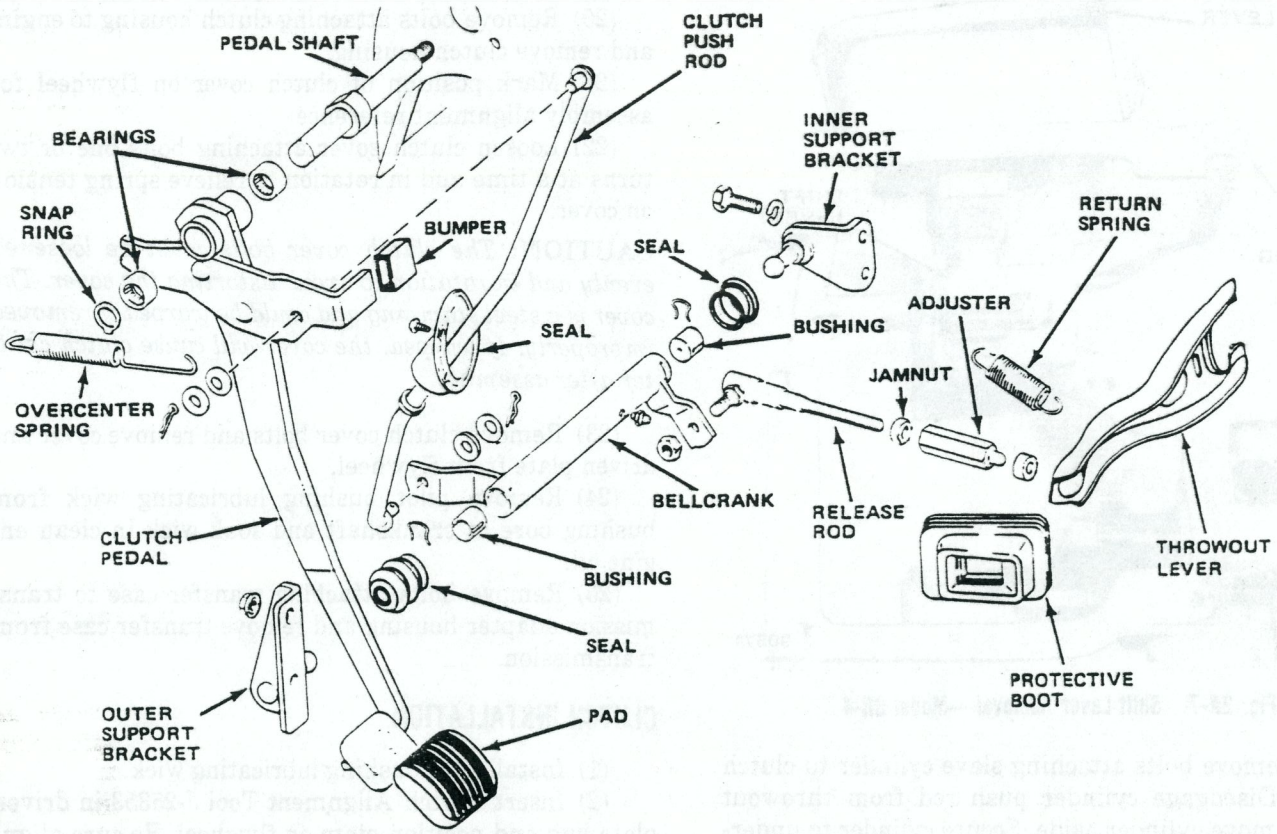

Fig. 2A-6 Clutch Linkage—Six- and Eight-Cylinder CJ Models

CLUTCH SERVICE—FOUR-CYLINDER CJ MODELS

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CLUTCH REMOVAL

(1) Remove screws attaching transmission shift lever boot to floorpan and slide boot upward on lever.

(2) Remove bolts attaching transmission shift lever housing to transmission (fig. 2A-7). Lift shift lever and housing upward and secure assembly to floorpan with wire.

(3) Raise vehicle.

(4) Mark rear propeller shaft and transfer case yoke for assembly alignment reference.

(5) Disconnect rear propeller shaft at transfer case. Move shaft aside and secure to underbody.

(6) Position safety stand under engine to support engine.

(7) Remove bolts/nuts attaching rear crossmember to frame rails and rear support cushion and remove crossmember.

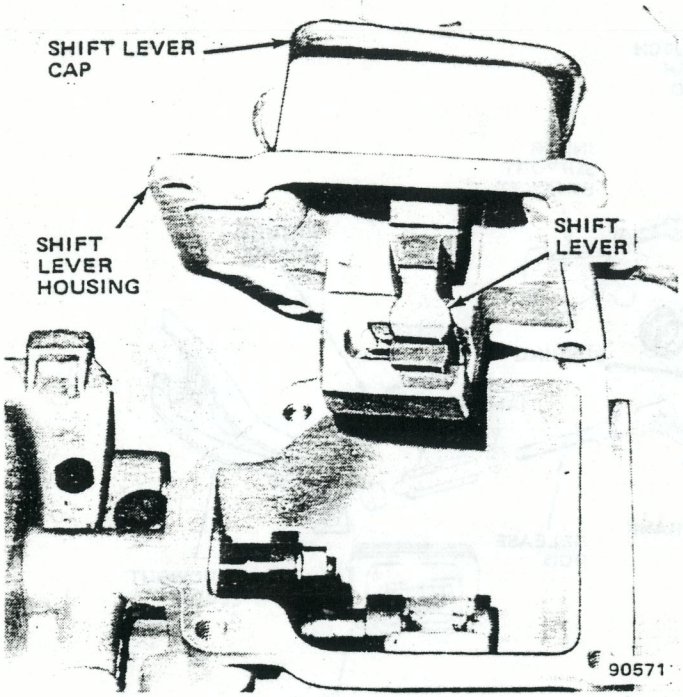

Fig. 2A-7 Shift Lever Removal—Model SR-4

(8) Remove bolts attaching slave cylinder to clutch housing. Disengage cylinder push rod from throwout lever and move cylinder aside. Secure cylinder to underbody with wire, if necessary.

(9) Drain transfer case and disconnect speedometer cable.

(10) Disconnect backup lamp switch wire.

(11) Disconnect parking brake cable, if necessary.

(12) Disconnect transfer case vent hose at transfer case and disconnect 4WD indicator switch wire.

(13) Remove starter motor.

(14) Mark front propeller shaft and transfer case yoke for assembly alignment reference.

(15) Disconnect front propeller shaft from transfer case yoke. Move shaft aside and secure to underbody with wire.

(16) Remove transfer case shift lever as follows: Remove shifter shaft retaining nut. Remove cotter pins that retain shift control link pins in shift rods and remove pins. Remove shifter shaft and disengage shift lever from shift control links. Slide lever upward in boot to move lever out of way.

NOTE: *On some models, the shifter shaft is threaded into the shift lever and must be unthreaded to remove it. On other models, the shaft is removed simply by sliding it out of the lever.*

(17) Support transmission-transfer case assembly with transmission jack. Use safety chain to secure assembly on jack.

(18) Remove bolts attaching transmission to clutch housing and remove transmission-transfer case assembly.

(19) Remove throwout bearing from throwout lever.

(20) Remove bolts attaching clutch housing to engine and remove clutch housing.

(21) Mark position of clutch cover on flywheel for assembly alignment reference.

(22) Loosen clutch cover attaching bolts one or two turns at a time and in rotation to relieve spring tension on cover.

CAUTION: *The clutch cover bolts must be loosened evenly and in rotation to avoid distorting the cover. The cover is a steel stamping and could be warped if removed improperly. If warped, the cover will cause clutch chatter after assembly.*

(23) Remove clutch cover bolts and remove cover and driven plate from flywheel.

(24) Remove pilot bushing lubricating wick from bushing bore in crankshaft and soak wick in clean engine oil.

(25) Remove bolts attaching transfer case to transmission adapter housing and remove transfer case from transmission.

CLUTCH INSTALLATION

(1) Install pilot bushing lubricating wick.

(2) Insert Clutch Alignment Tool J-25353 in driven plate hub and position plate on flywheel. Be sure alignment tool is fully seated in pilot bushing.

NOTE: *Be sure the driven plate side marked flywheel side is positioned against the flywheel.*

(3) Position clutch cover on flywheel and over driven plate.

(4) Align driven plate and clutch cover using alignment tool and install cover attaching bolts finger-tight only.

(5) Tighten clutch cover bolts alternately and evenly to 23 foot-pounds (31 N•m) torque.

CAUTION: *To avoid warping the clutch cover, tighten the cover attaching bolts a few turns at a time only.*

(6) Install clutch housing on engine and install housing attaching bolts. Tighten bolts to 54 foot-pounds (73 N•m) torque.

(7) Install throwout bearing in throwout lever. Center bearing over clutch cover release fingers.

(8) Shift transmission into gear using long handle screwdriver.

(9) Install transmission. Be sure to align transmission clutch shaft and driven plate splines before installation.

(10) Install and tighten transmission-to-clutch housing bolts to 54 foot-pounds (73 N•m) torque.

(11) Install transfer case on transmission. Raise transfer case using transmission jack. Align transmission output and transfer case input shaft splines by rotating output shaft yoke.

(12) Install and tighten transfer case attaching bolts to 30 foot-pounds (41 N•m) torque, and remove transmission jack.

(13) Position transfer case shift lever and shifter shaft. Install shaft retaining nut and tighten nut securely.

(14) Install transfer case shift control link assembly and install link retaining pins through links and shift rods. Use new cotter keys to retain link pins. Be sure shift lever is properly aligned in control link assembly.

(15) Connect vent hose to transfer case vent.

(16) Connect backup light switch and 4WD indicator switch wires.

(17) Connect speedometer cable to transfer case.

(18) Connect front and rear propeller shafts to transfer case yokes. Be sure to align shafts and yokes using assembly reference marks made previously. Tighten U-joint clamp strap bolts to 15 foot-pounds (20 N•m) torque.

(19) Install rear crossmember. Tighten crossmember attaching nuts to 30 foot-pounds (41 N•m) torque.

(20) Connect parking brake cable if cable was disconnected.

(21) Install slave cylinder on clutch housing. Be sure cylinder push rod is properly seated in throwout lever.

(22) Fill transfer case to correct level with specified lubricant. Refer to Chapter 2D.

(23) Remove stand used to support engine and lower vehicle.

(24) Install transmission shift lever assembly.

(25) Install screws attaching transmission shift lever boot to floorpan.

PILOT BUSHING REPLACEMENT

Removal

(1) Remove clutch assembly. Refer to Clutch Removal in this section.

(2) Obtain and lubricate replacement pilot bushing with engine oil.

(3) Remove pilot bushing lubricating wick and soak wick in engine oil.

(4) Remove old bushing using Tool J-5822. Or, pack bushing bore with grease, insert clutch alignment tool into bushing, and tap tool with mallet. Hydraulic pressure of grease will force bushing out.

(5) Clean crankshaft bore if grease was used to remove old bushing.

Installation

(1) Install pilot bushing lubricating wick in bushing bore in crankshaft.

(2) Install replacement pilot bushing in crankshaft bushing bore using Clutch Alignment Tool J-25353.

CAUTION: *Do not allow the bushing to become cocked during installation. The bushing and installer tool must be kept parallel with the crankshaft centerline during installation.*

(3) Remove bushing installer tool.

(4) Install clutch, transmission, and transfer case assemblies. Refer to Clutch Installation in this section.

THROWOUT BEARING AND LEVER

Removal

(1) Remove transmission-transfer case assembly. Refer to Clutch Removal in this section.

(2) Remove throwout lever boot.

(3) Disconnect throwout lever spring (fig. 2A-5).

(4) Remove throwout lever and bearing as assembly.

(5) Remove throwout bearing from lever.

Installation

(1) Fill slots in inner groove of replacement throwout bearing with AMC/Jeep chassis lubricant, or equivalent.

(2) Position throwout lever on pivot ball in clutch housing and connect lever spring to lever.

(3) Install throwout lever boot.

(4) Install throwout bearing in lever. Be sure bearing retaining springs are engaged in lever and that locating lugs on lever are seated in locating slots in bearing.

(5) Install transmission-transfer case assembly. Refer to Clutch Installation in this section.

FLYWHEEL REPLACEMENT

Removal

(1) Remove clutch, transmission, and transfer case assemblies. Refer to Clutch Removal in this section.

(2) Remove bolts attaching flywheel to crankshaft flange and remove flywheel.

Installation

(1) Mount flywheel on crankshaft flange and install attaching bolts finger-tight.

(2) Tighten flywheel attaching bolts alternately and evenly to 65 foot-pounds (88 N•m) torque.

(3) Clean surface of replacement flywheel with alcohol to remove all traces of oil, grease, or other protective substances.

(4) Install clutch, transmission, and transfer case assemblies. Refer to Clutch Installation in this section.

TRANSMISSION CLUTCH SHAFT

If the transmission clutch shaft requires replacement, remove and disassemble the transmission and replace the shaft. Refer to Chapter 2B—Manual Transmission for the necessary service procedures.

CLUTCH HOUSING ALIGNMENT

The clutch housing alignment procedure for four-cylinder CJ models is the same as for six- or eight-cylinder models without transmission adapters. Refer to Clutch Housing Alignment—Alignment Check without Transmission Adapter in the Six- and Eight-Cylinder Model Clutch service section.

CLUTCH CYLINDER SERVICE

Removal

(1) Disconnect hydraulic line at clutch cylinder (fig. 2A-8). Use flarenut wrench to loosen and remove fitting as fitting hex may be damaged by open end wrench.

(2) Cap hydraulic line and cylinder opening to prevent dirt entry.

(3) Remove cotter pin and washer that retain cylinder push rod on clutch pedal and slide rod off pedal pivot.

(4) Remove nuts attaching clutch cylinder to mounting studs on dash panel and remove cylinder.

Disassembly

(1) Remove reservoir cap and rubber cover. Place cap and cover on clean, lint free paper or cloth.

NOTE: *It is not necessary to remove the rubber outer cover from the reservoir cap unless the cover is damaged.*

(2) Remove push rod dust cover. Use screwdriver to pry cover off cylinder. Discard cover after removal.

(3) Remove snap ring that retains push rod in cylinder. Use needlenose pliers to compress ends of snap ring and remove ring from cylinder bore. Discard snap ring after removal.

(4) Remove push rod, retaining washer and seal as assembly (fig. 2A-9). Remove and discard push rod seal.

(5) Remove plunger, valve spring, and valve stem assembly from cylinder bore (fig. 2A-9). Tap cylinder body lightly on wood block to dislodge assembly from bore.

(6) Compress valve spring slightly and pry tab of valve stem retainer upward to release retainer, spring, and stem assembly from plunger (fig. 2A-10).

NOTE: *The retainer tab is located in the rectangular slot in the side of the stem retainer (fig. 2A-10). Use a small, thin blade screwdriver to pry the tab upward.*

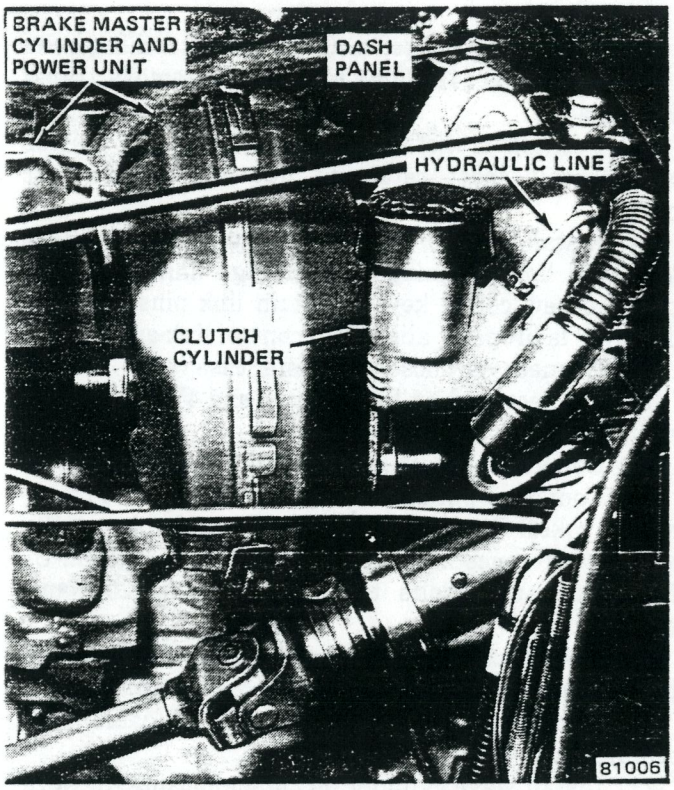

Fig. 2A-8 Clutch Cylinder Location

(7) Remove seal from plunger (fig. 2A-9). Discard seal after removal.

(8) Remove spring retainer and valve stem from valve spring.

(9) Remove valve stem from retainer and remove spring washer and stem tip seal from end of valve stem (fig 2A-9). Discard stem tip seal and spring washer.

(10) Clean all parts thoroughly with brake fluid or brake cleaning solvent only.

(11) Inspect cylinder bore for cracks, porosity, wear, deep scoring or nicks, and severe corrosion or pitting. If bore exhibits any of these conditions, replace cylinder.

Assembly

(1) Lubricate cylinder bore with brake fluid.

(2) Install replacement seals on plunger and valve stem. Be sure lip of plunger seal faces stem end of plunger. Also be sure stem tip seal is installed so that seal shoulder fits in undercut at end of valve stem.

(3) Install new spring washer on valve stem. Install plastic spring retainer on valve stem and over spring washer. Be sure large end of retainer is facing end of stem (fig. 2A-10).

(4) Install valve spring over stem and seat spring on stem retainer.

(5) Install assembled valve spring, retainer, and stem assembly on plunger (fig. 2A-10). Compress spring against plunger. When end of valve stem passes through

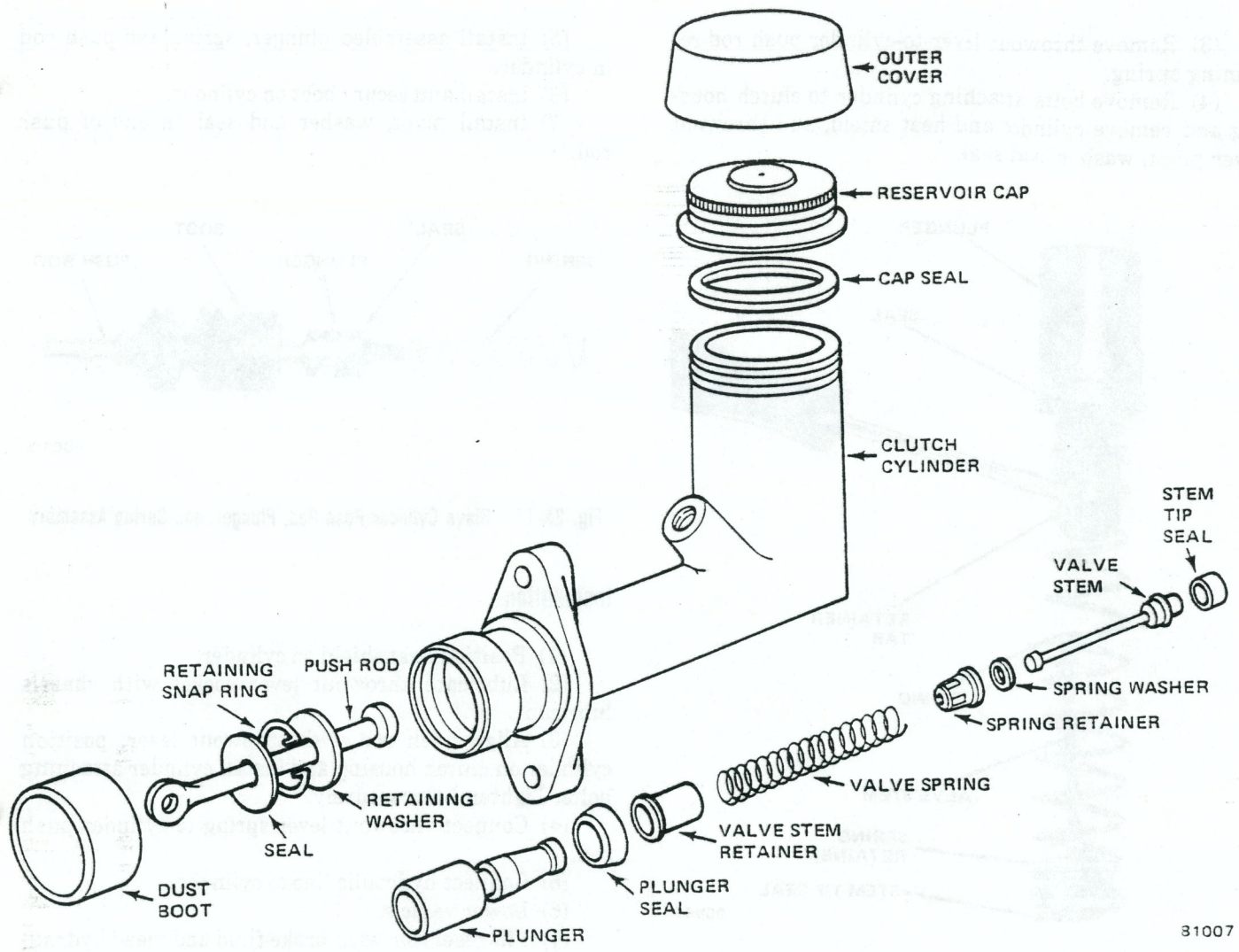

Fig. 2A-9 Clutch Cylinder Assembly

stem retainer and seats in small bore in end of plunger, bend retainer tab downward to lock stem and retainer on plunger.

(6) Lubricate spring and plunger assembly with brake fluid and insert assembly (spring end first) into cylinder bore.

(7) Install new seal and dust cover on push rod.

(8) Lubricate ball-end of push rod, seal, and lip of dust cover with lubricant supplied in cylinder overhaul kit.

(9) Insert push rod and push rod retainer into cylinder bore. Secure push rod and retainer in bore using replacement snap ring supplied in overhaul kit.

(10) Slide push rod seal up against push rod retainer and install dust cover on end of cylinder. Be sure cover lip is seated in undercut on end of cylinder.

(11) Remove and discard old seal from filler cap and install new seal supplied in kit.

(12) Install rubber outer cover on filler cap, if removed.

Installation

(1) Install clutch cylinder on dash panel mounting studs. Tighten cylinder attaching nuts to 11 foot-pounds (15 N•m) torque.

(2) Connect hydraulic line to clutch cylinder.

(3) Install cylinder push rod on clutch pedal pivot and install retaining washer and cotter pin.

(4) Fill clutch cylinder reservoir with brake fluid to level indicated on side of reservoir. Use AMC/Jeep brake fluid, or equivalent, marked SAE J-1703 or DOT 3 only to fill reservoir.

(5) Install reservoir cap and bleed clutch hydraulic system. Refer to Clutch Hydraulic System Bleeding.

SLAVE CYLINDER SERVICE

Removal

(1) Raise vehicle.

(2) Disconnect hydraulic line at cylinder.

(3) Remove throwout lever-to-cylinder push rod retaining spring.

(4) Remove bolts attaching cylinder to clutch housing and remove cylinder and heat shield, and throwout lever pivot, washer, and seal.

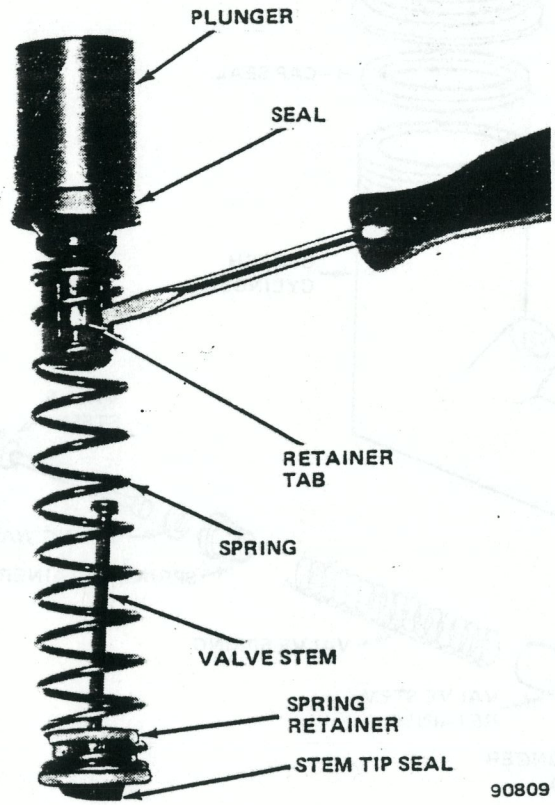

Fig. 2A-10 Removing Valve Spring and Stem from Plunger

Disassembly

(1) Clean cylinder exterior thoroughly.

(2) Remove boot from cylinder.

(3) Remove cylinder push rod, boot, plunger and spring as assembly (fig. 2A-11).

(4) Remove spring and seal from plunger.

(5) Remove snap ring that retains push rod in plunger and remove push rod and boot.

(6) Remove boot from push rod.

(7) Clean parts with brake fluid.

Assembly

(1) Install new boot on push rod.

(2) Install push rod in plunger and install new push rod retaining snap ring.

(3) Install spring on plunger.

(4) Lubricate cylinder bore and seal with brake fluid.

(5) Install assembled plunger, spring and push rod in cylinder.

(6) Install and secure boot on cylinder.

(7) Install pivot, washer and seal on end of push rod.

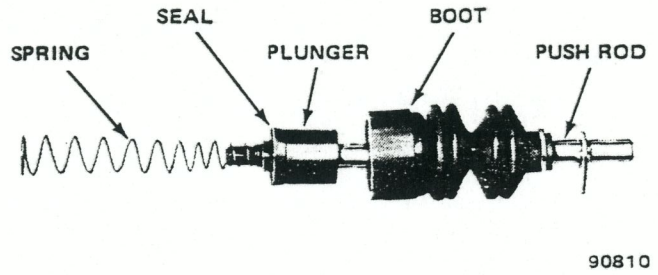

Fig. 2A-11 Slave Cylinder Push Rod, Plunger, and Spring Assembly

Installation

(1) Position heat shield on cylinder.

(2) Lubricate throwout lever socket with chassis lubricant.

(3) Align push rod with throwout lever, position cylinder on clutch housing and install cylinder attaching bolts. Tighten bolts securely.

(4) Connect throwout lever spring to cylinder push rod.

(5) Connect hydraulic line to cylinder.

(6) Lower vehicle.

(7) Fill reservoir with brake fluid and bleed hydraulic system. Refer to Clutch Hydraulic System Bleeding.

CLUTCH HYDRAULIC SYSTEM BLEEDING

(1) Fill reservoir with brake fluid.

(2) Raise vehicle.

(3) Compress slave cylinder plunger by pushing throwout lever forward as far as possible.

(4) Attach one end of rubber hose to slave cylinder bleed screw. Place opposite end of hose in glass container 1/2 full of brake fluid. Be sure hose end is submerged in fluid.

(5) Loosen bleed screw.

(6) Have helper press and hold clutch pedal to floor. Tighten bleed screw and release pedal. Repeat bleeding operation until fluid entering container is free of bubbles.

NOTE: *Do not allow the reservoir to run out of fluid during the bleeding operation.*

(7) Lower vehicle.

(8) Adjust reservoir fluid level to level indicated on reservoir after completing bleeding operations.

SPECIFICATIONS

Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft-lbs)		Metric (N•m)	
	Service Set-To Torque	In-Use Recheck Torque	Service Set-To Torque	In-Use Recheck Torque
Clutch Cover Bolts:				
Four-Cylinder	23	20-26	31	27-35
Clutch Housing-to-Engine Bolts:				
Four-Cylinder — All	54	46-62	73	62-84
Clutch Housing-to-Transmission Bolts:				
Four-Cylinder	54	46-62	73	62-84
Starter Motor-to-Clutch Housing Bolts:				
Four-Cylinder	54	46-62	73	62-84
Clutch Cable Locknut:				
Four-Cylinder	25	21-29	34	28-39
Clutch Housing Inspection Cover Screws:				
Four-Cylinder	30	25-35	41	34-47
Flywheel-to-Crankshaft Bolts:				
Four-Cylinder	65	59-71	88	80-96
Rear Crossmember Stud Nuts:				
Four-Cylinder	35	30-40	47	41-54
Transmission Support Cushion-to-Crossmember Bolts:				
Four-Cylinder	25	20-30	34	27-41

All Torque values given in foot-pounds and newton•meters with dry fits unless otherwise specified.

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CLUTCH SERVICE — SIX- AND EIGHT-CYLINDER MODELS

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CLUTCH REMOVAL

(1) Remove transmission as outlined in Chapter 2B.
(2) Remove starter motor.
(3) Remove throwout bearing.
(4) Remove clutch housing.
(5) Mark position of clutch cover on flywheel for assembly alignment reference.
(6) Loosen clutch cover attaching bolts one or two turns at a time and in rotation to relieve spring tension on cover.

CAUTION: *The clutch cover bolts must be loosened evenly and in rotation to avoid cover distortion. The cover is a steel stamping and could be warped if improperly removed resulting in clutch chatter when installed.*

(7) Remove clutch cover bolts and remove cover and driven plate from flywheel.

NOTE: *Observe which side of the driven plate faces the flywheel before removing the plate. Paint or chalk alignment marks on the plate for assembly reference.*

(8) Remove pilot bushing lubricating wick and soak wick in engine oil.

(9) Inspect and service clutch components as outlined under Clutch Component Inspection.

CLUTCH INSTALLATION

(1) Check and correct clutch cover release lever height if necessary. Lubricate release lever pivots sparingly. Do not over lubricate pivots.

(2) Install pilot bushing lubricating wick in crankshaft bore.

(3) Insert Clutch Alignment Tool J-22056 (Cherokee, Wagoneer and Truck), or Alignment Tool J-25353 (CJ), or spare clutch shaft in driven plate hub and mount assembled plate and tool on flywheel. Be sure alignment tool is fully seated in pilot bushing.

CAUTION: *Be sure the correct side of the driven plate faces the flywheel. Refer to the reference marks placed on the driven plate during clutch removal.*

(4) Position clutch cover on flywheel and over driven plate and alignment tool. Align cover and flywheel according to reference marks made during clutch removal and install cover attaching bolts finger tight only.

(5) Tighten cover attaching bolts alternately and evenly to 40 foot-pounds (54 N•m) torque. Be sure to maintain cover-to-plate alignment while tightening bolts.

CAUTION: *The cover attaching bolts must be tightened alternately and evenly to avoid distorting the cover.*

(6) Install clutch housing and tighten housing attaching bolts to specified torque. Refer to Specifications.

(7) Install starter motor.

(8) Install throwout bearing. On Cherokee, Wagoneer and Truck models, be sure wave washer is installed on throwout lever. On CJ models, be sure bearing tension springs are engaged in throwout lever.

(9) Install transmission as outlined in Chapter 2B.

CLUTCH INSPECTION AND SERVICE

Driven Plate

Inspect the friction material for excessive wear, or charred, cracked, broken or loose friction material. Check the driven plate steel hub and cushion springs for distortion, cracks, or breakage. Replace the driven plate if it exhibits any of these conditions.

NOTE: *Do not replace the driven plate if the cushion springs only appear loose. This is a normal condition when the plate is removed from the vehicle and the springs are not under load.*

Clutch Cover

Inspect the cover for cracks, distortion, broken or collapsed apply springs and for broken, bent, loose, or excessively worn release levers. Inspect the pressure plate surface for deep scores, cracks, heat checking or discoloration, and for evidence of warping (use a straightedge to check pressure plate surface flatness). Replace the cover as an assembly if it exhibits any of these conditions.

NOTE: *The centrifugal rollers in the clutch cover may rattle when the cover is removed and not under load. Do not replace the cover if this occurs, it is a normal condition.*

Throwout Bearing

A simple throwout bearing design is used on Jeep vehicles. The bearing is retained on the throwout lever by tension springs.

CAUTION: *The throwout bearings used on Jeep vehicles are permanently lubricated during manufacture. Do not wash or immerse the bearings in solvent as the bearing lubricant could be dissolved. Clean the bearing by wiping it with shop towels.*

Inspect the bearing for excessive wear and deep scoring on the release lever contact surface, looseness on the sleeve, or discoloration which indicates overheating. Check the sleeve bore for excessive wear or burrs which could cause it to bind on the front bearing cap. Rotate the bearing on the sleeve. The bearing must rotate freely and not bind. When rotating the bearing, also listen for grinding or grating sounds which indicate that the internal rollers are worn or damaged. Check the bearing tension springs for distortion or breakage. Replace the bearing if it exhibits any of these conditions.

Transmission Front Bearing Cap

Inspect the bearing cap for deep scoring or excessive wear. Replace the bearing cap if worn or scored and inspect the throwout bearing sleeve for burrs, wear or other damage which could cause a bind condition. Replace the bearing cap or throwout bearing if either exhibits these conditions.

Crankshaft Pilot Bushing

Inspect the bushing for excessive wear, deep scoring, cracks, or looseness. Replace the bushing if worn or damaged

Bushing Replacement

(1) Obtain replacement bushing and soak bushing in engine oil.

(2) Remove bushing lubricating wick.

(3) Fill crankshaft bore and pilot bushing with chassis grease.

(4) Insert clutch aligning tool into bushing and tap end of tool with lead hammer. Hydraulic pressure generated by compressed grease will force bushing out of crankshaft bore.

NOTE: *If the bushing proves difficult to remove using the hydraulic method, remove the bushing using Puller Tool J-5822 and Slide Hammer J-2619-01.*

(5) Remove all grease from crankshaft bore and clean bore thoroughly.

(6) Install replacement pilot bushing on clutch alignment tool.

(7) Install bushing in crankshaft bore using clutch alignment tool as bushing driver. Keep bushing straight during installation and be sure it is fully seated.

(8) Install bushing lubricating wick.

Flywheel

Inspect the flywheel surfaces for cracks, deep scoring, excessive wear, heat checking, discoloration, and excessive face runout or distortion. Check face runout using a dial indicator. Runout must not exceed 0.005 inch (0.12 mm) with the crankshaft end play held to zero. Use a straightedge to check surface flatness. Inspect the ring gear teeth for cracks, breakage, or excessive wear. If the ring gear teeth are severely milled (worn), also check the starter motor drive teeth for similar wear or damage. Check the flywheel attaching bolt torque and tighten the bolts to 105 foot-pounds (142 N•m) torque if necessary. Replace the flywheel if it exhibits any of the conditions just described.

Transmission Clutch Shaft

Install the driven plate on the clutch shaft. The driven plate must move freely on the shaft splines. If the splines have burrs, remove them using a file or oilstone. If the driven plate does not move freely on the splines, incomplete clutch release will occur resulting in hard shifting. Replace the clutch shaft if worn or damaged. Refer to Chapter 2B for procedure.

CLUTCH HOUSING ALIGNMENT

Clutch housing misalignment is caused by excessive face or bore runout of the clutch housing or housing-to-transmission adapter. Misalignment will cause improper clutch release, driven plate failure, front transmission bearing failure, premature crankshaft pilot bushing wear, and clutch noise and vibration. In severe cases, misalignment will also cause gear jump-out on deceleration. If these malfunctions occur, the rear face and bore of the clutch housing or housing-to-transmission adapter must be checked for excessive runout.

Alignment Check—Without Transmission Adapter

NOTE: *Use the following procedure when the vehicle is not equipped with a clutch housing-to-transmission adapter.*

(1) Remove transmission as outlined in Chapter 2B.

(2) Remove clutch housing, clutch cover, and driven plate.

(3) Remove one flywheel attaching bolt.

(4) Obtain 1/2-20 x 9-inch bolt and 1/2-20 nut for use as dial indicator support.

(5) Thread nut onto bolt until 10 or 12 bolt threads are exposed.

(6) Thread bolt into crankshaft attaching bolt hole and tighten nut to secure bolt.

(7) Install clutch housing on engine and tighten housing attaching bolts to specified torque. Refer to Specifications.

(8) Mount dial indicator on 9-inch bolt. Indicator stylus must contact rear face of clutch housing approximately 1/8-inch from edge of bore (fig. 2A-12).

(9) Rotate crankshaft and check face runout of housing. Face runout must not exceed 0.010 inch (0.25 mm) total indicator reading at any point throughout 360 degrees rotation.

NOTE: *Crankshaft end play must be held to zero to obtain an accurate face runout reading. Move and hold the crankshaft forward or rearward using a pry bar to remove end play.*

(10) If face runout is over specified limits, correct runout as follows:

(a) Move dial indicator aside and loosen clutch housing attaching bolts.

(b) Insert shims between housing and engine-to-housing spacer as required to correct runout (fig. 2A-13). Install shims at points A to align top of housing with bottom of housing. Install shims at points B, D, C, or E to correct runout at either side of clutch housing. Shims installed at points D and E will also align housing from bottom to top.

(c) Tighten housing attaching bolts to specified torque.

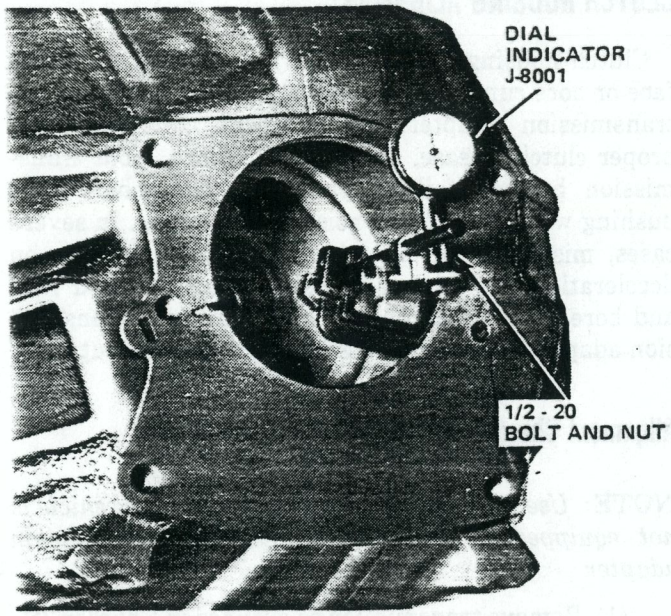

Fig. 2A-12 Mounting Dial Indicator

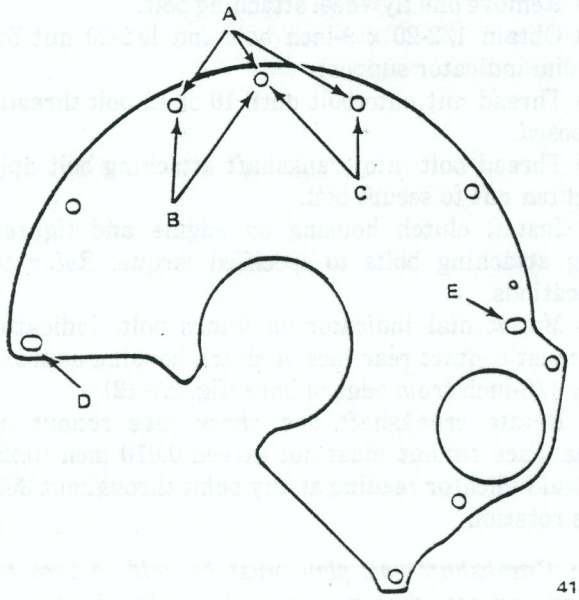

Fig. 2A-13 Shim Placement (Six-Cylinder Engine Shown)

(d) Reposition dial indicator stylus on housing face and recheck face runout.

(e) Total face runout of clutch housing must not exceed 0.010 inch (0.25 mm). Relocate shims as necessary to correct runout.

(11) Check clutch housing bore alignment by positioning dial indicator stylus on inside diameter of housing bore.

(12) Hold crankshaft end play to zero, rotate crankshaft and note dial indicator reading at four equally spaced points. Bore runout must not exceed 0.010 inch (0.25 mm) total indicator reading at any point.

NOTE: *Any change in face alignment will also change bore alignment. In some cases, it is possible to correct bore alignment simply by correcting face alignment. Where it is impossible to correct bore alignment to a maximum of 0.010 inch (0.25 mm) runout (after changing face alignment), replace the clutch housing.*

Alignment Check—With Transmission Adapter

Use the following procedure to check clutch housing-to-transmission adapter alignment.

(1) Remove transmission as outlined in Chapter 2B.

(2) Remove clutch housing and adapter as assembly. Do not remove adapter from housing.

(3) Remove clutch cover and driven plate.

(4) Remove one flywheel attaching bolt.

(5) Obtain 1/2-20 x 15-inch bolt and 1/2-20 nut for use as dial indicator support.

(6) Thread nut onto bolt until 10 to 12 threads are exposed.

(7) Thread bolt into flywheel attaching bolt hole and tighten nut to secure bolt.

(8) Install clutch housing and adapter assembly and tighten housing bolts to specified torque.

(9) Mount dial indicator on bolt. Position indicator so stylus contacts transmission mating face of adapter about 1/8 inch from edge of adapter bore.

(10) Zero dial indicator, rotate crankshaft 360 degrees, and observe adapter face runout. Runout must not exceed 0.010 inch (0.25 mm) total indicator reading at any point through 360 degrees of rotation.

CAUTION: *Crankshaft end play must be held to zero to obtain an accurate face runout reading. Move and hold the crankshaft forward or rearward using a pry bar to eliminate end play.*

(11) Check bore runout of adapter. Position dial indicator so stylus contacts adapter bore at approximate center of bore.

(12) Zero dial indicator, rotate crankshaft 360 degrees, and observe runout of adapter bore. Runout must not exceed 0.010 inch (0.25 mm) at any point through 360 degrees of rotation.

NOTE: *Crankshaft end play must be held to zero to obtain an accurate runout reading. Move and hold the crankshaft forward or rearward using a pry bar to eliminate end play.*

(13) If adapter runout is above specified limits, correct adapter misalignment as outlined in following steps.

(14) If adapter bore runout is within limits but out of tolerance at face, shim clutch housing as required to obtain runout of 0.010 inch (0.25 mm) or less. Shim housing as outlined under Alignment Check—Without Transmission Adapter.

(15) If adapter face runout is within limits but out of tolerance at bore, proceed as follows:

(a) Loosen adapter-to-clutch housing bolts one or two turns.

(b) Move adapter up, down, or side-to-side as required to obtain runout of 0.010 inch (0.25 mm) or less. Tap adapter with hammer to reposition it.

(c) When runout is corrected, tighten adapter bolts to 35 foot-pounds (47 N•m) torque.

(d) Recheck runout and adjust adapter position again if necessary.

(16) If adapter face or bore runout cannot be brought within tolerance, replace adapter and clutch housing.

(17) If adapter and housing are replaced, install dial indicator and check runout of replacement parts.

(18) After checking and correcting adapter alignment, remove dial indicator and remove clutch housing with adapter attached. Do not remove adapter or disturb adapter position if runout was corrected.

CAUTION: *If the clutch housing was shimmed, mark the location of the shims for assembly reference before removing the housing.*

(19) Remove 1/2-20 bolt and nut from flywheel and install flywheel bolt removed previously. Tighten bolt to 105 foot-pounds (142 N•m) torque.

(20) Install driven plate and clutch cover. Tighten clutch cover bolts to 40 foot-pounds (54 N•m) torque.

(21) Install clutch housing and adapter assembly and clutch housing alignment shims as necessary.

(22) Tighten clutch housing bolts to specified torque. Refer to Specifications.

(23) Install transmission as outlined in Chapter 2B.

CLUTCH COVER RELEASE LEVER ADJUSTMENT

NOTE: *Always check and correct the release lever height adjustment, if necessary, before installing an original or replacement clutch cover.*

(1) Install Gauge Plate Tool J-1048, on flywheel in position normally occupied by driven plate (fig. 2A-14).

(2) Position clutch cover over gauge plate. Cover release levers must be directly over machined lands of gauge plate and gauge plate hub must be centered between ends of release levers.

(3) Install clutch cover on flywheel. Tighten cover attaching bolts in rotation, one or two turns at a time to avoid distorting cover.

(4) Compress each release lever several times to seat levers in operating position (fig. 2A-15). Use hammer handle to compress levers.

(5) Measure height of each lever relative to gauge hub using Clutch Lever Height Gauge Tool J-23330 (fig. 2A-16). Gauge tool has four different dimensional settings which can be used for measuring above and below hub.

(6) Adjust release levers by turning lever height adjusting nuts until lever is at desired height.

(7) After each lever has been adjusted, work lever down and up several times and recheck adjustment. If adjustment is correct, stake nut with punch to secure it.

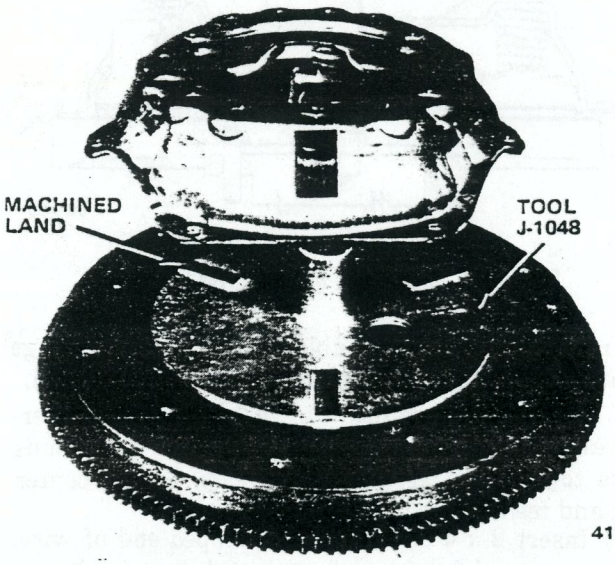

Fig. 2A-14 Mounting Gauge Plate J-1048

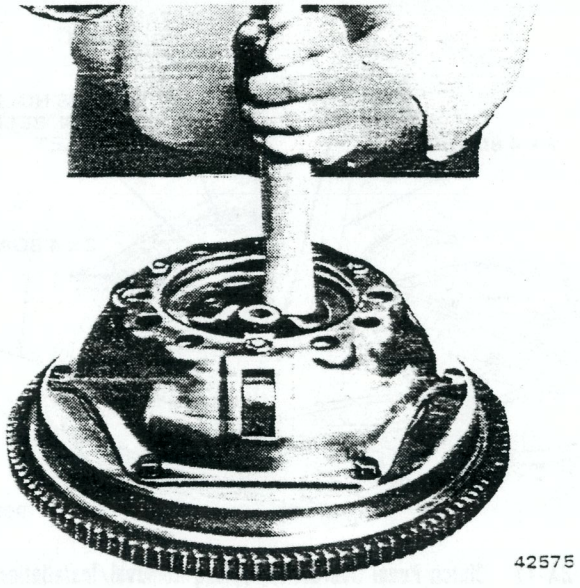

Fig. 2A-15 Compressing and Seating Release Levers

CLUTCH PEDAL OVERCENTER SPRING REPLACEMENT—CJ MODELS

(1) Disconnect battery negative cable.

(2) Remove main wiring harness from clip that secures harness to dash panel. Clip is located below dash panel rod mounting bracket.

(3) Center punch and drill 3/8-inch diameter access hole in dash panel, 1-3/4 inches below center of dash panel rod mounting bracket.

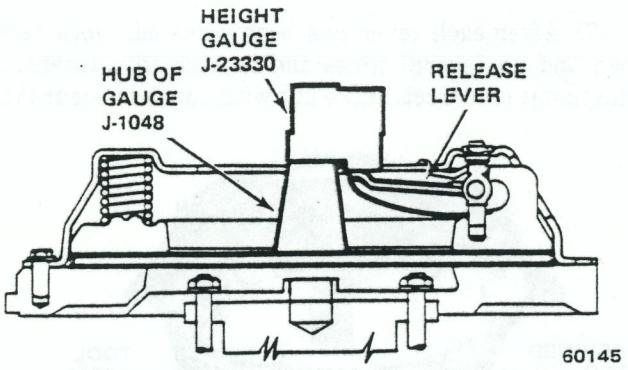

Fig. 2A-16 Measuring Release Lever Height

(4) Feed 3-foot long double strand of heavy gauge mechanics wire through hole just drilled in dash panel.

(5) Wrap wire around end of clutch pedal overcenter and feed wire back out of drilled hole. Twist ends of wire together securely to form loop. Spring center spring and feed wire back out of drilled hole.

(6) Insert 2 x 4 board through looped end of wire. Position a second 2 x 4 board against dash panel to pry against (fig. 2A-17).

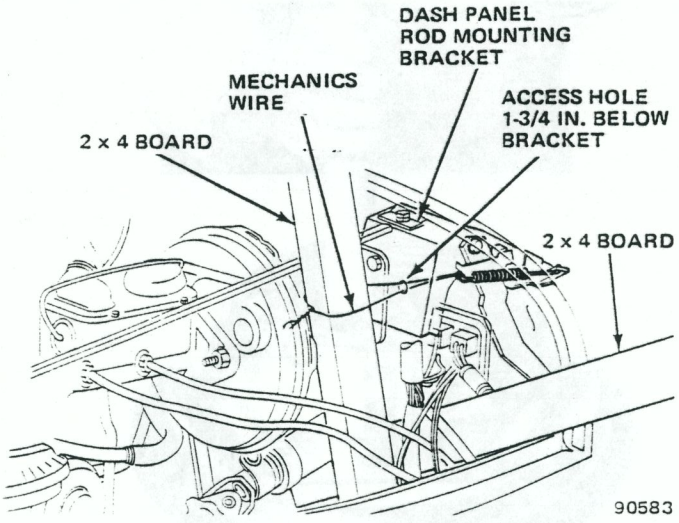

Fig. 2A-17 Clutch Pedal Overcenter Spring Removal/Installation

(7) Position bottom end of 2 x 4 board inserted in looped end of wire against 2 x 4 board on dash panel and pull back on board to release overcenter spring from clutch pedal.

CAUTION: *Be sure the 2 x 4 boards do not contact any of the brake lines during overcenter spring removal or installation.*

(8) Clamp vise grips on lower end of clutch pedal support bracket. Bend bracket downward to provide access to end of overcenter spring that is attached to bracket. Disconnect and remove overcenter spring after bending support bracket.

(9) Connect replacement overcenter spring to pedal support bracket.

(10) Install mechanics wire on new overcenter spring and position spring on lower portion of clutch pedal.

(11) Pull 2 x 4 board (with wire wrapped around it) forward until overcenter spring slides into and seats in pedal arm slot. Have helper observe and assist in spring seating if necessary.

NOTE: *As the spring is pulled forward, it will ride along the pedal edge until it seats in the pedal slot.*

(12) Remove 2 x 4 boards and mechanics wire.

(13) Plug hole drilled in dash panel.

(14) Install main wiring harness in dash panel clip.

(15) Connect battery negative cable.

CLUTCH PEDAL REPLACEMENT—CJ MODELS

(1) Disconnect battery negative cable.

(2) Disconnect clutch pedal push rod at bellcrank.

(3) Remove fuse panel attaching screws and remove panel.

(4) Remove main wiring harness from clip that secures harness to dash panel. Clip is located below dash panel rod mounting bracket.

(5) Center punch and drill 3/8-inch diameter access hole in dash panel, 1-3/4 inches below center of dash panel rod mounting bracket (fig. 2A-17).

(6) Feed 3-foot long double strand of heavy gauge mechanics wire through hole just drilled in dash panel.

(7) Wrap wire around end of clutch pedal overcenter spring and feed wire back-out of drilled hole. Twist ends of wire together securely to form loop.

(8) Insert a 2 x 4 board through looped end of wire. Position a second 2 x 4 board against dash panel to pry against (fig. 2A-17).

(9) Position bottom end of 2 x 4 board inserted in looped end of wire against 2 x 4 board on dash panel. Pull back on board to release overcenter spring from clutch pedal.

CAUTION: *Be sure the 2 x 4 boards do not contact any of the brake lines during overcenter spring removal or installation.*

(10) Clamp vise grips on lower end of clutch pedal support bracket. Bend bracket downward to provide access to end of overcenter spring that is attached to bracket. Disconnect and remove overcenter spring.

(11) Remove snap ring on end of pedal shaft and remove clutch pedal.

(12) Disconnect clutch pedal push rod from clutch pedal and remove clutch pedal.

(13) Lubricate bushings in replacement clutch pedal with Lubriplate, or equivalent, lubricant.

(14) Connect clutch pedal push rod to replacement clutch pedal.

(15) Install clutch pedal on pedal shaft and install snap ring on end of shaft.

(16) Install fuse panel.
(17) Connect clutch pedal push rod to bellcrank.
(18) Position overcenter spring on lower portion of clutch pedal.
(19) Pull 2 x 4 board (and mechanics wire) forward until overcenter spring slides into and seats in pedal arm slot.

NOTE: *As the spring is pulled forward, it will ride along the pedal arm edge and snap into the pedal slot.*

(20) Remove 2 x 4 boards and mechanics wire.
(21) Plug access hole drilled in dash panel.
(22) Secure main wire harness in clip.
(23) Connect battery negative cable.
(24) Check and adjust clutch pedal free play if necessary.

CLUTCH PEDAL AND OVERCENTER SPRING REPLACEMENT—CHEROKEE-WAGONEER-TRUCK

Overcenter Spring

Overcenter Spring Removal

(1) On vehicles with air conditioning, remove left side duct extension.
(2) Disconnect clutch push rod at clutch pedal.
(3) Remove clutch pedal stop.
(4) Press clutch pedal halfway down to spread overcenter spring coils slightly and insert thin shims between overcenter spring coils.
(5) Raise clutch pedal until pedal stops against lower edge of instrument panel.
(6) Disconnect and remove overcenter spring from pedal and support bracket.

Installation

(1) Insert thin shims between overcenter spring coils.
(2) Install overcenter spring on support bracket and clutch pedal.
(3) Remove shims from overcenter spring coils.
(4) Connect clutch push rod to clutch pedal.
(5) Install clutch pedal stop.
(6) Check clutch release rod position. Be sure rod has not become disengaged from throwout lever.
(7) Check and adjust clutch pedal free play if necessary.

Clutch Pedal

Removal

(1) Disconnect battery negative cable.
(2) Remove bolt attaching engine compartment wiring harness to dash panel connector.
(3) Disconnect engine compartment wiring harness out of dash panel connector.
(4) On vehicles with air conditioning, remove left side duct extension.
(5) Disconnect clutch push rod at clutch pedal.
(6) Remove clutch pedal stop.
(7) Remove overcenter spring. Refer to Clutch Pedal Overcenter Spring Replacement—Cherokee-Wagoneer-Truck.
(8) Remove fuse panel attaching screws and remove fuse panel.
(9) Remove snap ring from clutch pedal end of pedal shaft using snap ring pliers with 90 degree tips.
(10) Remove clutch pedal from pedal shaft.

Installation

(1) Install clutch pedal on pedal shaft.
(2) Install retaining snap ring on clutch pedal end of pedal shaft. Be sure ring is fully seated.
(3) Install fuse panel.
(4) Install overcenter spring. Refer to Clutch Pedal Overcenter Spring Replacement—Cherokee-Wagoneer-Truck.
(5) Install clutch pedal stop.
(6) Connect clutch push rod to clutch pedal.
(7) On vehicles with air conditioning, install left side duct extension.
(8) Connect engine compartment wiring harness to dash panel connector and install connector attaching screw.
(9) Install battery negative cable.
(10) Check and adjust clutch pedal free play if necessary.

SPECIFICATIONS

Clutch Specifications

Model	Engine (CID)	Clutch Diameter	Release Lever Height (Above Gauge Hub)	Pedal Free Play
CJ-5/CJ-7	151	9-1/8 (23.5 cm)	1.595 to 1.720 (40.5 to 43.7 mm)	N/A
	258 304	10-1/2 in. (26.7 cm)	3/32 to 7/64 in. (2.3 to 2.7 mm)	1 to 1-1/4 in. (25.4 to 31.7 mm)
Cherokee, Wagoneer, Truck	258 360	11 (27.9 cm)	3/16 (4.7 mm)	3/8 to 5/8 (9.5 to 15.8 mm)

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Clutch Housing Alignment Specifications

Clutch Housing Bore to Crankshaft Centerline	0.010 max. (0.25 mm)
Clutch Housing Transmission Mounting Face to Crankshaft Centerline	0.010 max. (0.25 mm)
Clutch Housing to Transmission Adapter Bore to Crankshaft Centerline	0.010 max. (0.25 mm)
Clutch Housing to Transmission Adapter Face to Crankshaft Centerline	0.010 max. (0.25 mm)
Flywheel Runout at Face	0.005 max. (0.12 mm)

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Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft-lbs)		Metric (N·m)	
	Service Set-To Torque	In-Use Recheck Torque	Service Set-To Torque	In-Use Recheck Torque
Clutch Bellcrank Bracket to Frame Rail Bolt (Cke., Trk.)	14	12-16	19	16-22
Clutch Bellcrank Pivot	35	30-40	47	41-54
Clutch Housing Inspection Cover Screws:				
Four-Cylinder	30	25-35	41	34-47
Clutch Housing Spacer to Block Bolt (Eight-Cylinder Engines)	15	12-17	20	16-23
Clutch Housing to Engine Block Bolt				
Six-Cylinder Engines				
Top	35	30-40	47	41-54
Bottom	45	40-50	61	54-68
Eight-Cylinder Engines				
Top	30	25-35	41	34-47
Bottom	30	25-35	41	34-47
Clutch Housing-to-Engine Bolts:				
Four-Cylinder — All	54	46-62	73	62-84
Clutch Housing to Engine Dowel Bolt Nut (6- and 8-Cylinder)	45	40-50	61	54-68
Clutch Housing-to-Transmission Bolts:				
Four-Cylinder	54	46-62	73	62-84
Clutch, Hydraulic Fluid Line Fitting to Master Cylinder	132 in-lbs		120-144 in-lbs	
Clutch, Hydraulic Fluid Line Fitting to Slave Cylinder	190 in-lbs		160-220 in-lbs	
Clutch Pedal Rebound Bumper, Bolt, Nut, and Lockwasher Assembly to Pedal	40	35-45	54	47-61
Clutch Pedal Shaft Locknut	33	30-36	45	41-49
Flywheel-to-Crankshaft Bolts:				
Four-Cylinder	65	59-71	88	80-96
Rear Crossmember Stud Nuts:				
Four-Cylinder	35	30-40	47	41-54
Starter Motor-to-Clutch Housing Bolt:				
Four-Cylinder	54	46-62	73	62-84
Six- and Eight-Cylinder	18	12-25	24	16-34
Transmission Case to Clutch Housing Bolt	55	50-60	74	68-81
Transmission Support Cushion-to-Crossmember Bolt:				
Four-Cylinder	25	20-30	34	27-41

All Torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified. Refer to Standard Torque Specifications and Capscrew Markings Chart in Section A of this manual for any torque specifications not listed above.

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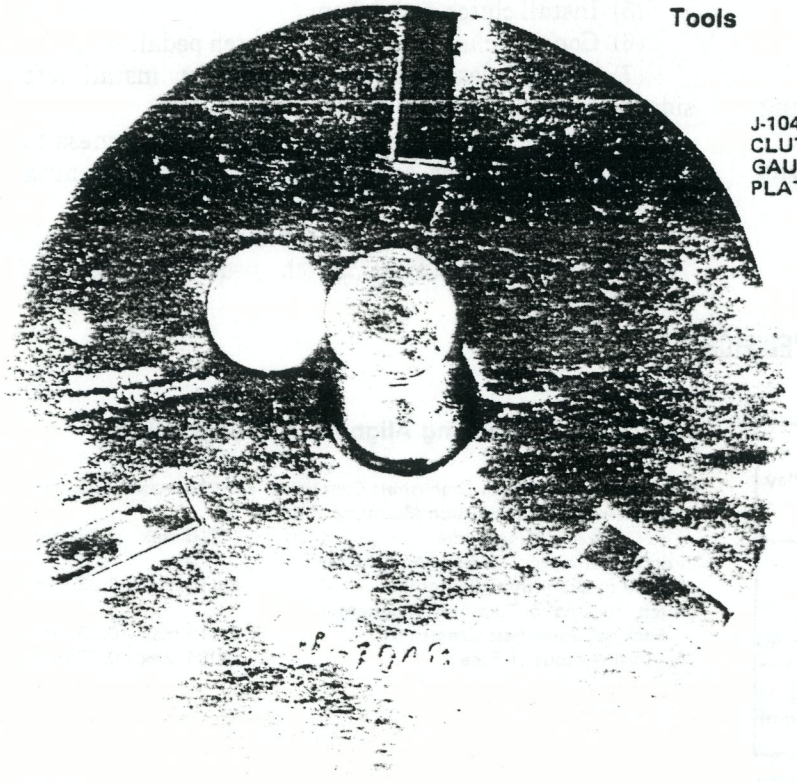
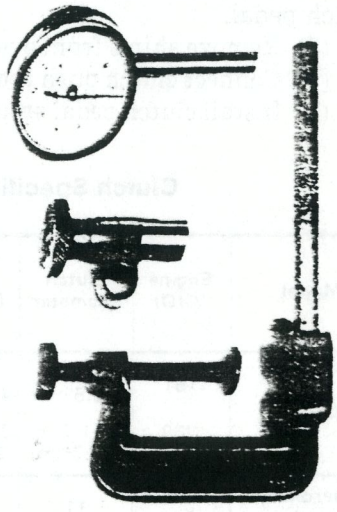
Tools



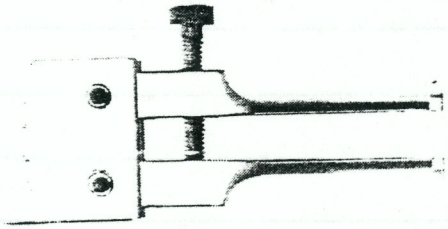
J-1048
CLUTCH
GAUGE
PLATE



J-8001
DIAL
INDICATOR
SET

Tools

J-22056 OR J-25353
ALIGNING
TOOL



REMOVER TOOL
J-5822

J-23330
CLUTCH LEVER
HEIGHT GAUGE

SLIDE HAMMER
J-2619-01

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NOTES

MANUAL TRANSMISSION 2B

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GENERAL

Three manual transmission models are used in Jeep vehicles; they are Models SR-4, T-176, and T-18A.

Models SR-4 and T-176 are 4-speed, constant mesh units providing synchromesh engagement in all forward gear ranges. Model T-18A is a 4-speed, constant mesh unit providing synchromesh engagement in second, third, and fourth gear ranges only. First (low) gear is not synchronized in this transmission.

Model SR-4 is used with four- and six-cylinder engines. Model T-176 is used with six- and eight-cylinder engines. Model T-18A is used in J-20 Truck models only.

The three transmission models are all floor shift units. Column shift units are not available in any Jeep model.

The shift mechanism on all transmission models is located within the shift control housing which also serves as the transmission top cover. The shift mechanism does not require adjustment and can be serviced independently of the transmission.

GEARSHIFT PATTERNS

The gearshift pattern for each transmission model is shown in the Gearshift Pattern Chart. Forward gear ranges for each model are in a standard "H" configuration. However, reverse gear position differs between them. The SR-4 requires that the lever be pressed downward first before moving into the reverse position.

BACKUP LAMP SWITCH

A spring and plunger-type backup lamp switch is used on all models. The switch is located in the shift control housing and is actuated by the reverse shift rail. The switch does not require adjustment and is serviced as an assembly only.

IDENTIFICATION

An identification tag displaying the Jeep part number is attached to the shift control housing. The information on this tag is necessary to obtain correct replacement parts should replacement become necessary. Be sure the tag is securely attached in the original location after completing all service operations.

TRANSMISSION GEAR RATIOS

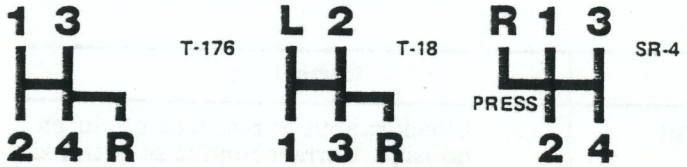
Different ratio gear sets are used in SR-4 and T-176 transmissions. The ratios used for six- and eight-cylinder engine applications are not the same. Refer to the Transmission Gear Ratio Chart at the end of this section for ratio applications.

Service Diagnosis

Condition	Possible Cause	Correction
TRANSMISSION SHIFTS HARD	(1) Clutch adjustment incorrect	(1) Adjust clutch.
	(2) Clutch linkage or cable binding	(2) Lubricate or repair as necessary.
	(3) Shift rail binding	(3) Check for mispositioned selector arm roll pin, loose cover bolts, worn shift rail bores, worn shift rail, distorted oil seal, or extension housing not aligned with case. Repair as necessary.
	(4) Internal bind in transmission caused by shift forks, selector plates, or synchronizer assemblies	(4) Remove, disassemble and inspect transmission. Replace worn or damaged components as necessary.
	(5) Clutch housing misalignment	(5) Check runout at rear face of clutch housing. Correct runout as outlined in Chapter 2A.
	(6) Incorrect lubricant	(6) Drain and refill transmission.
	(7) Block rings and/or cone seats worn	(7) Blocking ring to gear clutch tooth face clearance must be 0.030 inch or greater. If clearance is correct it may still be necessary to inspect blocking rings and cone seats for excessive wear. Repair as necessary.
GEAR CLASH WHEN SHIFTING FROM ONE GEAR TO ANOTHER	(1) Clutch adjustment incorrect	(1) Adjust Clutch.
	(2) Clutch linkage or cable binding	(2) Lubricate or repair as necessary.
	(3) Clutch housing misalignment	(3) Check runout at rear of clutch housing. Correct runout as outlined in Chapter 2A
	(4) Lubricant level low or incorrect lubricant	(4) Drain and refill transmission and check for lubricant leaks if level was low. Repair as necessary.
	(5) Gearshift components, or sychronizer assemblies worn or damaged	(5) Remove, disassemble and inspect transmission. Replace worn or damaged components as necessary.
TRANSMISSION NOISY	(1) Lubricant level low or incorrect lubricant	(1) Drain and refill transmission. If lubricant level was low, check for leaks and repair as necessary.
	(2) Clutch housing-to-engine, or transmission-to-clutch housing bolts loose	(2) Check and correct bolt torque as necessary.
	(3) Dirt, chips, foreign material in transmission	(3) Drain, flush, and refill transmission.
	(4) Gearshift mechanism, transmission gears, or bearing components worn or damaged	(4) Remove, disassemble and inspect transmission. Replace worn or damaged components as necessary.
	(5) Clutch housing misalignment	(5) Check runout at rear face of clutch housing. Correct runout as outlined in Chapter 2A.

Condition	Possible Cause	Correction
JUMPS OUT OF GEAR	(1) Clutch housing misalignment	(1) Check runout at rear face of clutch housing. Correct runout as outlined in Chapter 2A.
	(2) Gearshift lever loose	(2) Check lever for worn fork. Tighten loose attaching bolts.
	(3) Offset lever nylon insert worn or lever attaching nut loose	(3) Remove gearshift lever and check for loose offset lever nut or worn insert. Repair or replace as necessary.
	(4) Gearshift mechanism, shift forks, selector plates, interlock plate, selector arm, shift rail, detent plugs, springs or shift cover worn or damaged	(4) Remove, disassemble and inspect transmission cover assembly. Replace worn or damaged components as necessary.
	(5) Clutch shaft or roller bearings worn or damaged	(5) Replace clutch shaft or roller bearings as necessary.
	(6) Gear teeth worn or tapered, synchronizer assemblies worn or damaged, excessive end play caused by worn thrust washers or output shaft gears	(6) Remove, disassemble, and inspect transmission. Replace worn or damaged components as necessary.
	(7) Pilot bushing worn	(7) Replace pilot bushing.
WILL NOT SHIFT INTO ONE GEAR	(1) Gearshift selector plates, interlock plate, or selector arm, worn, damaged, or incorrectly assembled	(1) Remove, disassemble, and inspect transmission cover assembly. Repair or replace components as necessary.
	(2) Shift rail detent plunger worn, spring broken, or plug loose	(2) Tighten plug or replace worn or damaged components as necessary.
	(3) Gearshift lever worn or damaged	(3) Replace gearshift lever.
	(4) Synchronizer sleeves or hubs, damaged or worn	(4) Remove, disassemble and inspect transmission. Replace worn or damaged components.
LOCKED IN ONE GEAR — CAN NOT BE SHIFTED OUT	(1) Shift rail(s) worn or broken, shifter fork bent, setscrew loose, center detent plug missing or worn	(1) Inspect and replace worn or damaged parts.
	(2) Broken gear teeth on countershaft gear, clutch shaft, or reverse idler gear	(2) Inspect and replace damaged part.
	(3) Gearshift lever broken or worn, shift mechanism in cover incorrectly assembled or broken, worn damaged gear train components	(3) Disassemble transmission. Replace damaged parts or assemble correctly.

Gearshift Pattern Chart



TRANSMISSION LUBRICANT

The recommended lubricant for all transmission models is SAE 85W-90, A.P.I. classification GL-5 Gear Lubricant. This lubricant grade should be used during all service and maintenance operations.

NOTE: *Do not use gear lubricants containing lead, chlorine, or sulphur compounds.*

When refilling or adding lubricant to the transmission, fill the transmission until the lubricant level is at the lower edge of the fill plug hole only. Lubricant capacities for the three transmission models are:

- SR-4—3.0 Pints (1.4 liters).
- T-176—3.5 Pints (1.7 liters).
- T-18A—6.5 Pints (3.07 liters).

TRANSMISSION REMOVAL

(1) Remove screws attaching transmission shift lever boot to floorpan and slide boot upward on lever.

(2) On models with SR-4 transmission, remove bolts attaching transmission shift lever housing to transmission. Lift shift lever and housing upward and secure assembly to floorpan with wire.

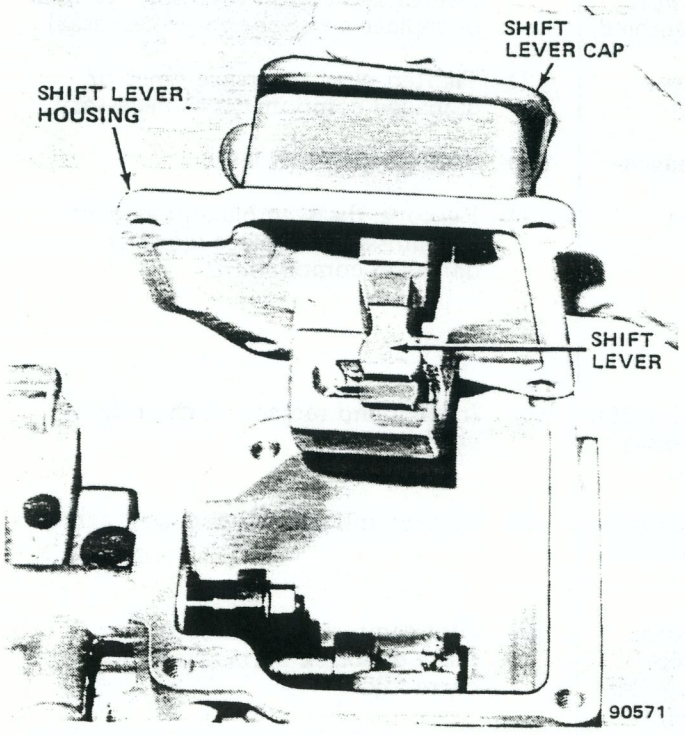


Fig. 2B-1 Shift Lever Removal—Model SR-4

(3) On models with T-18A transmission, unthread shift lever cap and remove cap, gasket, spring seat, spring and shift lever as assembly. Remove shift lever locating pin from housing.

(4) On models with T-176 transmission, press and turn transmission shift lever retainer to release lever. Remove lever, boot, spring and seat as assembly.

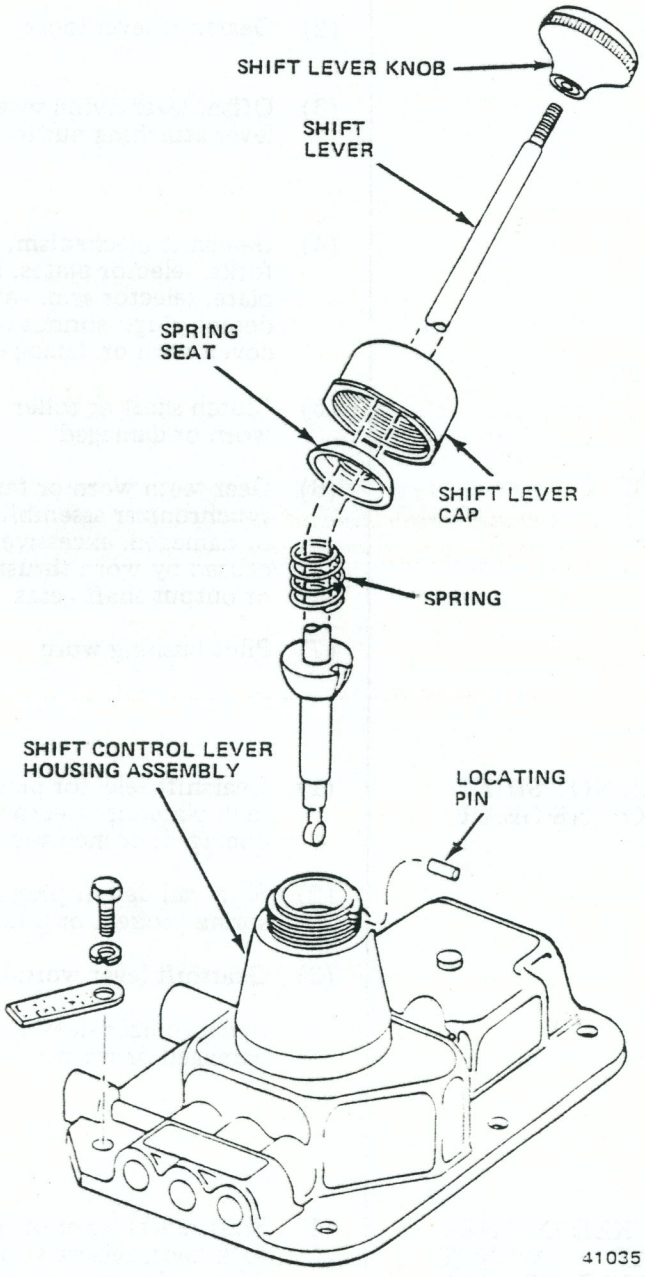


Fig. 2B-2 Shift Lever Removal—Model T-18A

(5) Raise vehicle.

(6) Mark rear propeller shaft and transfer case yoke for assembly alignment reference.

(7) Disconnect rear propeller shaft at transfer case yoke. Move shaft aside and secure to underbody with wire.

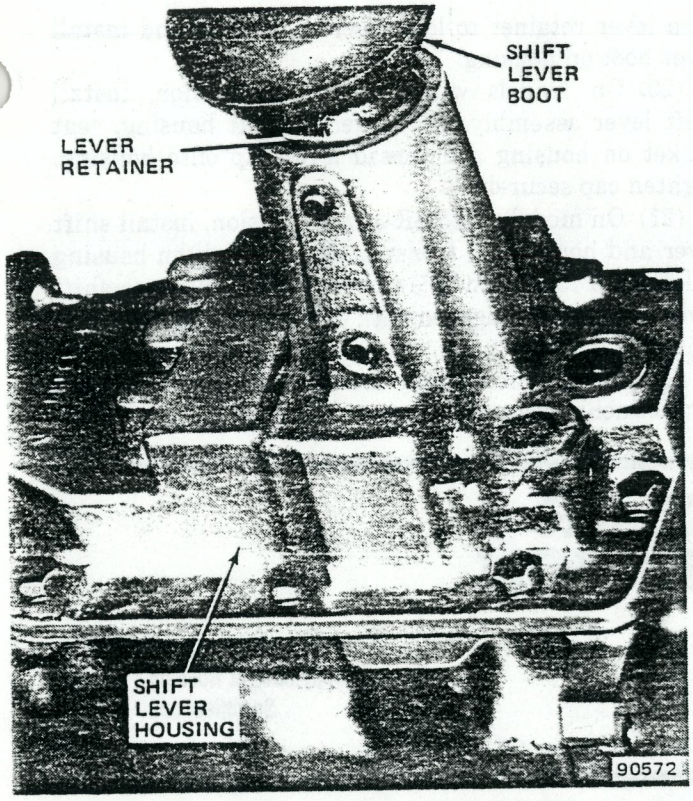


Fig. 2B-3 Shift Lever Removal—Model T-176

(8) On Cherokee and Truck models, disconnect front parking brake cable at equalizer. Remove clip that retains rear cable to rear crossmember and move cable aside.

(9) Position safety stand under clutch housing to support engine.

(10) Remove nuts and bolts attaching rear crossmember to frame rails and rear support cushion and remove crossmember.

(11) Disconnect speedometer cable.

(12) Disconnect backup light switch wire.

(13) Disconnect four-wheel drive indicator switch wire.

(14) Disconnect transfer case vent hose at transfer case.

(15) Mark front propeller shaft and transfer case yoke for assembly alignment reference.

(16) Disconnect front propeller shaft from transfer case yoke. Move shaft aside and secure to underbody with wire.

(17) On CJ models, remove transfer case shift lever as follows: Remove shifter shaft retaining nut. Remove cotter pins that retain shift control link pins in shift rods and remove pins. Remove shifter shaft and disengage shift lever from shift control links. Slide lever upward in boot to move lever out of way.

NOTE: *On some models, the shifter shaft must be unthreaded from the shift lever in order to remove it. On other models, the shaft can be removed simply by sliding it out of the lever.*

(18) On Cherokee and Truck models, remove cotter pin and washers that connect link to shift lever and disconnect link from shift lever.

(19) Support transmission-transfer case assembly with transmission jack. Use safety chain to secure assembly on jack.

(20) Remove bolts attaching transmission to clutch housing and remove transmission-transfer case assembly.

(21) Remove bolts attaching transfer case to transmission and remove transfer case.

(22) Clean old gasket material and sealer from mating surfaces of transmission and transfer case.

(23) Remove pilot bushing lubricating wick from bushing and soak wick in engine oil. Use long needle-nose pliers to remove wick from bushing.

TRANSMISSION INSTALLATION

(1) Install pilot bushing lubricating wick and align throwout bearing with splines in driven plate hub.

(2) Shift transmission into gear using shift lever or long screwdriver. This prevents clutch shaft from rotating during installation and makes clutch shaft-to-driven plate spline alignment easier.

(3) Mount transmission on transmission jack. Raise transmission and align transmission clutch shaft with splines in driven plate hub.

(4) Install transmission. When transmission is seated on clutch housing, install and tighten transmission-to-clutch housing bolts to 55 foot-pounds (75 N•m) torque.

(5) Apply Permatex Number 3 sealer, or equivalent, to both sides of replacement transmission-to-transfer case gasket and position gasket on transfer case.

(6) Mount transfer case on transmission jack. Raise transfer case and align transmission output shaft and transfer case input shaft splines.

(7) Install transfer case on transmission. On CJ models, install and tighten transfer case attaching bolts to 30 foot-pounds (41 N•m) torque. On Cherokee and Truck models, install and tighten transfer case attaching stud nuts to 40 foot-pounds (54 N•m) torque.

(8) On CJ models, install transfer case shift lever, shifter shaft, link pins and control link assembly. On Cherokee and Truck models, connect shift lever link to operating lever on transfer case.

(9) Connect front propeller shaft to transfer case yoke. Tighten clamp strap bolts to 15 foot-pounds (20 N•m) torque. Be sure shaft and yoke are aligned according to reference marks made at disassembly.

(10) Connect vent hose to transfer case.

(11) Connect wire to four-wheel drive indicator switch.

(12) Connect speedometer cable.

(13) Install rear crossmember. Tighten crossmember attaching nuts and bolts to 30 foot-pounds (41 N•m) torque.

(14) Remove safety stand used to support engine.

(15) On Cherokee and Truck models, connect parking brake rear cable to clip that retains cable on crossmember, and connect front cable to equalizer.

(16) Connect rear propeller shaft to transfer case yoke. Tighten clamp strap bolts to 15 foot-pounds (20 N•m) torque. Be sure shaft and yoke are aligned according to reference marks made at disassembly.

(17) Check and correct transmission and transfer case lubricant levels, if necessary.

(18) Lower vehicle.

(19) On models with T-176 transmission, install shift lever assembly. Seat lever in shift housing, press and turn lever retainer to lock lever in housing and install lever boot on housing.

(20) On models with T-18A transmission, install shift lever assembly. Seat lever in shift housing, seat gasket on housing and thread lever cap onto housing. Tighten cap securely.

(21) On models with SR-4 transmission, install shift lever and housing on transmission and tighten housing bolts to 10 foot-pounds (14 N•m) torque. Be sure shift lever is properly engaged with offset lever before tightening housing bolts.

(22) Position shift lever boot on floorpan and install boot attaching screws.

MODEL SR-4 4-SPEED TRANSMISSION

	Page		Page
Assembly	2B-10	Shift Control Housing	2B-12
Cleaning and Inspection	2B-7	Specifications	2B-14
Disassembly	2B-6		

DISASSEMBLY

(1) Remove bolts attaching transfer case to transmission.

(2) Remove transfer case from transmission.

(3) Place drain pan under transmission and adapter housing.

(4) Remove drain bolt (fig. 2B-4) and drain lubricant from transmission.

(5) Remove flanged nut attaching offset lever to shift rail (fig. 2B-5) and remove offset lever.

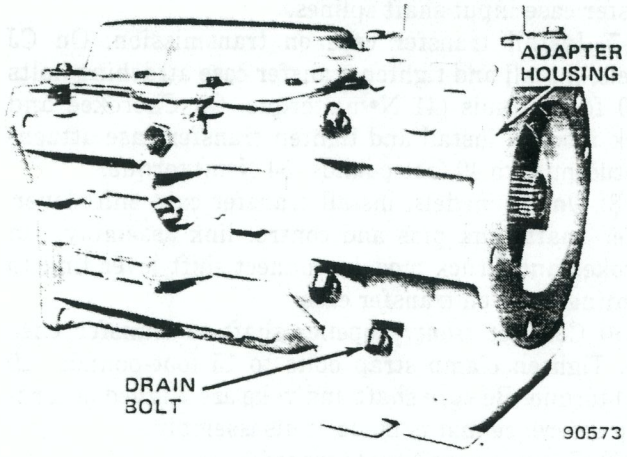


Fig. 2B-4 Drain Bolt Location

(6) Remove bolts attaching adapter housing to transmission case and remove housing.

(7) Remove shift control housing and gasket from transmission (fig. 2B-6). Discard gasket.

NOTE: *Two of the shift control housing attaching bolts are dowel-type alignment bolts (fig. 2B-6). Note the location of these bolts for assembly reference.*

(8) Remove spring clip that attaches reverse lever to reverse lever pivot bolt (fig. 2B-7).

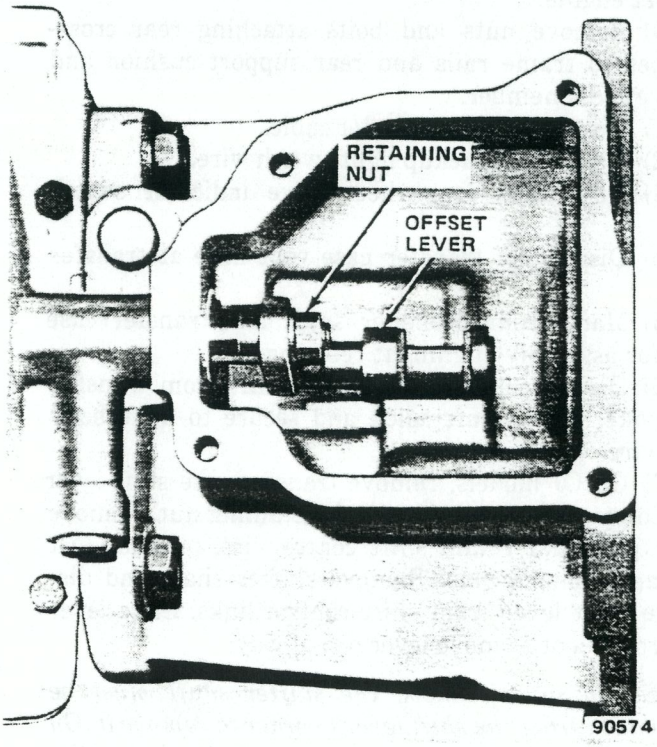


Fig. 2B-5 Offset Lever and Retaining Nut

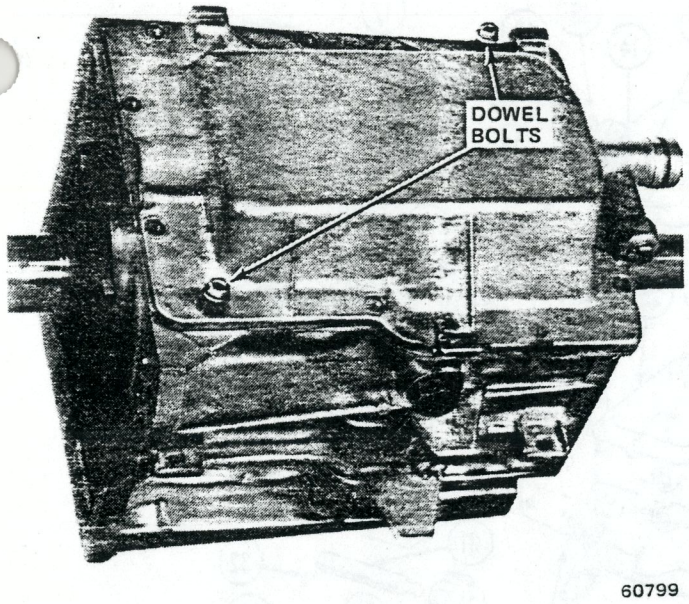


Fig. 2B-6 Shift Control Housing Dowel Bolt Location

(9) Remove reverse lever pivot bolt (fig. 2B-8) and remove reverse lever and reverse lever fork as assembly.

(10) Punch alignment marks in front bearing cap and transmission case for assembly reference and remove bearing cap and gasket. Discard gasket.

(11) Remove small retaining and large locating snap rings from front and rear bearings.

(12) Remove front bearing from clutch shaft using Bearing Remover J-8157-01, Puller Bolts J-26636 and Puller Assembly J-25152 (fig. 2B-9), and remove clutch shaft from case.

(13) Remove rear bearing from output shaft using Bearing Remover J-8157-01, Puller Bolts J-26827, and Puller Assembly J-25152 (fig. 2B-10).

(14) Remove output shaft and gear train as assembly. Do not allow first-second or third-fourth synchronizer sleeves to separate from hubs during removal.

(15) Push reverse idler gear shaft out rear of case and remove shaft and reverse idler gear.

(16) Remove countershaft from rear of case using Countershaft Loading Tool J-26624 (fig. 2B-11).

(17) Remove countershaft gear and loading tool as assembly and remove countershaft gear thrust washers and any clutch shaft pilot bearings that fell into case during disassembly.

NOTE: *The countershaft gear front thrust washer is plastic. The rear washer is metal.*

(18) Remove countershaft loading tool, needle bearing retainers and 50 needle bearings from countershaft gear.

Disassembly—Output Shaft Gear Train

(1) Scribe alignment marks on third-fourth synchronizer hub and sleeve for assembly alignment reference (fig. 2B-12).

(2) Remove output shaft snap ring (fig. 2B-12) and remove third-fourth synchronizer assembly.

(3) Disassemble third-fourth synchronizer assembly. Remove blocking rings, insert springs and inserts, and separate synchronizer sleeve from hub.

(4) Remove third gear.

(5) Remove second gear retaining snap ring, remove tabbed thrust washer and remove second gear and blocking ring.

(6) Remove first gear thrust washer (fig. 2B-13) and first gear roll pin (fig. 2B-14) from rear of output shaft. Use diagonal cutters to remove roll pin.

NOTE: *The thrust washer has an oil groove and roll pin locating slot on one side. This side must face first gear when assembled.*

(7) Remove first gear and blocking ring.

(8) Scribe alignment marks on first-second synchronizer sleeve and output shaft hub for assembly reference.

(9) Remove insert spring and inserts from first-second sleeve and remove sleeve from output shaft hub.

CAUTION: *Do not attempt to remove the first-second-reverse hub from the output shaft. The hub and shaft are assembled and machined as a matched unit during manufacture to insure concentricity.*

CLEANING AND INSPECTION

Thoroughly wash all parts in solvent and dry them with compressed air. Do not dry the front or rear bearings with compressed air. Allow them to air dry or wipe them dry with a clean shop cloth.

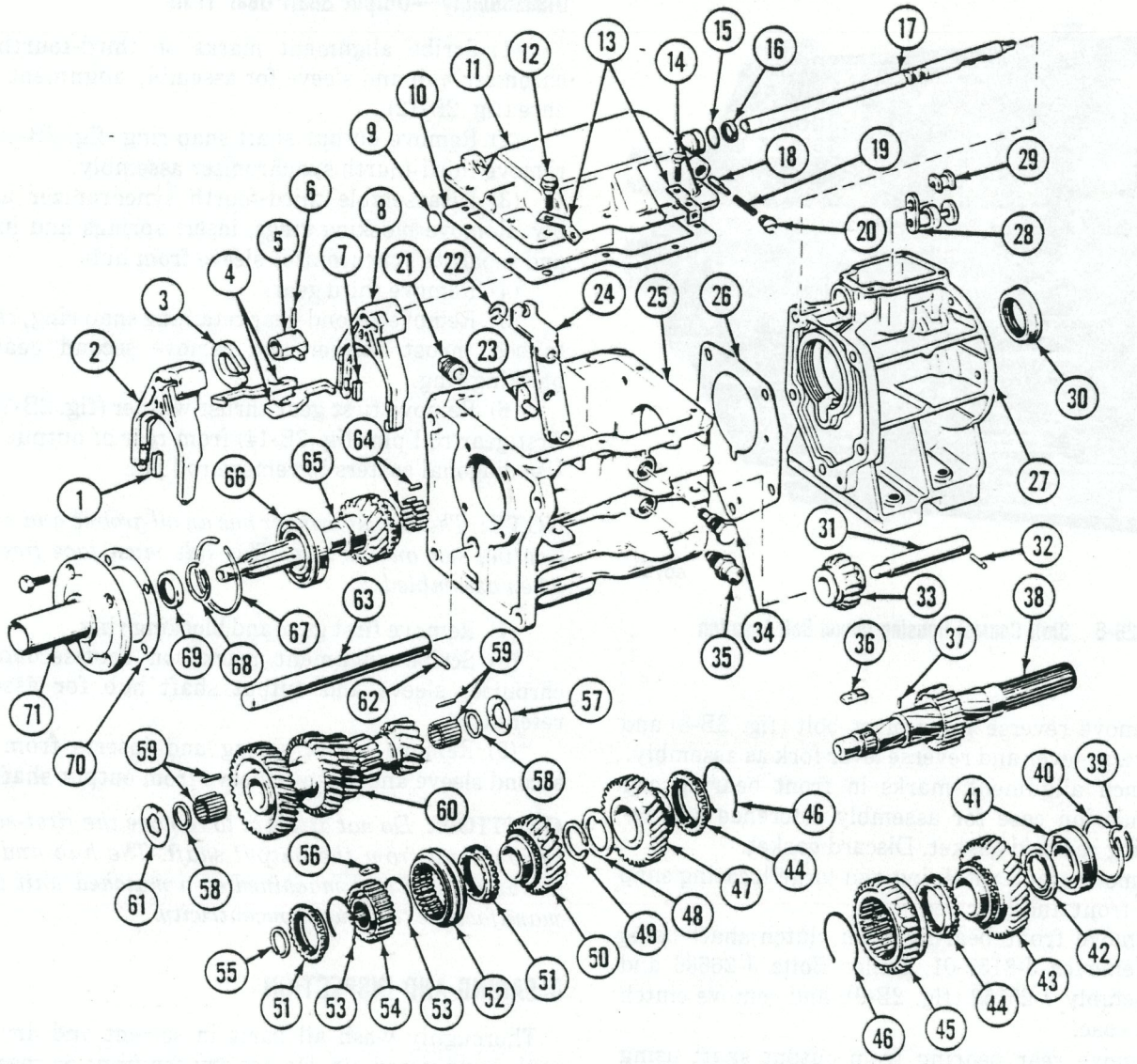
Clean the needle and roller bearings by wrapping them in a cloth and submerging the cloth and bearings in solvent. Or, place them in a shallow parts cleaning tray and cover them with solvent. Allow the bearings to air dry or wipe them dry with a clean shop cloth.

Inspect the transmission case, cover and extension housing. Replace any of these parts if they exhibit the following conditions:

- Cracks in bores, sides, bosses or at bolt holes.
- Stripped threads in bolt holes.
- Nicks, burrs, rough surfaces in shaft bores or on gasket surfaces.

Inspect the gear train and shift mechanism. Replace any parts that exhibit the following conditions:

- Broken, chipped or worn gear teeth.
- Bent or broken inserts.
- Weak or broken insert springs.
- Damaged roller or needle bearings, or bearing bores in countershaft gear or clutch shaft.



1. THIRD – FOURTH SHIFT INSERT
2. THIRD – FOURTH SHIFT FORK
3. SELECTOR INTERLOCK PLATE
4. SELECTOR ARM PLATE (2)
5. SELECTOR ARM
6. SELECTOR ARM ROLL PIN
7. FIRST – SECOND SHIFT FORK INSERT
8. FIRST – SECOND SHIFT FORK
9. SHIFT RAIL PLUG
10. TRANSMISSION COVER GASKET
11. TRANSMISSION COVER
12. TRANSMISSION COVER DOWEL BOLT (2)
13. CLIP
14. TRANSMISSION COVER BOLT (8)
15. SHIFT RAIL O-RING SEAL
16. SHIFT RAIL OIL SEAL
17. SHIFT RAIL
18. DETENT PLUNGER
19. DETENT SPRING
20. DETENT PLUG
21. FILL PLUG
22. REVERSE LEVER PIVOT BOLT C-CLIP
23. REVERSE LEVER FORK
24. REVERSE LEVER
25. TRANSMISSION CASE
26. GASKET
27. ADAPTER HOUSING
28. OFFSET LEVER
29. OFFSET LEVER INSERT
30. EXTENSION HOUSING OIL SEAL
31. REVERSE IDLER SHAFT
32. REVERSE IDLER SHAFT ROLL PIN
33. REVERSE IDLER GEAR
34. REVERSE LEVER PIVOT BOLT
35. BACKUP LAMP SWITCH
36. FIRST – SECOND SYNCHRONIZER INSERT (3)
37. FIRST GEAR ROLL PIN
38. OUTPUT SHAFT AND HUB ASSEMBLY
39. REAR BEARING RETAINING SNAP RING
40. REAR BEARING LOCATING SNAP RING
41. REAR BEARING
42. FIRST GEAR THRUST WASHER
43. FIRST GEAR
44. FIRST – SECOND SYNCHRONIZER BLOCKING RING (2)
45. FIRST – REVERSE SLEEVE AND GEAR
46. FIRST – SECOND SYNCHRONIZER INSERT SPRING (2)
47. SECOND GEAR
48. SECOND GEAR THRUST WASHER (TABBED)
49. SECOND GEAR SNAP RING
50. THIRD GEAR
51. THIRD – FOURTH SYNCHRONIZER BLOCKING RING (2)
52. THIRD – FOURTH SYNCHRONIZER SLEEVE
53. THIRD – FOURTH SYNCHRONIZER INSERT SPRING (2)
54. THIRD – FOURTH SYNCHRONIZER HUB
55. OUTPUT SHAFT SNAP RING
56. THIRD – FOURTH SYNCHRONIZER INSERT (3)
57. COUNTERSHAFT GEAR REAR THRUST WASHER (METAL)
58. COUNTERSHAFT NEEDLE BEARING RETAINER (2)
59. COUNTERSHAFT NEEDLE BEARING (50)
60. COUNTERSHAFT GEAR
61. COUNTERSHAFT GEAR FRONT THRUST WASHER (PLASTIC)
62. COUNTERSHAFT ROLL PIN
63. COUNTERSHAFT
64. CLUTCH SHAFT ROLLER BEARINGS (15)
65. CLUTCH SHAFT
66. FRONT BEARING
67. FRONT BEARING LOCATING SNAP RING
68. FRONT BEARING RETAINING SNAP RING
69. FRONT BEARING CAP OIL SEAL
70. FRONT BEARING CAP GASKET
71. FRONT BEARING CAP

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Fig. 2B-7 Model SR-4 4-Speed Transmission

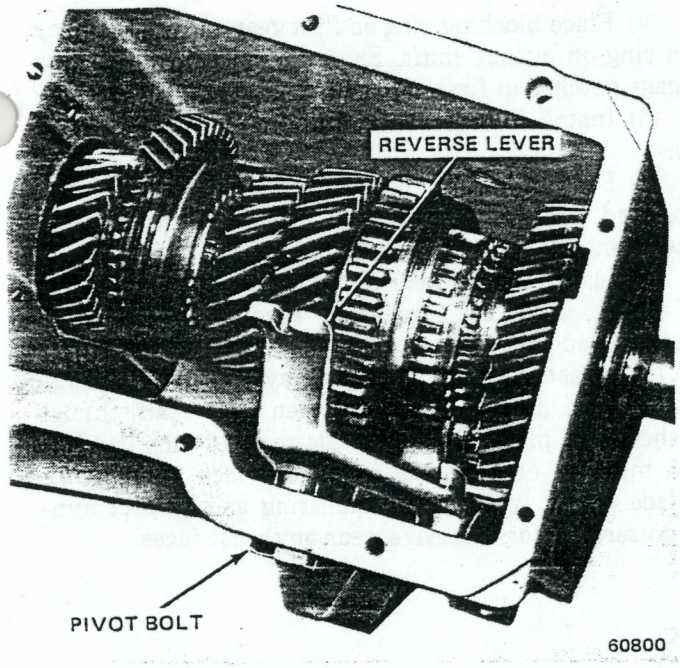


Fig. 2B-8 Reverse Lever and Pivot Bolt

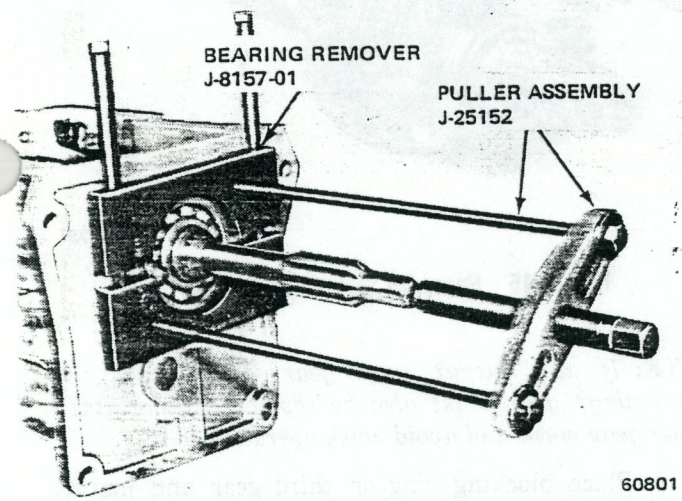


Fig. 2B-9 Front Bearing Removal

- Worn or galled countershaft and hub, clutch shaft or reverse idler gear shaft.
- Worn thrust washers.
- Nicked, broken or worn output or clutch shaft splines.
- Bent, distorted or weak snap rings.
- Worn bushings in reverse idler gear.
- Rough, galled or broken front or rear bearing.
- Worn shift fork inserts.
- Broken, cracked or worn shift forks.
- Bent, worn or galled shift rail.
- Worn, bent or broken selector arms, plates, or interlock.
- Worn, bent, broken or stripped offset lever, or worn lever insert.

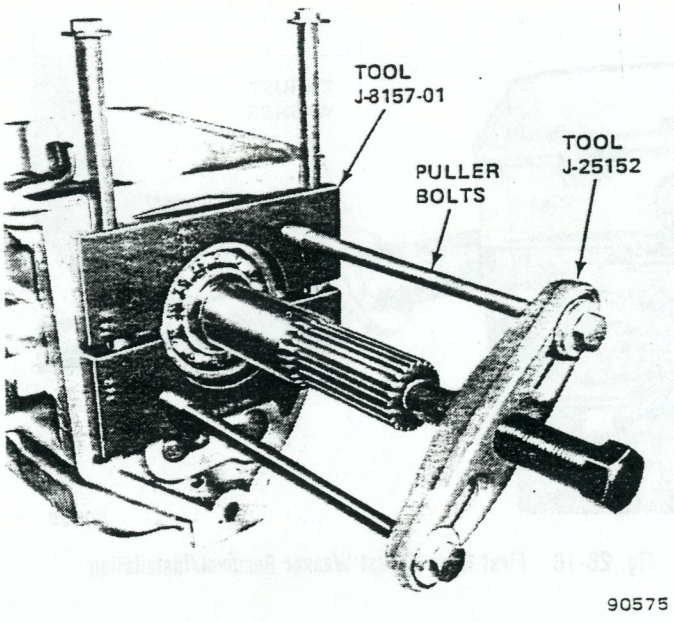


Fig. 2B-10 Rear Bearing Removal

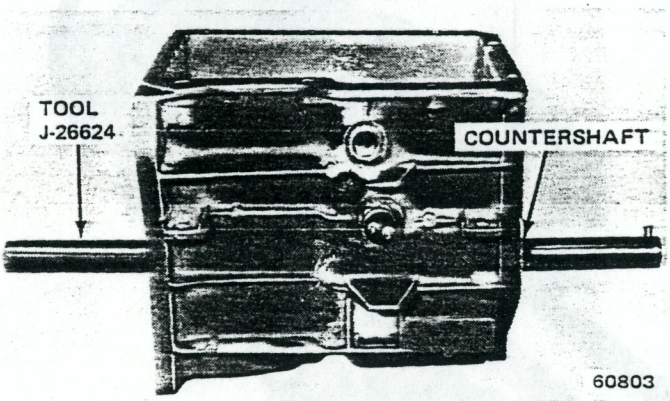


Fig. 2B-11 Countershaft Removal/Installation

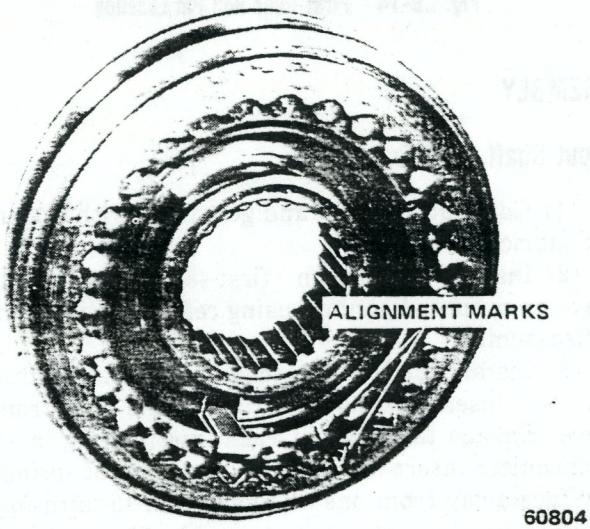


Fig. 2B-12 Marking Synchronizer Assembly

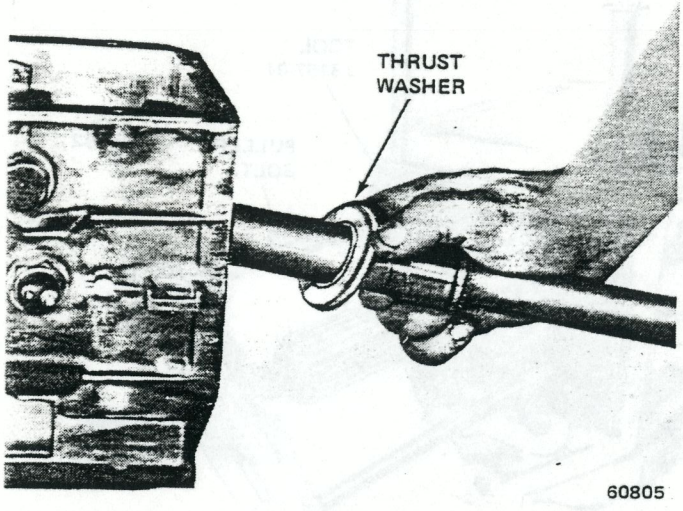


Fig. 2B-13 First Gear Thrust Washer Removal/Installation

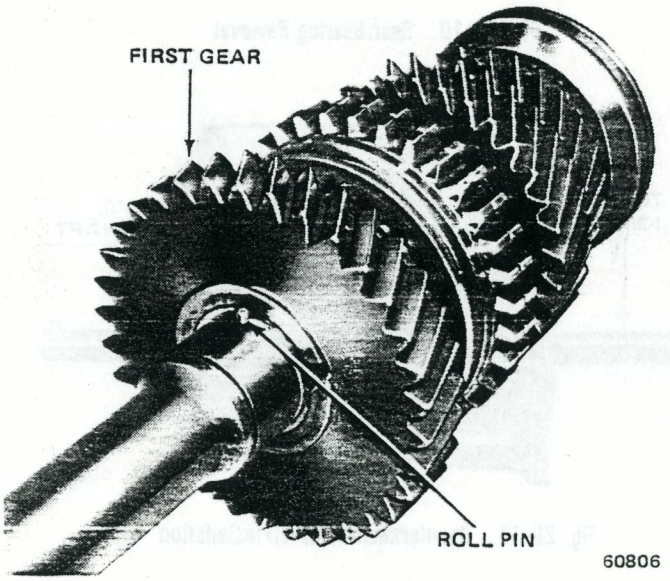


Fig. 2B-14 First Gear Roll Pin Location

ASSEMBLY

Output Shaft Gear Train

(1) Coat output shaft and gear bores with transmission lubricant.

(2) Install and align first-second synchronizer sleeve on output shaft hub using reference marks made at disassembly.

(3) Install three first-second synchronizer inserts and two insert springs in first-second synchronizer sleeve. Engage tang end of each insert spring in same synchronizer insert but position open ends of springs so they face away from one another. Refer to third-fourth synchronizer insert spring assembly illustration (fig. 2B-16).

(4) Place blocking ring on first gear and install gear and ring on output shaft. Be sure synchronizer inserts engage notches in first gear blocking ring.

(5) Install first gear roll pin in output shaft (fig. 2B-14).

(6) Place blocking ring on second gear and install gear and ring on output shaft. Be sure synchronizer inserts engage notches in second gear blocking ring.

(7) Install second gear thrust washer and snap ring on output shaft. Be sure sharp edge of washer faces outward and that tab is engaged in output shaft notch.

(8) Measure second gear end play using feeler gauge (fig. 2B-15). Insert gauge between gear and thrust washer. End play should be 0.004 to 0.014 inch (0.10 to 0.35 mm). If end play is over 0.014 inch (0.35 mm), replace thrust washer and snap ring and inspect synchronizer hub for excessive wear on thrust faces.

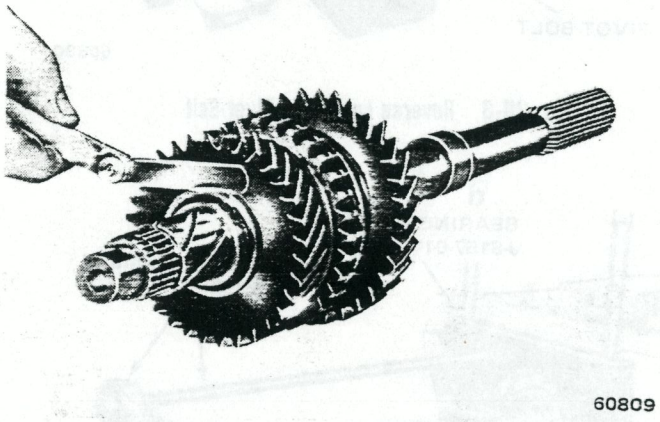


Fig. 2B-15 Measuring Second Gear End Play

NOTE: *If any output shaft gear is replaced, the countershaft gear must also be replaced to maintain proper gear mesh and avoid noisy operation.*

(9) Place blocking ring on third gear and install gear and ring on output shaft.

(10) Install and align third-fourth synchronizer sleeve on third-fourth synchronizer hub using reference marks made at disassembly.

(11) Install three inserts and two insert springs in third-fourth synchronizer. Engage tang end of each insert spring in same synchronizer insert but position open ends of springs so they face away from one another (fig. 2B-16).

(12) Install assembled third-fourth synchronizer on output shaft with machined groove in synchronizer hub facing forward and install output shaft snap ring. Be sure synchronizer inserts engage notches in third gear blocking rings.

(13) Measure third-fourth synchronizer end play using feeler gauge (fig. 2B-17). Insert gauge between output shaft snap ring and third-fourth synchronizer hub. End play should be 0.004 to 0.014 inch (0.10 to 0.35 mm).

If end play is over 0.014 inch (0.35 mm), replace snap ring and inspect synchronizer hub for excessive wear on thrust faces.

NOTE: *If any output shaft gear is replaced, the countershaft gear must also be replaced to maintain proper gear mesh and prevent noisy operation.*

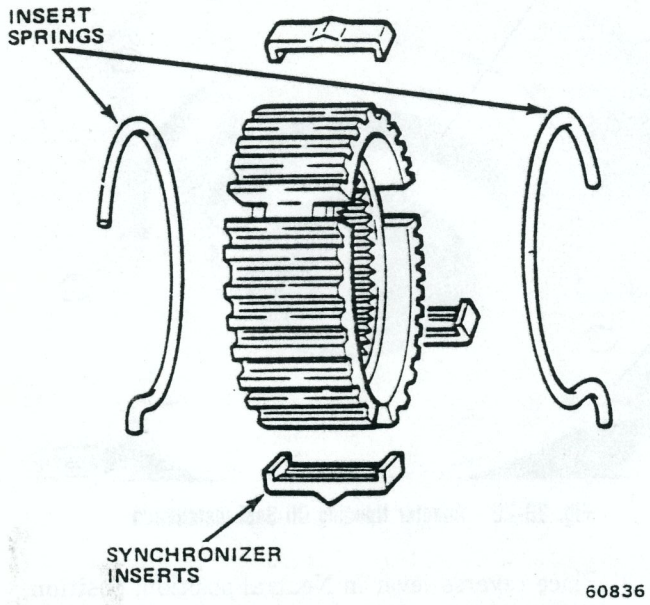


Fig. 2B-16 Third-Fourth Synchronizer Spring Installation

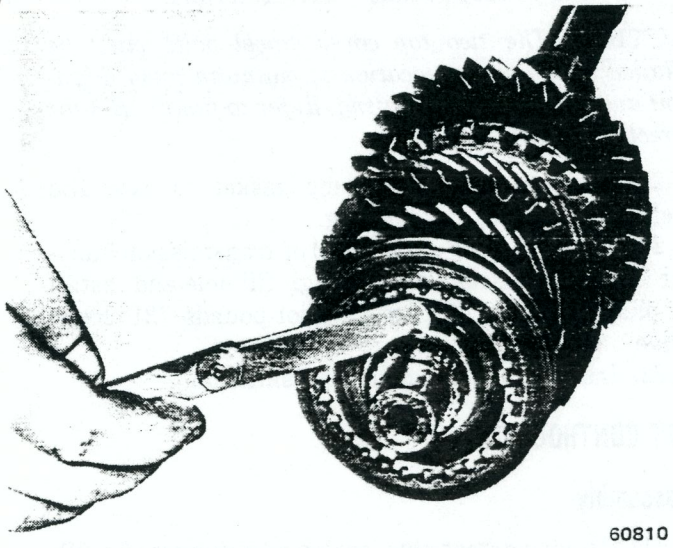


Fig. 2B-17 Measuring Third-Fourth Synchronizer End Play

Transmission Case

CAUTION: *Except for the gearshift lever attaching bolts and fill plug, all threaded holes and bolts used in the Model SR-4 Transmission are metric sizes. Do not attempt to substitute a different thread-type bolt if the original ones are lost.*

(1) Coat countershaft gear thrust washers with petroleum jelly and position washers in case.

NOTE: *Install the plastic washer at the front of the case and the metal washer at the rear.*

(2) Insert Countershaft Loading Tool J-26624 in countershaft gear. Install 50 needle bearings in bearing bores at front and rear of gear and install needle bearing retainers. Lubricate bearings with petroleum jelly during installation.

(3) Position assembled countershaft gear in case and install countershaft from rear of case (fig. 2B-11). Be sure that thrust washers are not displaced during installation of countershaft and gear.

(4) Position reverse idler gear in case with shift lever groove facing front of case and install reverse idler shaft from rear of case.

(5) Install output and gear train in case. Do not disturb position of synchronizer assemblies during installation.

(6) Install fourth gear blocking ring in third-fourth synchronizer sleeve. Be sure synchronizer inserts engage notches in blocking ring.

(7) Coat all 15 roller bearings and clutch shaft roller bearing bore with petroleum jelly (only) and install bearings in shaft bore.

(8) Install clutch shaft in case and engage shaft in third-fourth synchronizer sleeve and blocking ring.

(9) Install front bearing using Tool J-22697 (fig. 2B-18). Start front bearing onto clutch shaft. Position output shaft first gear against rear of case. Align bearing with bearing bore in case and drive bearing completely onto clutch shaft and into case.

NOTE: *To identify the front and rear bearings, inspect the bearing races. The rear bearing race has a notch in it, while the front bearing race does not.*

(10) Install front bearing retaining and locating snap rings.

(11) Install front bearing cap oil seal in front bearing cap using Tool J-26625 (fig. 2B-19).

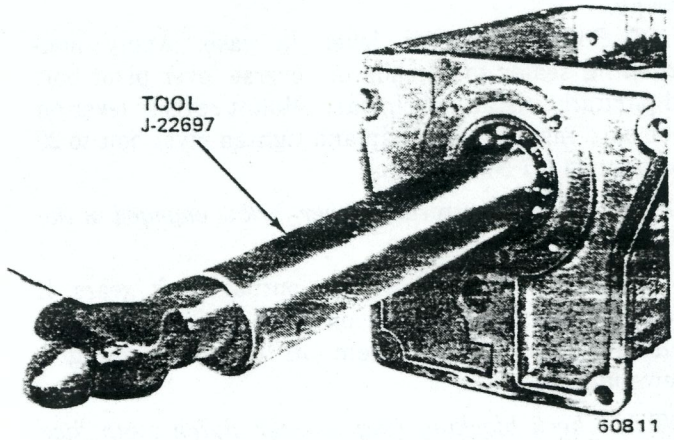


Fig. 2B-18 Bearing Installation

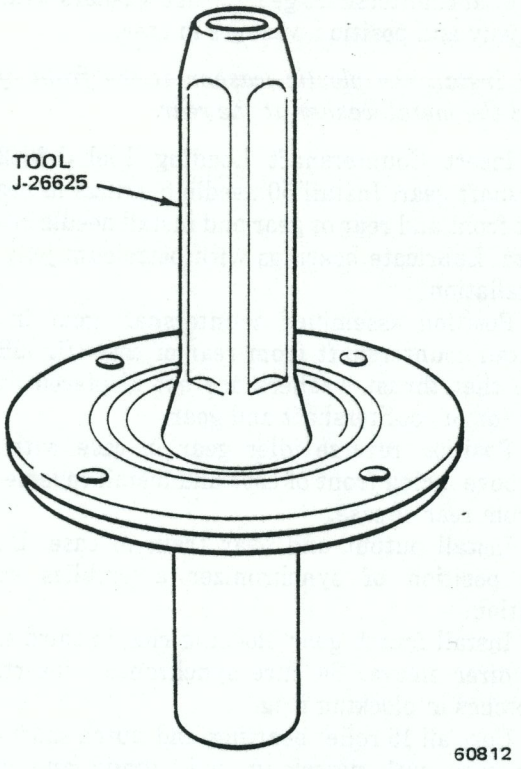


Fig. 2B-19 Front Bearing Cap Seal Installation

(12) Install front bearing cap gasket and front bearing cap. Be sure to align groove in cap and cutout in gasket with oil hole in case. Coat bearing cap bolts with nonhardening sealer and install bolts. Tighten bolts to 13 foot-pounds (18 N•m) torque.

(13) Install first gear thrust washer on output shaft. Be sure side of washer with oil groove faces first gear after installation (fig. 2B-13).

(14) Install rear bearing using Tool J-22697 or J-25234. Refer to figure 2B-18 for procedure.

CAUTION: *Be sure the first gear thrust washer is correctly installed and is engaged on the first gear roll pin before installing the rear bearing.*

(15) Install retaining and locating snap rings on rear bearing.

(16) Position reverse lever in case. Apply nonhardening sealer to threads of reverse lever pivot bolt and partially install bolt in case. Mount reverse lever on pivot bolt, install spring clip and tighten pivot bolt to 20 foot-pounds (27 N•m) torque.

NOTE: *Be sure the reverse lever fork is engaged in the reverse idler gear.*

(17) Rotate clutch shaft and output shaft gears. If blocking rings tend to stick on gear cones, release the rings by gently prying them off the cones using a screwdriver.

NOTE: *Check blocking ring to gear clutch tooth face clearance. Clearance should be 0.030 inch (0.001 mm) minimum.*

(18) Remove adapter housing oil seal using punch or screwdriver. Install new seal so metal face of seal is flush with or slightly below edge of seal bore in housing (fig. 2B-20).

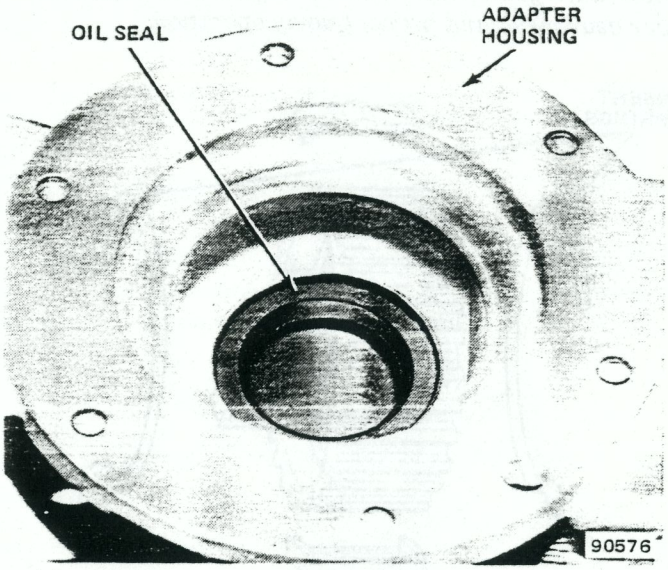


Fig. 2B-20 Adapter Housing Oil Seal Installation

(19) Place reverse lever in Neutral position, position transmission cover gasket and cover assembly on case, and install cover bolts. Alternately and evenly tighten cover bolts to 10 foot-pounds (14 N•m) torque.

CAUTION: *The two top cover dowel bolts must be installed in the proper location to maintain cover alignment and prevent hard shifting. Refer to figure 2B-6 for correct bolt location.*

(20) Position adapter housing gasket on case and carefully install adapter housing.

(21) Pour 3.0 pints (1.41 liters) of transmission lubricant into transmission case through fill hole and install fill plug. Tighten plug to 23 foot-pounds (31 N•m) torque.

(22) Install transfer case on transmission.

SHIFT CONTROL HOUSING

Disassembly

(1) Remove detent plug, spring and plunger (fig. 2B-21).

(2) Place selector arm plates and shift rail in Neutral position (centered).

(3) Rotate shift rail counterclockwise until selector arm disengages from selector arm plates and selector arm roll pin is accessible (fig. 2B-22).

(4) Pull shift rail rearward until selector arm contacts first-second shift fork.

(5) Remove selector arm roll pin using 3/16-inch (4.76 mm) diameter pin punch and remove shift rail.

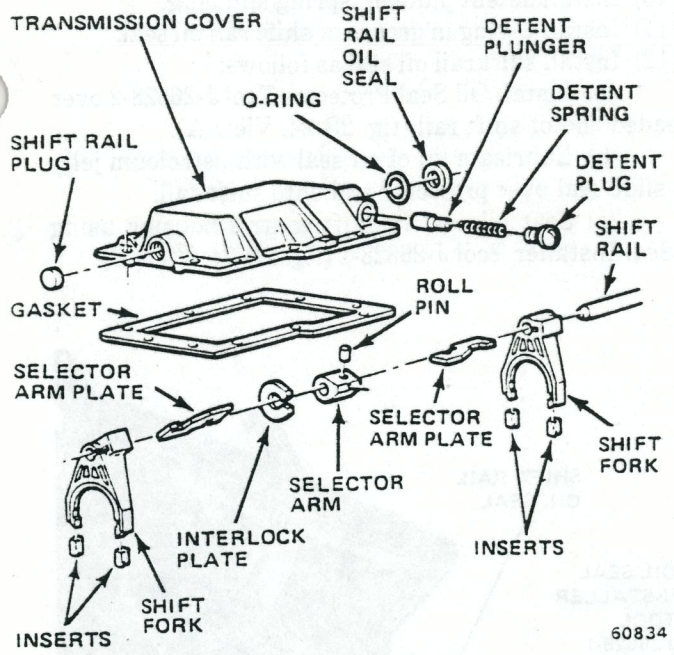


Fig. 2B-21 Shift Control Housing Assembly

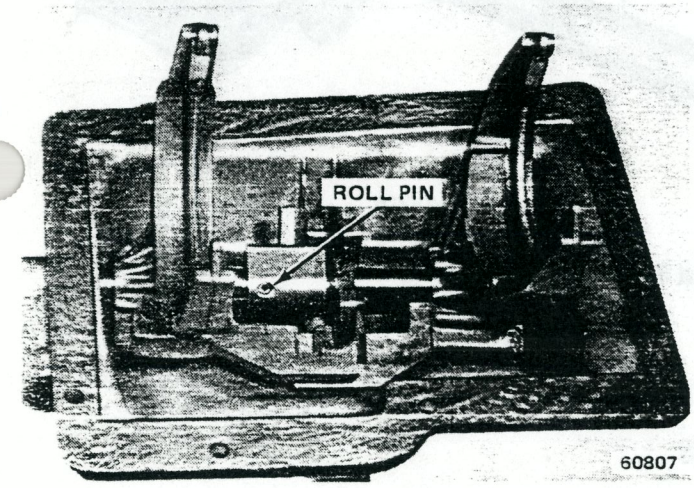


Fig. 2B-22 Roll Pin Location

(6) Remove shift forks, selector arm plates, selectorarm and roll pin, and interlock plate.

(7) Remove shift rail oil seal and O-ring using screwdriver.

(8) Remove shift rail plug using hammer and punch.

(9) Remove nylon inserts and selector arm plates from shift forks. Note position of inserts and plates for assembly reference.

Cleaning and Inspection

Thoroughly wash all parts in solvent and dry them with compressed air.

Inspect the shift control housing. Replace the housing if it exhibits the following conditions:

- Cracks in bores, sides, bosses, or at bolt holes.
- Nicks, burrs, rough surfaces in shaft bores or on gasket surfaces.

Inspect the shift mechanism. Replace any parts that exhibit the following conditions:

- Bent or broken inserts
- Worn shift fork inserts.
- Broken, cracked or worn shift forks.
- Damaged shift rail.
- Worn or damaged shift rail bores (in housing).
- Worn, damaged or bent offset lever.
- Worn, bent or broken selector arms, plates, or interlock.

Assembly

(1) Install nylon inserts and selector arm plates in shift forks (fig. 2B-23).

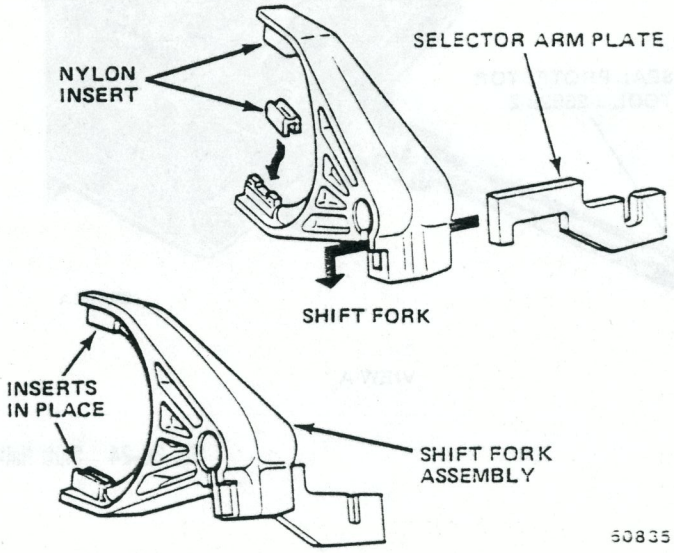


Fig. 2B-23 Assembling Shift Forks and Selector Arm Plates

(2) Install shift rail plug. Coat edges of plug with sealer before installing.

(3) Coat shift rail and shift rail bores with petroleum jelly and insert shift rail in cover. Install rail until end of rail is flush with inside edge of cover.

(4) Position first-second shift fork in cover with fork offset facing rear of cover and push shift rail through fork.

NOTE: *The first-second shift fork is the larger of the two forks.*

(5) Position selector arm and C-shaped interlock plate in cover and insert shift rail through arm. Widest part of interlock plate must face away from cover, and selector arm roll pin hole must face downward and toward rear of cover.

(6) Position third-fourth shift fork in cover with fork offset facing rear of cover. Third-fourth shift fork selector arm plate must be positioned under first-second shift fork selector arm plate.

(7) Insert shift rail through third-fourth shift fork and into front shift rail bore in cover.

(8) Rotate shift rail until selector arm plate at forward end of rail faces away from, but is parallel to cover.

(9) Align roll pin holes in selector arm and shift rail and install roll pin. Be sure roll pin is installed flush with surface of selector arm to prevent pin from contacting selector arm plates during shifts.

(10) Install detent plunger, spring and plug.

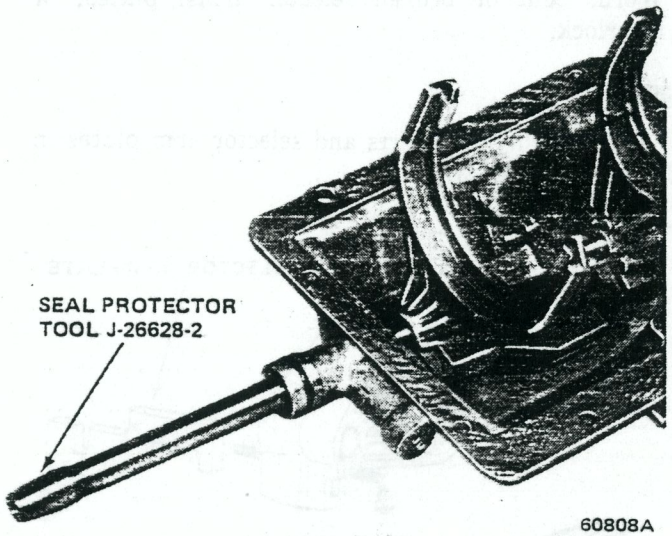
(11) Install O-ring in groove of shift rail oil seal.

(12) Install shift rail oil seal as follows:

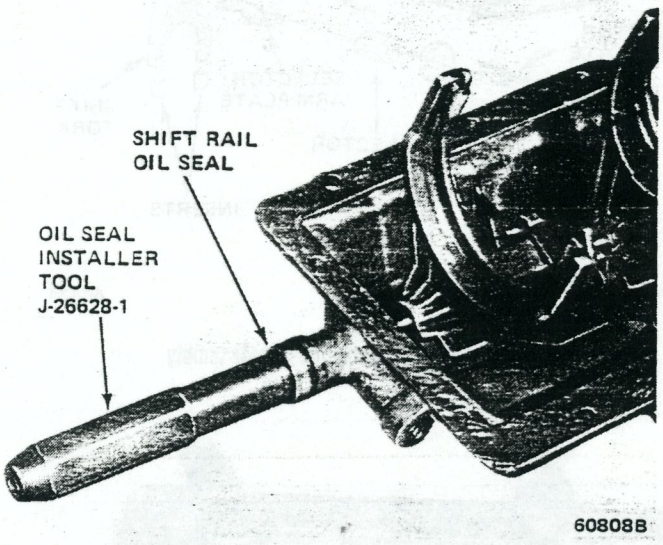
(a) Install Oil Seal Protector Tool J-26628-2 over threaded end of shift rail (fig. 2B-24, View A).

(b) Lubricate lip of oil seal with petroleum jelly and slide seal over protector and onto shift rail.

(c) Seat oil seal in shift control housing using Oil Seal Installer Tool J-26628-1 (fig. 2B-24, View B).



VIEW A



VIEW B

Fig. 2B-24 Shift Rail Oil Seal Installation

SPECIFICATIONS

Transmission Specifications—Model SR-4

Transmission Specifications	
End Play Tolerance:	
Countershaft Gear End Play	0.004 to 0.018 inch (0.102 to 0.457 mm)
Second Gear End Play	0.004 to 0.014 inch (0.102 to 0.356 mm)
Output Shaft End Play	0.004 to 0.014 inch (0.102 to 0.356 mm)
Blocking Ring to Cone Seat Clearance	0.030 inch min. (0.001 mm)
Lubrication	
Level	to bottom of fill hole
Inspect Correct Fill Level	every 5000 miles (8045 km)
Recommended Lubricants	SAE 85W-90
Lubricant Capacity	
U.S. Measure	3.0 pints
Imperial Measure	3.5 pints
Metric Measure	1.41 liters

60790

Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft-lbs)		Metric (N-m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Backup Lamp Switch	10	8-12	14	11-16
Adapter Housing Bolt	23	18-27	31	24-37
Detent Plug (in housing)	10	8-12	14	11-16
Fill Plug	20	15-25	27	20-34
Front Bearing Cap Bolt	13	11-15	18	15-20
Offset Lever Nut	10	8-12	14	11-16
Reverse Lever Pivot Bolt	20	15-25	27	20-34
Shift Control Housing Bolt	10	7-12	14	9-16
Transmission-to-Clutch Housing Bolt	55	45-65	75	61-65
Universal Joint Clamp Strap Bolt	14	12-18	19	16-24

All torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

60791

Transmission Gear Ratios

ENGINE-VEHICLE MODEL	T-176					T-18A				
	1st	2nd	3rd	4th	REV.	1st	2nd	3rd	4th	REV.
4-Cylinder CJ-5, CJ-7 (SR-4 Only)	4.07:1	2.39:1	1.49:1	1.00:1	3.95:1					
6-Cylinder CJ-7	4.07:1	2.39:1	1.49:1	1.00:1	3.95:1					
6/8 Cylinder CJ-5, CJ-7	3.82:1	2.29:1	1.46:1	1.00:1	3.52:1					
6-Cylinder Cherokee, J-10 Truck	3.82:1	2.29:1	1.46:1	1.00:1	3.52:1					
8-Cylinder Cherokee, J-10 Truck	3.52:1	2.27:1	1.46:1	1.00:1	3.01:1					
J-20 Truck						6.32:1	3.09:1	1.69:1	1.00:1	7.44:1

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MODEL T-176
4-SPEED TRANSMISSION

	Page
Assembly	2B-18
Cleaning and Inspection	2B-17
Disassembly	2B-15
Shift Control Housing	2B-22
Specifications	2B-23

DISASSEMBLY

(1) Remove bolts attaching transfer case to transmission and remove transfer case.

(2) Remove shift control housing.

NOTE: *Two of the housing attaching bolts are dowel-type alignment bolts. Note the location of these bolts for assembly reference.*

(3) Drain lubricant from transmission case if not drained during removal.

(4) Remove countershaft using Arbor Tool J-29342 (fig. 2B-25). Tap countershaft out rear of case.

(5) Remove locating ring and retaining snap ring from rear bearing.

(6) Remove rear bearing using Puller Set J-25152 (fig. 2B-26).

(7) Scribe or punch alignment reference marks in front bearing cap and transmission case.

(8) Remove front bearing cap and gasket.

(9) Remove and discard front bearing cap oil seal. Use screwdriver to pry seal out of cap.

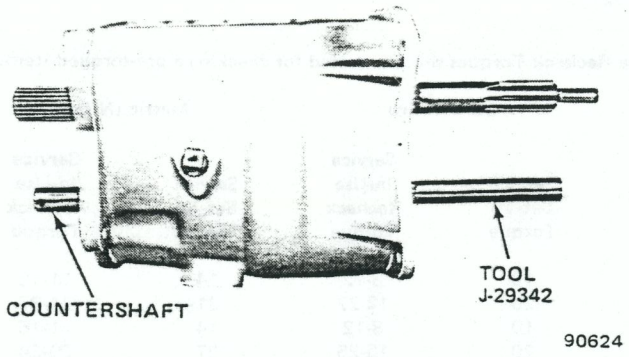


Fig. 2B-25 Countershaft Removal/Installation

(10) Remove locating ring and retaining snap ring from front bearing (fig. 2B-27).

(11) Remove clutch shaft and front bearing using Adapter J-29344 and Puller Set J-25152 (fig. 2B-28).

(12) Remove third-fourth blocking ring from clutch shaft or synchronizer hub.

(13) Remove front bearing from clutch shaft using Puller Set J-25152 (fig. 2B-29).

(14) Remove mainshaft pilot bearing rollers from clutch shaft (fig. 2B-27).

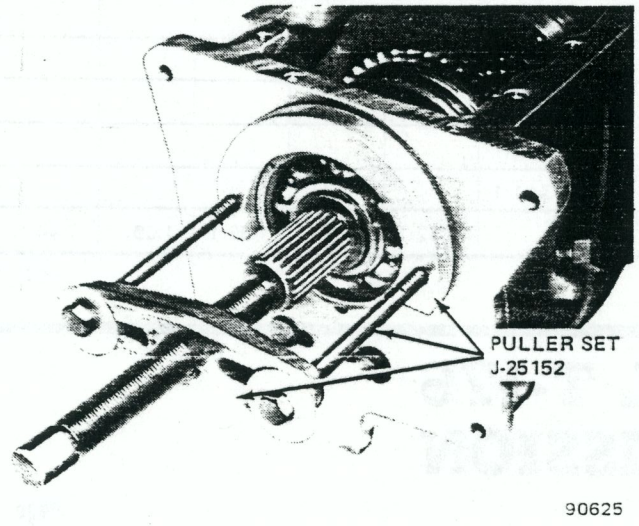


Fig. 2B-26 Rear Bearing Removal

(15) Remove mainshaft and geartrain assembly. Move third-fourth synchronizer sleeve rearward (to third gear position). Tilt rear end of shaft downward and lift front end of shaft upward and out of case.

(16) Remove countershaft gear and arbor tool as assembly.

(17) Remove countershaft gear thrust washers and any mainshaft pilot bearing rollers that may have fallen into case during clutch shaft removal.

(18) Remove reverse idler gear assembly. Tap idler gear shaft out rear of case (fig. 2B-30). Remove gear assembly thrust washers.

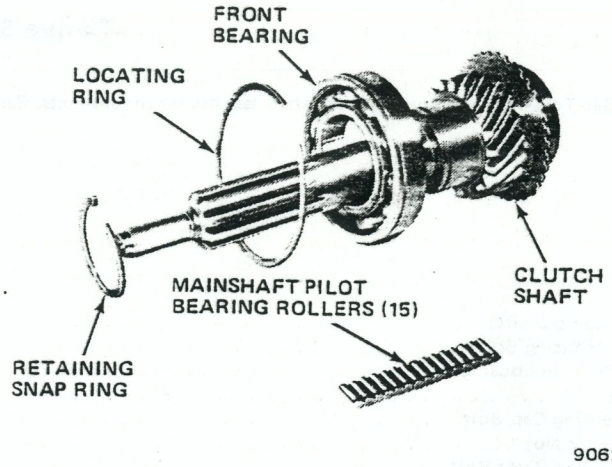


Fig. 2B-27 Clutch Shaft and Front Bearing Assembly

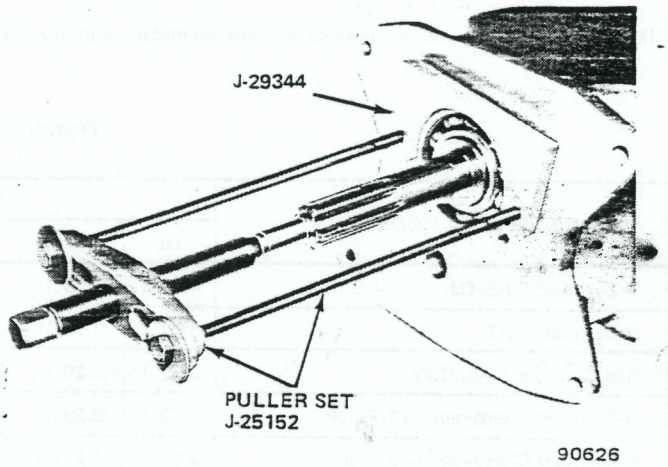


Fig. 2B-28 Clutch Shaft Front Bearing Removal

(19) Remove needle bearings and bearing retainers from gear assembly (fig. 2B-31). Remove sliding gear from idler gear. Note position of sliding gear for assembly reference.

(20) Remove arbor tool from countershaft gear and remove needle bearings and bearing retainers (fig. 2B-32).

Disassembly Mainshaft Geartrain

(1) Remove third-fourth synchronizer snap ring from front end of mainshaft (fig. 2B-33).

(2) Remove third-fourth synchronizer assembly from mainshaft. Slide hub out of sleeve. Remove insert springs and three inserts and blocking ring. Note position of insert springs for assembly reference.

(3) Remove third gear from mainshaft.

(4) Remove second gear snap ring from mainshaft and remove second gear and blocking ring.

(5) Remove tabbed thrust washer from mainshaft (fig. 2B-33).

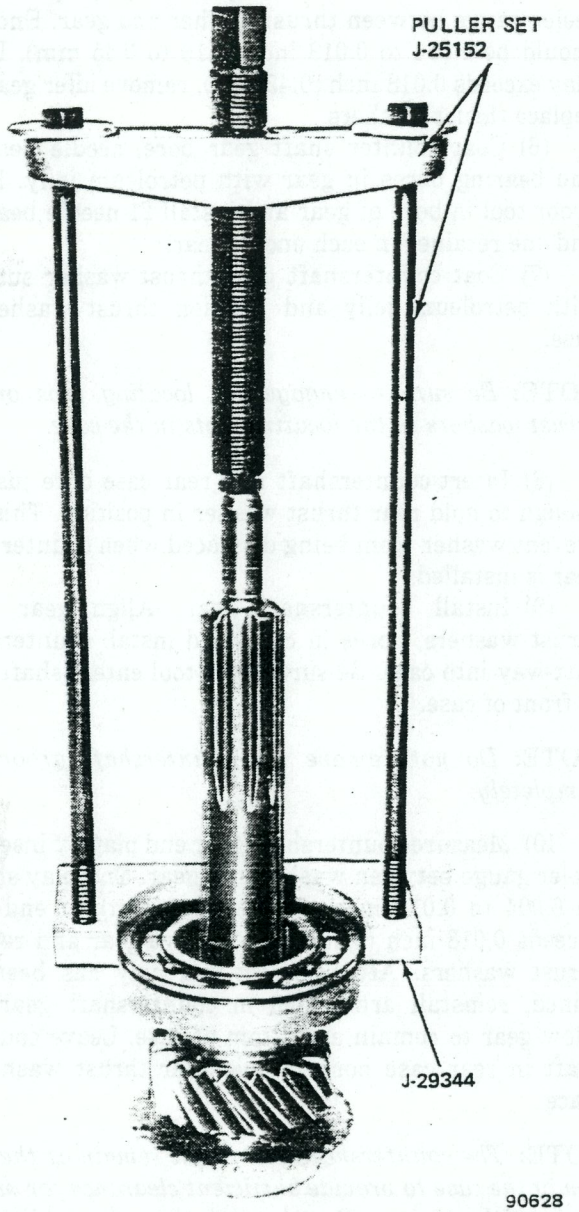


Fig. 2B-29 Removing Front Bearing from Clutch Shaft

(6) Remove snap ring from first-second synchronizer hub. Remove hub and reverse gear and sleeve as assembly. Mark hub and sleeve for assembly reference. Remove insert springs from hub, remove three inserts, and remove sleeve and gear from hub.

(7) Remove first gear thrust washer from rear of shaft and remove first gear and blocking ring (if ring was not removed previously).

CLEANING AND INSPECTION

Cleaning

Thoroughly wash all parts in solvent and dry using compressed air. However, do not dry the bearings with compressed air. Air dry the bearings or wipe them dry using a clean shop cloth only.

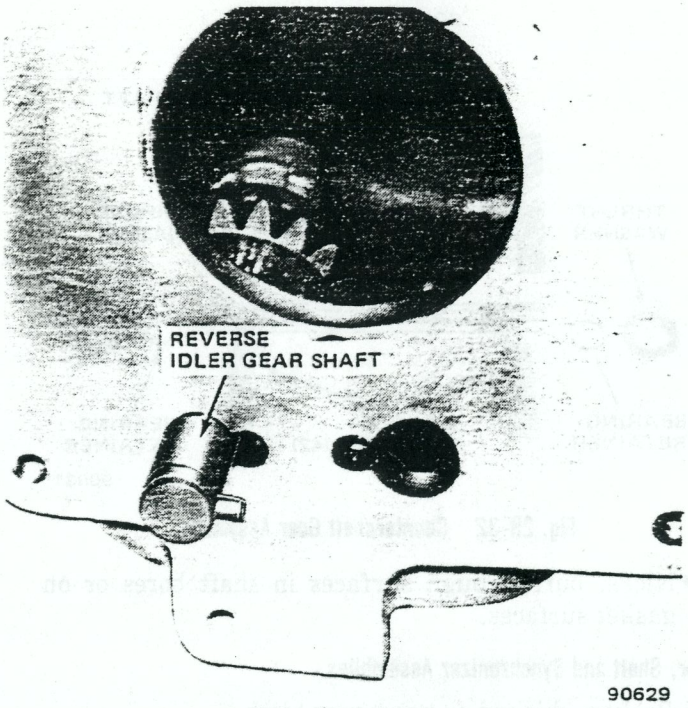


Fig. 2B-30 Reverse Idler Gear Shaft Removal/Installation

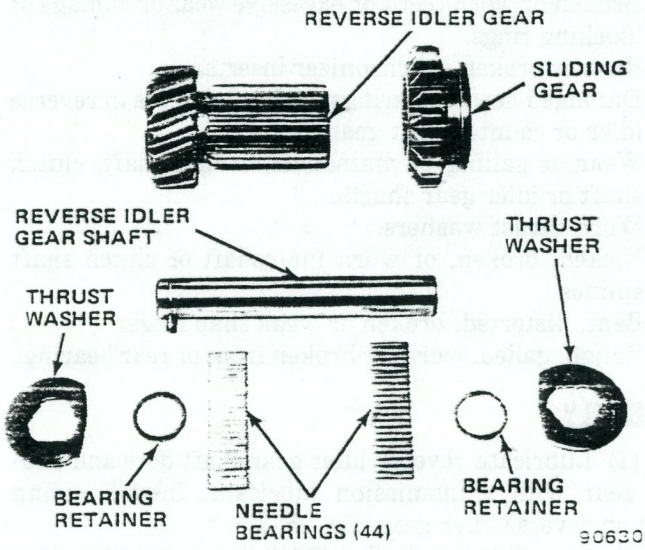


Fig. 2B-31 Reverse Idler Gear Assembly

Clean the needle and clutch shaft roller bearings by wrapping the bearings in a clean cloth and submerging them in solvent. Or, place the bearings in a shallow parts cleaning tray and cover them with solvent. Allow the bearings to air dry on a clean cloth.

Inspection

Inspect the transmission components. Replace any components that exhibit the following conditions:

Case

- Cracks in bores, sides, bosses or at bolt holes.
- Stripped threads in bolt holes.

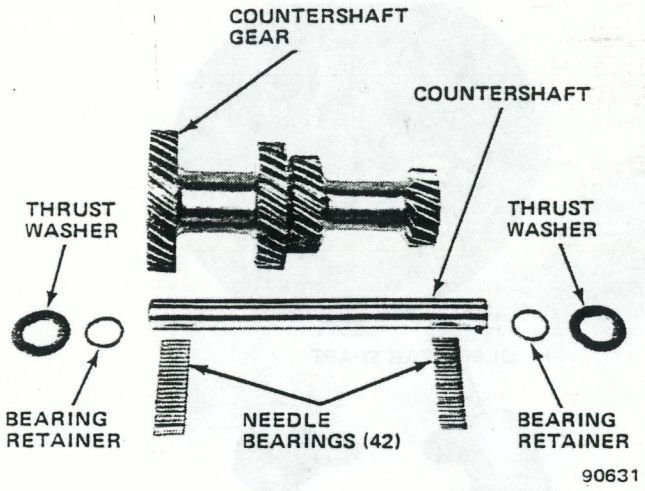


Fig. 2B-32 Countershaft Gear Assembly

- Nicks, burrs, rough surfaces in shaft bores or on gasket surfaces.

Gear, Shaft and Synchronizer Assemblies

- Broken, chipped or worn gear teeth.
- Damaged splines on mainshaft, synchronizer hubs, or sleeves.
- Broken or worn teeth or excessive wear or damage of blocking rings.
- Bent or broken synchronizer inserts.
- Damaged needle bearings or bearing bores in reverse idler or countershaft gear.
- Wear or galling of mainshaft, countershaft, clutch shaft or idler gear shafts.
- Worn thrust washers.
- Nicked, broken, or worn mainshaft or clutch shaft splines.
- Bent, distorted, broken or weak snap rings.
- Rough, galled, worn, or broken front or rear bearing.

ASSEMBLY

(1) Lubricate reverse idler gear shaft bore and sliding gear with transmission lubricant. Install sliding gear on reverse idler gear (fig. 2B-31).

(2) Install Arbor Tool J-29343 in reverse idler gear and install 22 needle bearings and one bearing retainer at each end of gear (fig. 2B-34).

(3) Coat reverse idler gear thrust washer surfaces with petroleum jelly and install thrust washers in case.

NOTE: *The thrust washers have flats on them. Be sure to install the washers so these flats will face the mainshaft. Also, be sure to engage the thrust washer locating tabs in the case locating slots.*

(4) Install reverse idler gear assembly (fig. 2B-35). Align gear bore, thrust washers, case bores, and install reverse idler gear shaft from rear of case. Be sure to seat roll pin in shaft, align roll pin with counterbore in case and push shaft into rear of case (fig. 2B-30).

(5) Measure reverse idler gear end play by inserting feeler gauge between thrust washer and gear. End play should be 0.004 to 0.018 inch (0.10 to 0.45 mm). If end play exceeds 0.018 inch (0.45 mm), remove idler gear and replace thrust washers.

(6) Coat counter shaft gear bore, needle bearings and bearing bores in gear with petroleum jelly. Insert arbor tool in bore of gear and install 21 needle bearings and one retainer in each end of gear.

(7) Coat countershaft gear thrust washer surfaces with petroleum jelly and position thrust washers in case.

NOTE: *Be sure to engage the locating tabs on the thrust washers in the locating slots in the case.*

(8) Insert countershaft into rear case bore just far enough to hold rear thrust washer in position. This will prevent washer from being displaced when countershaft gear is installed.

(9) Install countershaft gear. Align gear bore, thrust washers, bores in case, and install countershaft part-way into case. Be sure arbor tool enters shaft bore at front of case.

NOTE: *Do not remove the countershaft arbor tool completely.*

(10) Measure countershaft gear end play by inserting feeler gauge between washer and gear. End play should be 0.004 to 0.018 inch (0.10 to 0.45 mm). If end play exceeds 0.018 inch (0.45 mm), remove gear and replace thrust washers. After correct end play has been obtained, reinstall arbor tool in countershaft gear and allow gear to remain at bottom of case. Leave countershaft in rear case bore to hold rear thrust washer in place.

NOTE: *The countershaft gear must remain at the bottom of the case to provide sufficient clearance for installation of the mainshaft and clutch shaft assemblies.*

(11) Lubricate mainshaft, synchronizer assemblies and gear bores with transmission lubricant.

(12) Assemble first-second synchronizer hub and reverse gear and sleeve (fig. 2B-33):

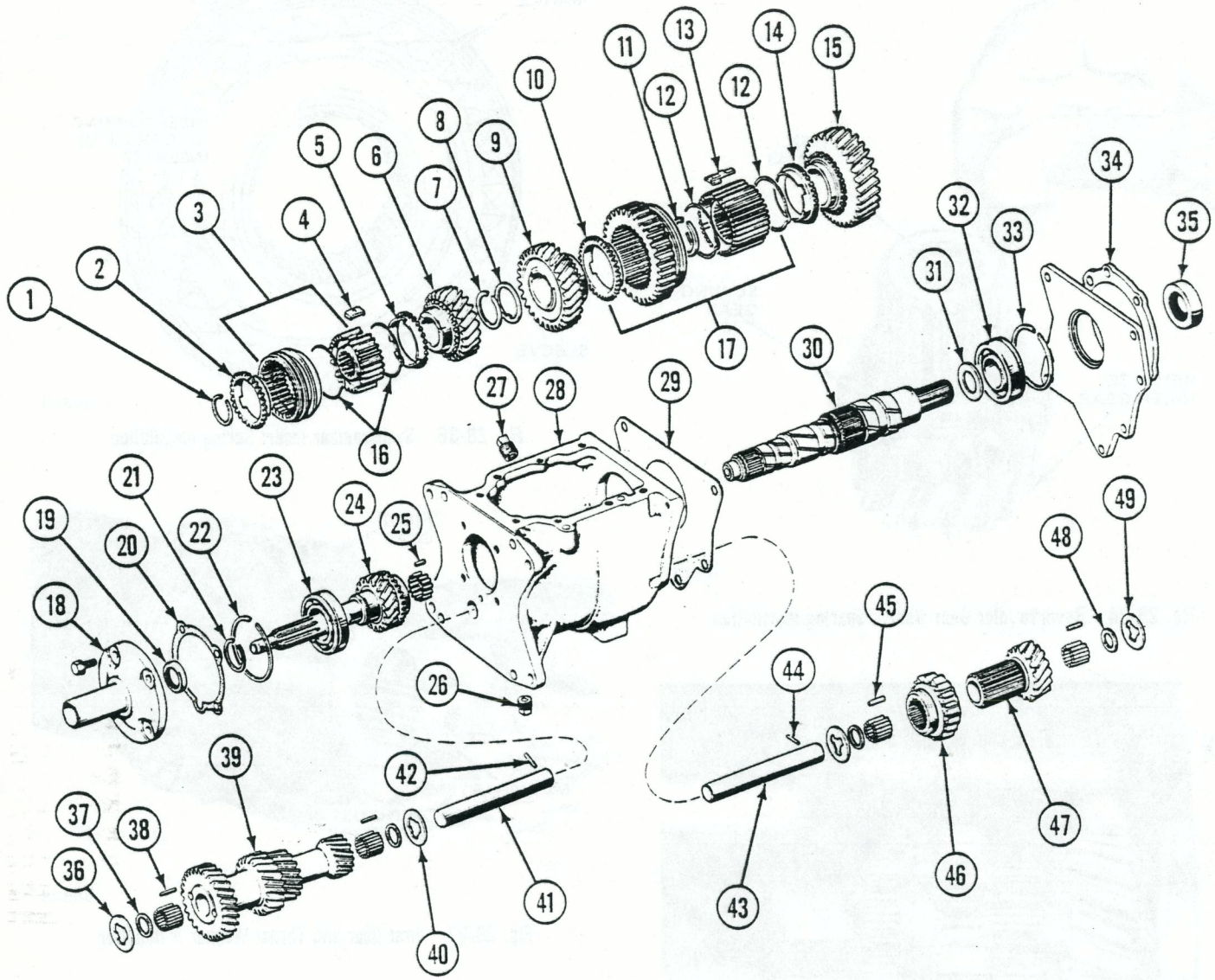
(a) Install gear and sleeve on hub and place assembly flat on workbench.

(b) Drop inserts into hub slots.

(c) Install insert spring. Position loop-end of spring in one insert, compress spring ends and insert spring ends under lips of remaining two inserts. Be sure spring is under lip of each insert (fig. 2B-36).

(d) Turn assembly over and install remaining insert spring as described in previous step. However, install this spring so open end faces 180° opposite first spring.

(13) Install assembled first-second synchronizer hub and reverse gear and sleeve on mainshaft.



1. THIRD-FOURTH GEAR SNAP RING
2. FOURTH GEAR SYNCHRONIZER RING
3. THIRD-FOURTH GEAR CLUTCH ASSEMBLY
4. THIRD-FOURTH GEAR PLATE
5. THIRD GEAR SYNCHRONIZER RING
6. THIRD SPEED GEAR
7. SECOND GEAR SNAP RING
8. SECOND GEAR THRUST WASHER
9. SECOND SPEED GEAR
10. SECOND GEAR SYNCHRONIZER RING
11. MAIN SHAFT SNAP RING
12. FIRST-SECOND SYNCHRONIZER SPRING
13. LOW-SECOND PLATE
14. FIRST GEAR SYNCHRONIZER RING
15. FIRST GEAR
16. THIRD-FOURTH SYNCHRONIZER SPRING
17. FIRST-SECOND GEAR CLUTCH ASSEMBLY
18. FRONT BEARING CAP
19. OIL SEAL
20. GASKET
21. SNAP RING
22. LOCK RING
23. FRONT BALL BEARING
24. CLUTCH SHAFT
25. ROLLER BEARING
26. DRAIN PLUG
27. FILL PLUG
28. CASE
29. GASKET
30. SPLINE SHAFT
31. FIRST GEAR THRUST WASHER
32. REAR BALL BEARING
33. SNAP RING
34. ADAPTER PLATE
35. ADAPTER SEAL
36. FRONT COUNTERSHAFT GEAR THRUST WASHER
37. ROLLER WASHER
38. REAR ROLLER BEARING
39. COUNTERSHAFT GEAR
40. REAR COUNTERSHAFT THRUST WASHER
41. COUNTERSHAFT
42. PIN
43. IDLER GEAR SHAFT
44. PIN
45. IDLER GEAR ROLLER BEARING
46. REVERSE IDLER SLIDING GEAR
47. REVERSE IDLER GEAR
48. IDLER GEAR WASHER
49. IDLER GEAR THRUST WASHER

Fig. 2B-33 Model T-176 4-Speed Transmission

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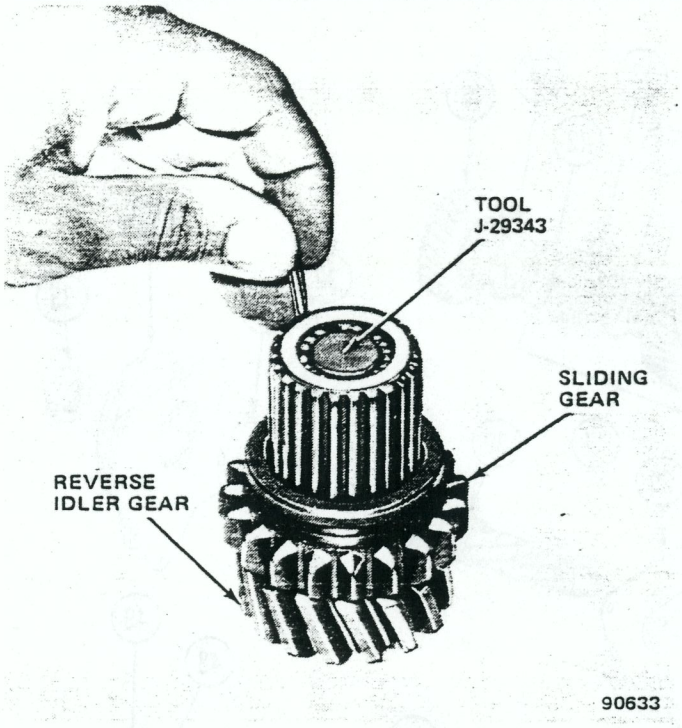

Fig. 2B-34 Reverse Idler Gear Needle Bearing Installation

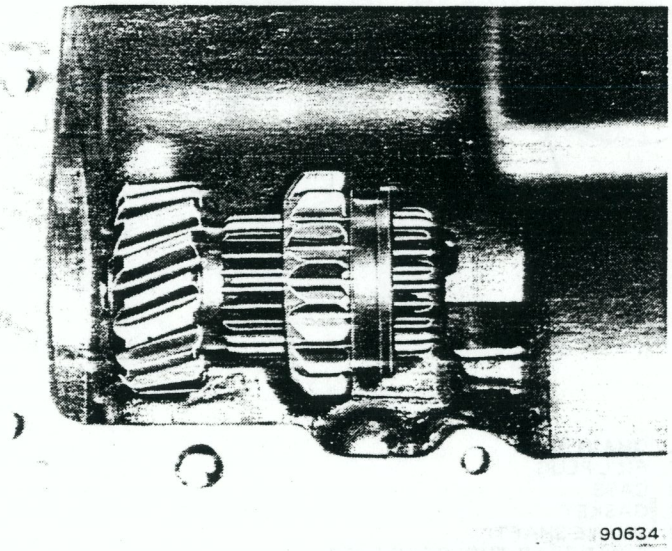

Fig. 2B-35 Reverse Idler Gear Installation

(14) Install new first-second synchronizer snap ring on mainshaft (fig. 2B-33).

(15) Install first gear and blocking ring on rear of mainshaft and install first gear thrust washer (fig. 2B-37).

(16) Install new tabbed thrust washer on mainshaft. Be sure washer tab is seated in mainshaft tab bore (fig. 2B-38).

(17) Install second gear and blocking ring on mainshaft and install new second gear snap ring.

(18) Install third gear and blocking ring on mainshaft.

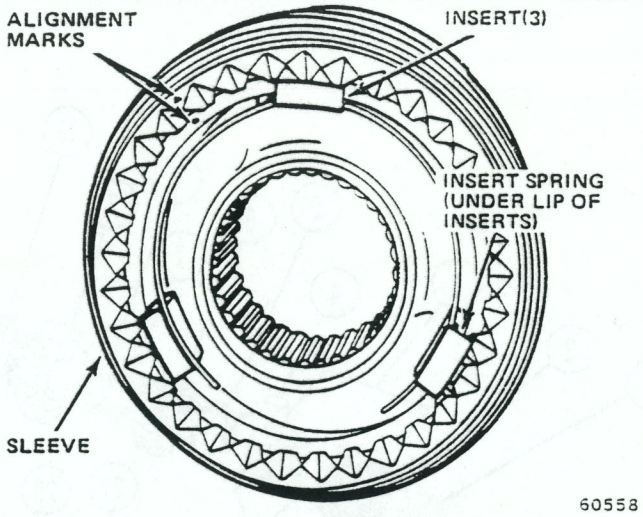

Fig. 2B-36 Synchronizer Insert Spring Installation

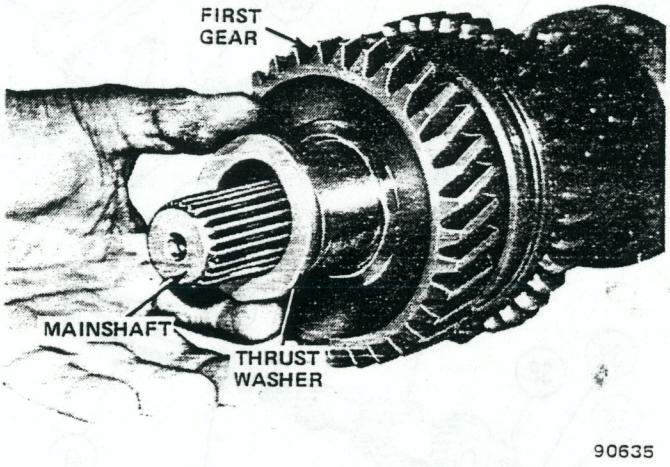

Fig. 2B-37 First Gear and Thrust Washer Installation

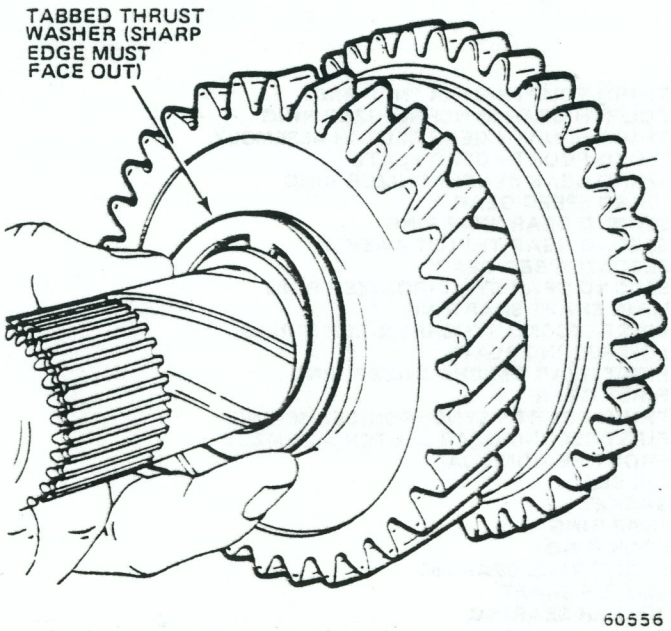

Fig. 2B-38 Tabbed Thrust Washer Installation

(19) Assemble third-fourth synchronizer (fig. 2B-33).

(a) Install sleeve on synchronizer hub. Align parts using reference marks.

(b) Place assembled hub and sleeve flat on workbench.

(c) Drop inserts into hub slots.

(d) Install insert spring. Position loop-end of spring in one insert, compress spring ends and insert spring ends under lips of remaining two inserts (fig. 2B-36).

(e) Turn assembly over and install remaining insert spring as described in previous step. However, position this spring so open end faces 180° opposite first spring.

(20) Install assembled third-fourth synchronizer assembly on mainshaft.

(21) Install new third-fourth synchronizer retaining snap ring on mainshaft and measure end play between synchronizer hub and snap ring (fig. 2B-39). End play should be 0.004 to 0.014 inches (0.10 to 0.35 mm). If end play exceeds limits, replace mainshaft thrust washers and snap rings.

(22) Install mainshaft geartrain assembly in case. Be sure synchronizers are in neutral position so sleeves will clear top of case when assembly is installed.

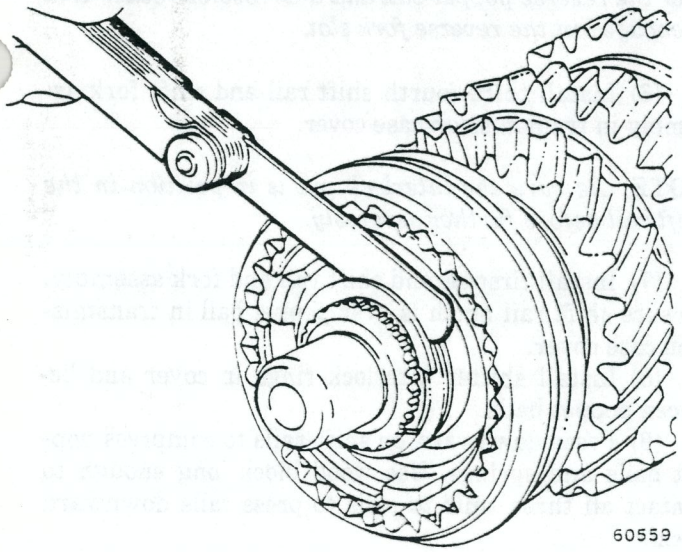

Fig. 2B-39 Checking Mainshaft Geartrain End Play

(23) Install locating snap ring on front bearing and install front bearing part-way onto clutch shaft.

NOTE: *Do not install the bearing completely at this time as the shaft will not clear the countershaft gear and prevent installation.*

(24) Coat bearing bore in clutch shaft and mainshaft pilot roller bearings with petroleum jelly. Install 15 roller bearings in clutch shaft bearing bore.

CAUTION: *Do not use chassis grease or a similar "heavy" grease in the clutch shaft bore. Use petroleum jelly only. Heavy grease will plug the lubrication holes in the shaft and prevent proper lubrication of the roller bearing.*

(25) Coat blocking ring surface of clutch shaft with transmission lubricant and position blocking ring on shaft.

(26) Support main shaft assembly and insert clutch shaft through front bearing bore in case. Seat main shaft pilot hub in clutch shaft roller bearings and tap front bearing and clutch shaft into case using rawhide mallet.

(27) Install front bearing cap and tighten cap bolts finger tight only.

(28) Position rear bearing on mainshaft. Do not install bearing locating ring at this time. Start bearing into shaft and into case bore using Tool J-29345. Remove tool and complete bearing installation using rawhide mallet. When bearing is fully seated on shaft, install bearing retaining snap ring.

NOTE: *In order to seat the rear bearing on the mainshaft, the bearing must be tapped into the case deeper than the locating snap ring would allow. For this reason, do not install the locating snap ring until after the bearing is fully seated on the shaft and the retaining snap ring is installed.*

(29) Remove front bearing cap, seat front bearing fully on clutch shaft and install bearing retaining snap ring.

(30) Apply thin film of sealer to front bearing cap gasket and position gasket on case. Be sure gasket notch is aligned with oil return hole in case.

(31) Remove front bearing cap oil seal using screwdriver and install replacement oil seal using Tool J-25233 (fig. 2B-40).

(32) Install front bearing cap. Tighten cap bolts to 12 foot-pounds (16 N•m) torque.

(33) Install locating ring on rear bearing. If necessary, reseat bearing in case using rawhide mallet.

(34) Install countershaft as follows:

(a) Turn transmission case on end. Position case at edge of workbench with clutch shaft pointing downward. Be sure countershaft bore in front of case is accessible.

(b) Have helper hold case in position.

(c) Align countershaft gear bores with thrust washers and case bores and tap shaft into place. Do not let arbor tool drop onto floor as shaft is installed.

CAUTION: *Do not damage the thrust washers during counter shaft installation. Be sure they are aligned with the case bores and gear bores before tapping the countershaft into place.*

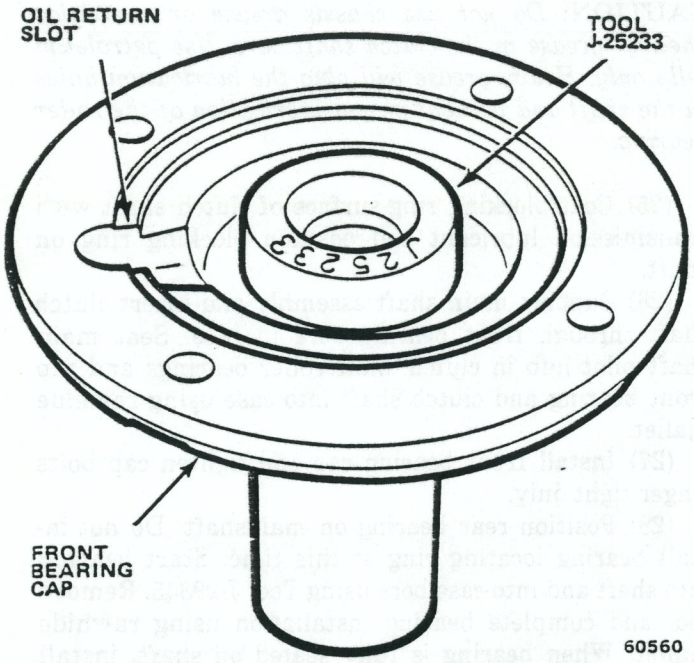

Fig. 2B-40 Front Bearing Cap Seal Installation

(35) Shift synchronizer sleeves into all gear positions and check operation. If clutch shaft and mainshaft appear to bind in Neutral position, check for blocking rings sticking on tapered portion of gears. Use screwdriver to free any sticking blocking rings.

(36) Fill transmission with 3.5 pints (1.7 liters) of SAE 85W-90 gear lubricant.

(37) Position new shift control housing gasket on case and install control housing. Tighten housing bolts to 12 foot-pounds (16 N•m) torque.

(38) Install transmission on transfer case.

SHIFT CONTROL HOUSING

Disassembly

(1) Remove shift lever cover, control housing cap, retainer and remove shift lever and spring.

(2) Position transmission case cover in vise so shift forks are facing upward. Use wood blocks to protect cover from vise jaws and do not overtighten vise.

(3) Place all shift forks in neutral position.

(4) Remove shift rail support plate attaching bolts and tabbed washers and remove support plates (fig. 2B-41).

(5) Remove first-second shift rail.

(6) Remove third-fourth shift rail, shift lug and interlock pin.

(7) Remove reverse shift rail.

(8) Remove poppet balls.

(9) Remove shifter interlock rings.

(10) Remove poppet springs.

(11) Remove fulcrum pins.

(12) Remove cover from vise.

(13) Clean all components in solvent and dry using compressed air.

(14) Inspect all components. Replace any components that are nicked, cracked, broken or excessively worn.

Assembly

(1) Clamp transmission case cover in vise using protective wood blocks and install fulcrum pins in cover.

CAUTION: *To avoid damaging the cover do not overtighten the vise jaws.*

(2) Lubricate shift rails and shift rail grooves in cover with petroleum jelly.

(3) Install poppet springs in transmission case cover bores.

(4) Install poppet balls (one on each spring).

(5) Position reverse gear shift rail and fork on reverse rocker arm in transmission case cover.

NOTE: *Be sure the notch on the shift rail is positioned over the reverse poppet ball and that reverse rocker arm is engaged in the reverse fork slot.*

(6) Install third-fourth shift rail and shift fork assembly in transmission case cover.

NOTE: *Be sure the interlock pin is in position in the shift rail before further assembly.*

(7) Install first-second shift rail and fork assembly. Be sure shift rail notch is over poppet ball in transmission case cover.

(8) Install shifter interlock rings in cover and between poppet balls.

(9) Press downward on shift rails to compress poppet balls and springs. Use wood block long enough to contact all three shift to rails to press rails downward evenly.

(10) While holding shift rails downward, position shift rail retaining plates on housing and install plate attaching bolts and tabbed washers finger-tight.

(11) Remove wood block and tighten shift rail retaining bolts to 12 to 15 foot-pounds (16 to 19 N•m) torque. Be sure tabbed washers are in correct position before bending washer tabs.

(12) Check shift rail operation. Each rail must slide smoothly in cover groove. Be sure it is not possible to overshift into another gear position. After checking shift operation, place forks in third gear position.

(13) Install shift lever, spring, spring retainer and control housing cap (fig. 2B-41). Push cap downward and turn clockwise to install and seat.

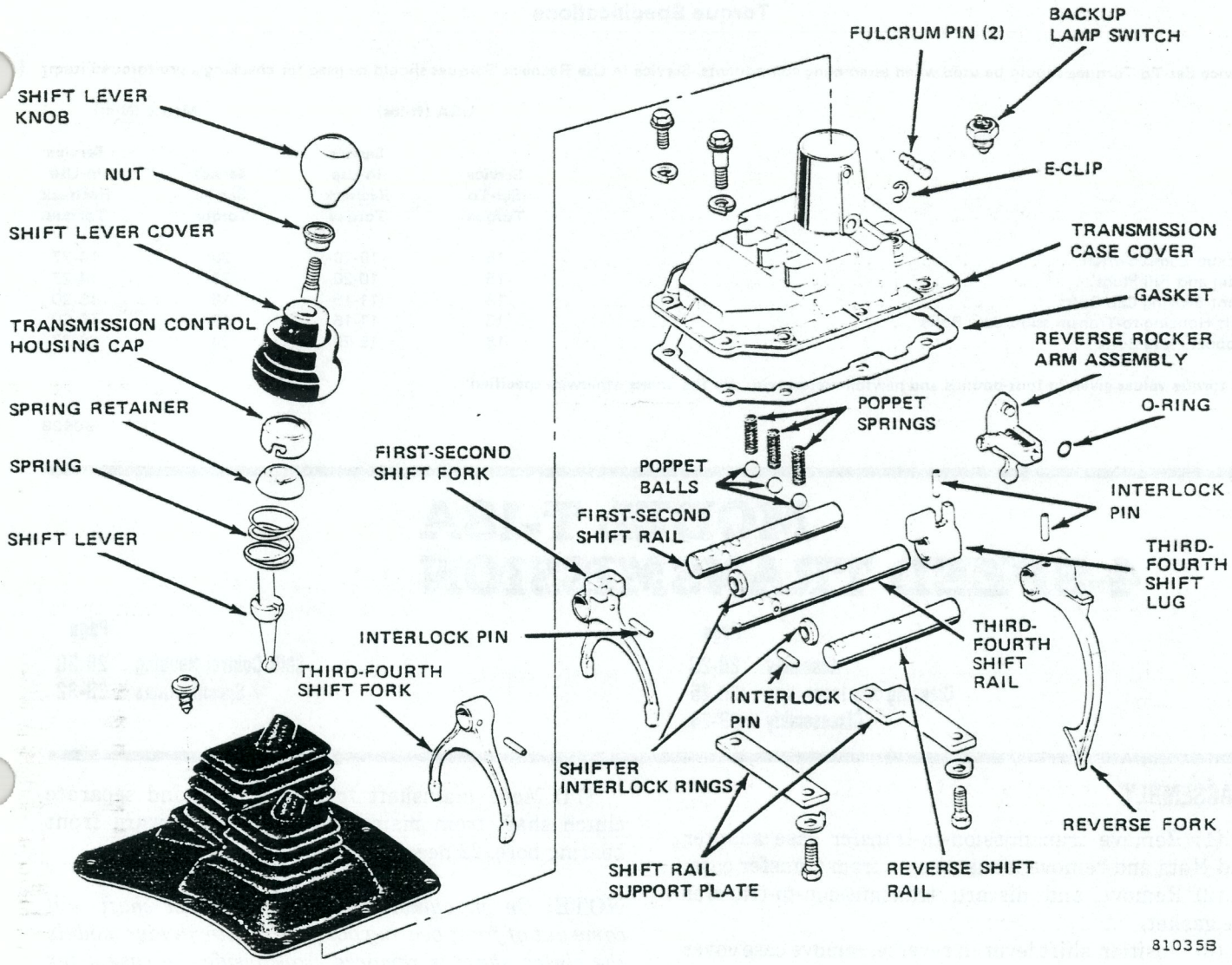

Fig. 2B-41 Shift Control Housing—T-176

SPECIFICATIONS

T-176 Lubricant Capacity and End Play Tolerances

End Play Tolerances:	
Countershaft Gear to Case	0.004 to 0.018 inch (0.10 to 0.45 mm)
Reverse Idler Gear to Case	0.004 to 0.018 inch (0.10 to 0.45 mm)
Mainshaft Gear Train	0.004 to 0.018 inch (0.10 to 0.45 mm)
Lubricant Capacity	3.5 pints (1.7 liters)
Lubricant Type	SAE 85W-90, API GL5

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Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft-lbs)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Backup Lamp Switch	15	10-20	20	14-27
Drain and Fill Plugs	15	10-20	20	14-27
Front Bearing Cap Bolts	13	11-15	18	15-20
Shift Housing-to-Transmission Case Bolts	13	11-15	18	15-20
Support Plate Bolts	18	15-20	24	20-27

All torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

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MODEL T-18A 4-SPEED TRANSMISSION

	Page		Page
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Cleaning and Inspection	2B-25	Specifications	2B-32
Disassembly	2B-24		

DISASSEMBLY

(1) Remove transmission-to-transfer case adapter Stud Nuts and remove transmission from transfer case.

(2) Remove and discard transmission-to-transfer case gasket.

(3) Position shift lever in reverse, remove case cover bolts, remove shift control housing.

(4) Punch alignment marks on the front bearing cap, remove capscrews and bearing cap.

(5) Remove front bearing lock ring and snap ring.

(6) Remove front bearing from clutch shaft using puller J-25152 (fig. 2B-43).

(7) Remove front bearing retainer washer from clutch shaft.

(8) Remove rear adapter housing retaining bolts and housing.

(9) Remove rear bearing lock ring and snap ring.

(10) Reinstall front bearing cap temporarily.

(11) Remove rear bearing using Puller Set J-25152.

NOTE: *If the bearing puller plates will not seat in the bearing snap ring groove, tap the end of the clutch shaft with a lead hammer to move the mainshaft rearward and expose the bearing groove fully.*

(12) Remove front bearing cap.

(13) Rotate clutch shaft until flat area of fourth speed gear is in line with the countershaft gear.

(14) Move mainshaft to rear of case and separate clutch shaft from mainshaft by pulling toward front bearing bore. 22 needle bearings will be displaced.

NOTE: *On six-cylinder models the clutch shaft will come out of front bearing bore. On eight-cylinder models the clutch shaft is removed from inside the case after mainshaft assembly removal.*

(15) Remove bearing roller spacer from mainshaft pilot hub (fig. 2B-42).

(16) Remove mainshaft assembly through top of case.

(17) Remove clutch shaft through top of case.

(18) Remove lock plate retaining bolt from countershaft and reverse idler gear shaft, and remove lock plate.

(19) Tap countershaft toward rear of case using brass drift and hammer. Stop when end of shaft is approximately even with front inside edge of case bore.

(20) Complete countershaft removal as follows:

(a) Make arbor tool from steel rod 1.115 inches (2.83 cm) in diameter by 9.85 inches (25.01 cm) long.

(b) After making tool, remove all burrs or sharp edges using file.

(c) Insert tool into shaft bore at front of case and drive countershaft out rear of case. Keep tool in constant contact with shaft to avoid displacing bearing rollers or washers.

(21) Tip case on side and remove countershaft gear and arbor tool as assembly.

(22) Remove countershaft gear thrust washers and any mainshaft pilot bearing rollers that may have fallen into case during mainshaft removal.

(23) Remove reverse idler gear shaft using brass drift through front bearing opening in case (fig. 2B-42).

(24) Remove arbor tool from countershaft gear and remove bearing rollers, washers and spacer.

(25) Remove snap rings, bearing rollers, washers and sleeve from reverse idler gear.

(26) Remove fill plug, drain plug and 22 clutch shaft needle bearings from case.

(27) Remove front bearing cap seal and rear adapter seal.

Main Shaft Gear Train Disassembly

(1) Scribe alignment marks on main shaft splines and clutch hubs for assembly reference.

(2) Remove pilot bearing spacer from front of main shaft (fig. 2B-42).

(3) Remove third-fourth synchronizer snap ring and remove third-fourth synchronizer assembly and third gear (fig. 2B-42).

(4) Remove first-second synchronizer snap ring and remove first-second synchronizer assembly (fig. 2B-42).

(5) Remove second gear snap ring and remove thrust washer and second gear.

(6) Scribe alignment marks on clutch hubs and sleeves for assembly reference.

(7) Remove insert springs and shifting plates from third-fourth clutch sleeve and remove sleeve from hub. Observe position of springs and plates for assembly reference.

(8) Place first-second synchronizer assembly on work bench and wrap cloth around clutch sleeve. Cloth is necessary to prevent losing shift plate lock balls during disassembly.

(9) Remove clutch sleeve from hub.

(10) Remove cloth from sleeve and remove lock balls, insert spring and shift plates from hub.

CLEANING AND INSPECTION

Clean and inspect the transmission case and all components thoroughly. If any transmission gear requires replacement, also replace the gear with which it meshes. Use new gaskets, oil seals and snap rings during assembly.

Inspect the transmission case for cracks and worn or scored bearing bosses. Examine the ball bearings for cracked races, excessive wear, looseness, and for tight fit in the case bores. Inspect all gear teeth for cracks, chips, or spots where gear hardening has worn through. Main shaft gears must not bind on the shaft and should not exhibit excessive play. Inspect the synchronizer blocking rings for cracks, excessive wear, or pitting in the tapered area of the ring. If thrust washer condition is doubtful, replace them.

Check all bearing rollers for flat spots, pitting, cracks or other damage. Replace rollers as required. Inspect the countershaft and reverse idler shafts for pitting, wear, scores, nicks, cracks and flat spots. Small nicks or scores can be reduced using crocus cloth or a fine-tooth file. Replace shafts if severely worn or damaged. Inspect the mainshaft and synchronizer hubs and sleeves for damaged or worn splines, cracks, worn mainshaft pilot hub and damaged mainshaft threads. Replace parts as required. Check reverse shifting arm and pivot pin for wear or other damage, and replace if necessary.

ASSEMBLY

NOTE: *Prelubricate all components with petroleum jelly during assembly.*

Reverse Idler Gear

(1) Install snap ring in one end of reverse idler gear.

(2) Install thrust washer in gear bore against snap ring.

(3) Insert sleeve in gear bore.

(4) Install 37 roller bearings in one end of gear and install bearing spacer (fig. 2B-42).

(5) Install remaining 37 roller bearings in opposite end of gear and install remaining thrust washer and snap ring.

Countershaft Gear Assembly

(1) Install bearing spacer sleeve in gear and insert arbor tool into gear and through sleeve.

(2) Slide one bearing spacer onto arbor tool and seat spacer against sleeve.

(3) Insert 22 roller bearings into gear bore and seat bearings against spacer just installed.

(4) Slide second bearing spacer onto arbor tool and seat spacer against bearings.

(5) Install 22 more roller bearings in gear bore and seat bearings against second spacer.

(6) Install third bearing spacer on arbor tool and seat spacer against bearings.

(7) Repeat spacer/bearing installation procedure at opposite end of gear.

First-Second Synchronizer Assembly

NOTE: *The third-fourth clutch hub is used to help assemble the first-second synchronizer assembly.*

(1) Place third-fourth clutch hub on workbench.

(2) Install insert spring in first-second clutch hub spring groove.

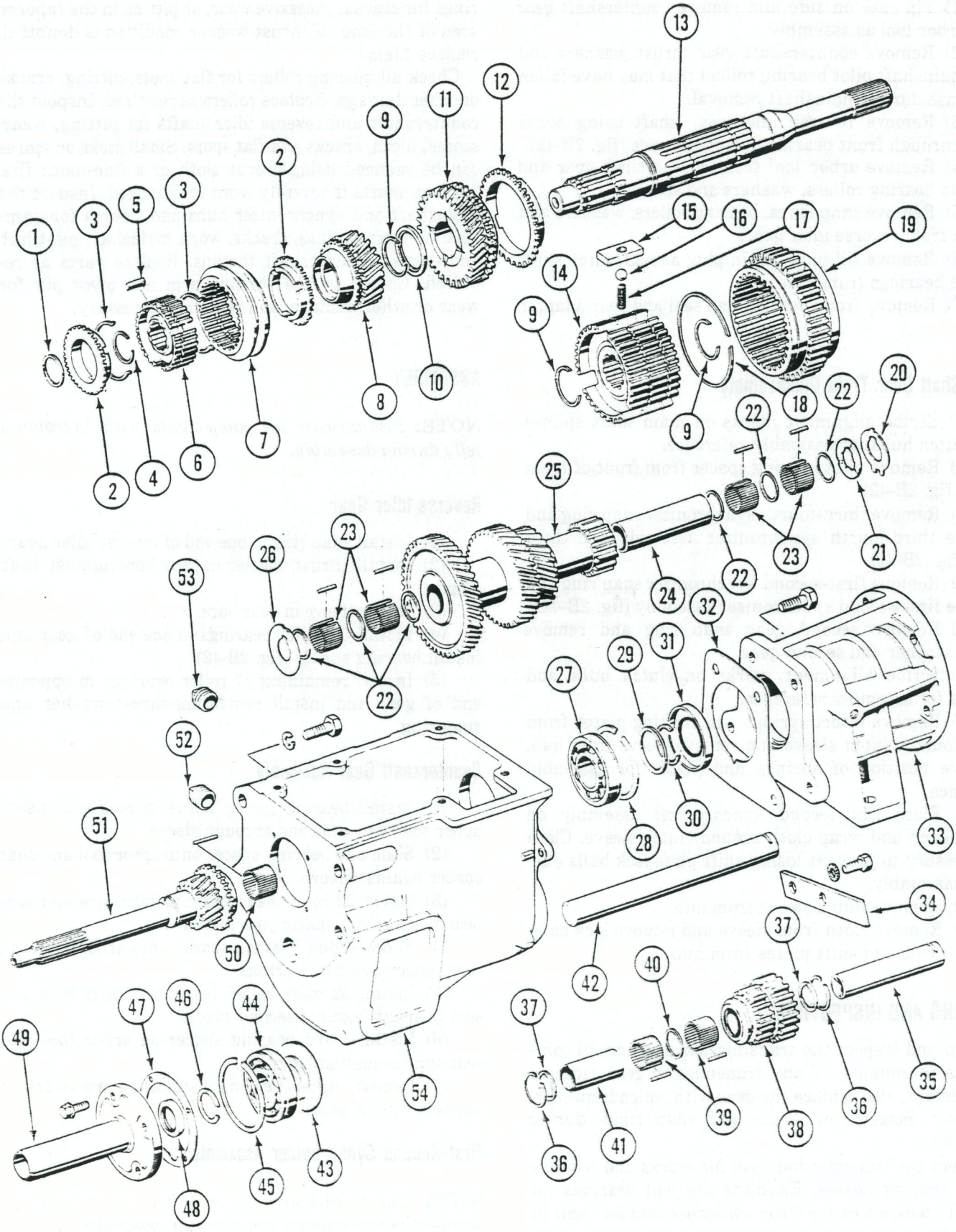


Fig. 2B-42 Model T-18A 4-Speed Transmission

1. MAINSHAFT PILOT BEARING ROLLER SPACER
2. THIRD-FOURTH BLOCKING RING
3. THIRD-FOURTH RETAINING RING
4. THIRD-FOURTH SYNCHRONIZER SNAP RING
5. THIRD-FOURTH SHIFTING PLATE (3)
6. THIRD-FOURTH CLUTCH HUB
7. THIRD-FOURTH CLUTCH SLEEVE
8. THIRD GEAR
9. MAINSHAFT SNAP RING
10. SECOND GEAR THRUST WASHER
11. SECOND GEAR
12. SECOND GEAR BLOCKING RING
13. MAINSHAFT
14. FIRST-SECOND CLUTCH HUB
15. FIRST-SECOND SHIFTING PLATE (3)
16. POPPET BALL
17. POPPET SPRING
18. FIRST-SECOND INSERT RING
19. FIRST-SECOND CLUTCH SLEEVE
20. COUNTERSHAFT GEAR THRUST WASHER (STEEL) (REAR)
21. COUNTER SHAFT GEAR THRUST WASHER (STEEL BACKED BRONZE) (REAR)
22. COUNTERSHAFT GEAR BEARING WASHER
23. COUNTERSHAFT GEAR BEARING ROLLERS (88)
24. COUNTERSHAFT GEAR BEARING SPACER
25. COUNTERSHAFT GEAR
26. COUNTERSHAFT GEAR THRUST WASHER (FRONT)
27. REAR BEARING
28. REAR BEARING LOCATING SNAP RING
29. REAR BEARING SPACER RING
30. REAR BEARING SNAP RING
31. ADAPTER PLATE SEAL
32. ADAPTER PLATE TO TRANSMISSION GASKET
33. ADAPTER TO TRANSMISSION
34. COUNTERSHAFT-REVERSE IDLER SHAFT LOCKPLATE
35. REVERSE IDLER GEAR SHAFT
36. REVERSE IDLER GEAR SNAP RING
37. REVERSE IDLER GEAR THRUST WASHER
38. REVERSE IDLER GEAR
39. REVERSE IDLER GEAR BEARING ROLLERS (74)
40. REVERSE IDLER GEAR BEARING WASHER
41. REVERSE IDLER SHAFT SLEEVE
42. COUNTERSHAFT
43. FRONT BEARING RETAINER WASHER
44. FRONT BEARING
45. FRONT BEARING LOCATING SNAP RING
46. FRONT BEARING LOCK RING
47. FRONT BEARING CAP GASKET
48. FRONT BEARING CUP SEAL
49. FRONT BEARING CAP
50. MAINSHAFT PILOT BEARING ROLLERS (22)
51. CLUTCH SHAFT
52. DRAIN PLUG
53. FILLER PLUG
54. TRANSMISSION CASE

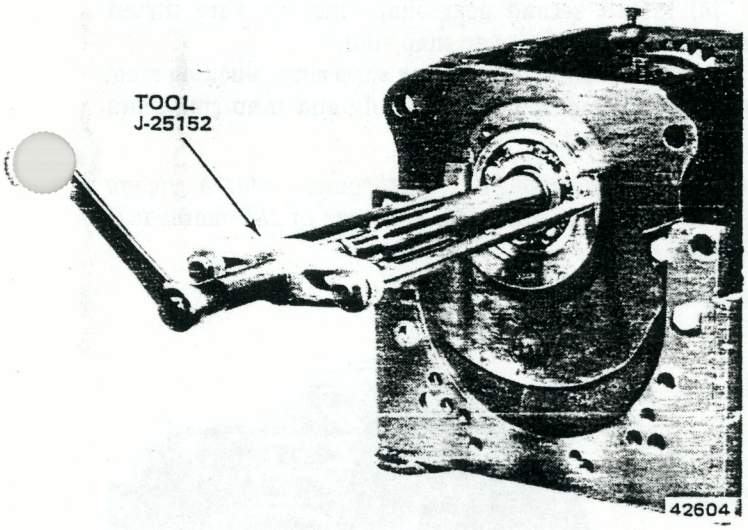


Fig. 2B-43 Front Bearing Removal

(3) Position first-second clutch hub on top of third-fourth hub so lock ball holes in first-second hub are in uppermost position (fig. 2B-44).

(4) Align scribe marks on first-second hub and sleeve and install sleeve on hub (fig. 2B-45). Allow sleeve to bottom against work bench.

(5) Install each shifting plate, poppet spring and lock ball assembly one at a time as follows (fig. 2B-45):

(a) Install shifting plate in hub slot.

(b) Insert poppet spring through plate.

(c) Position lock ball on poppet spring, and compress ball and spring (fig. 2B-45).

NOTE: *To ease lock ball installation use 7/32-inch socket and 1/4-inch drive extension to press lock ball into place.*

(d) Maintain pressure on ball and spring and slide shifting plate downward in hub slot until ball is held in position by clutch sleeve.

(6) Install remaining shift plates, poppet springs and lock balls as described in previous step.

(7) Complete synchronizer assembly by pressing down on hub and pulling up on sleeve.

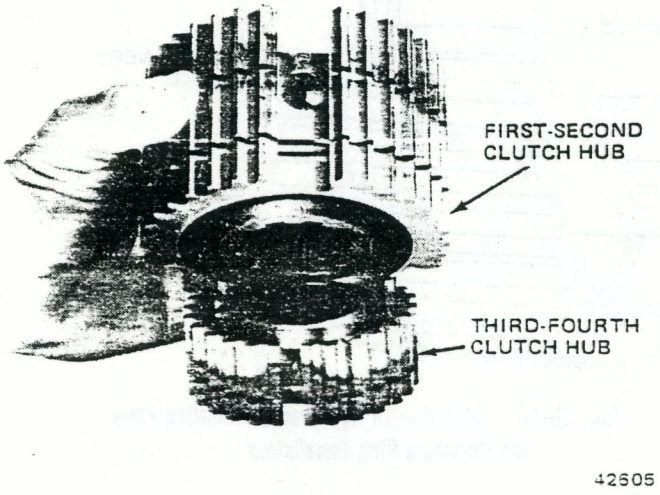


Fig. 2B-44 Supporting First-Second Clutch Hub

Third-Fourth Synchronizer Assembly

(1) Align and assemble third-fourth clutch hub and sleeve using reference marks made at disassembly.

(2) Insert shifting plates in hub slots.

(3) Install insert springs so one end of each spring is hooked into same shifting plate (fig. 2B-46).

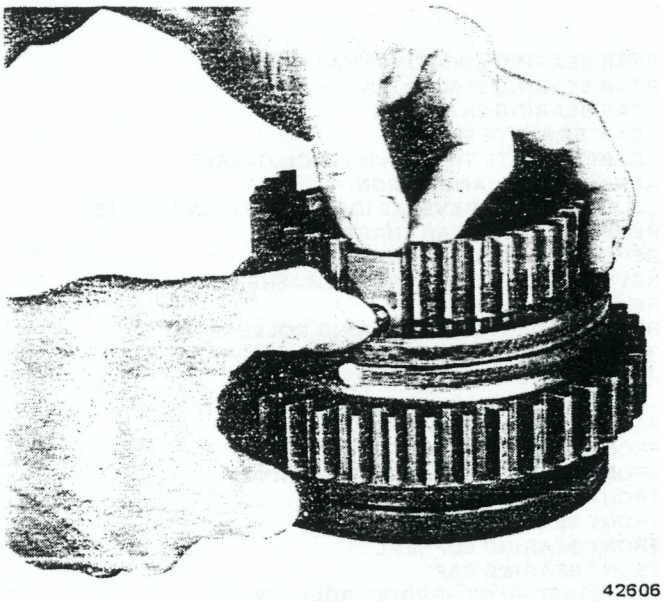


Fig. 2B-45 Assembling First-Second Synchronizer

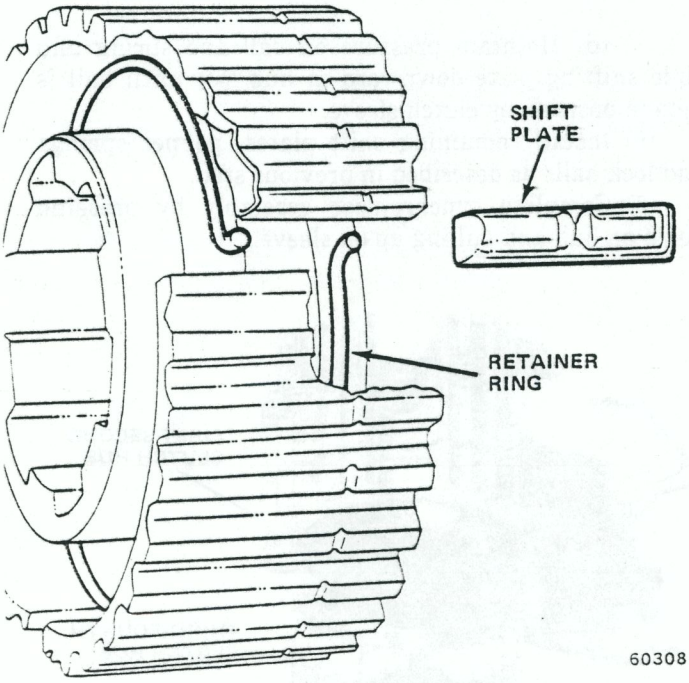


Fig. 2B-46 Third-Fourth Synchronizer Shifting Plate and Retaining Ring Installation

Clutch Shaft Assembly

(1) Lubricate mainshaft bearing rollers and clutch shaft bore with generous quantity of petroleum jelly.

(2) Install 22 bearing rollers in clutch shaft bore. Use additional petroleum jelly to help retain rollers in bore if necessary.

(3) Coat blocking ring with petroleum jelly and install ring on clutch shaft.

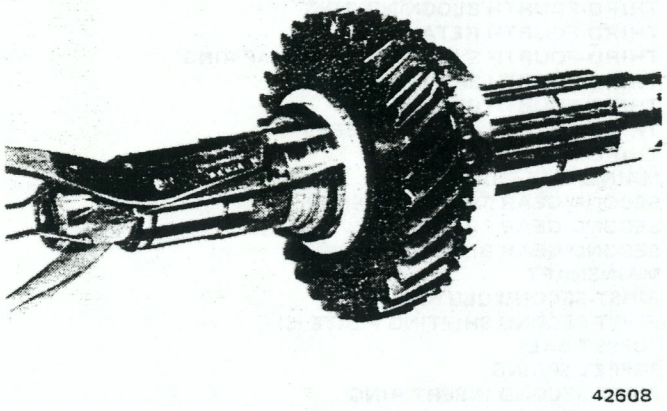


Fig. 2B-47 Second Gear and Thrust Washer Installation

Mainshaft and Geartrain Assembly

(1) Install second gear from front of mainshaft (fig. 2B-47).

(2) Install second gear thrust washer so step bore in washer faces front end of mainshaft.

(3) Install second gear snap ring. Be sure thrust washer step bore fits over snap ring.

(4) Install second gear rear snap ring, blocking ring, first-second synchronizer assembly and snap ring from rear of mainshaft.

NOTE: *The first-second synchronizer clutch sleeve shift fork groove must face the rear of the mainshaft (fig. 2B-48).*

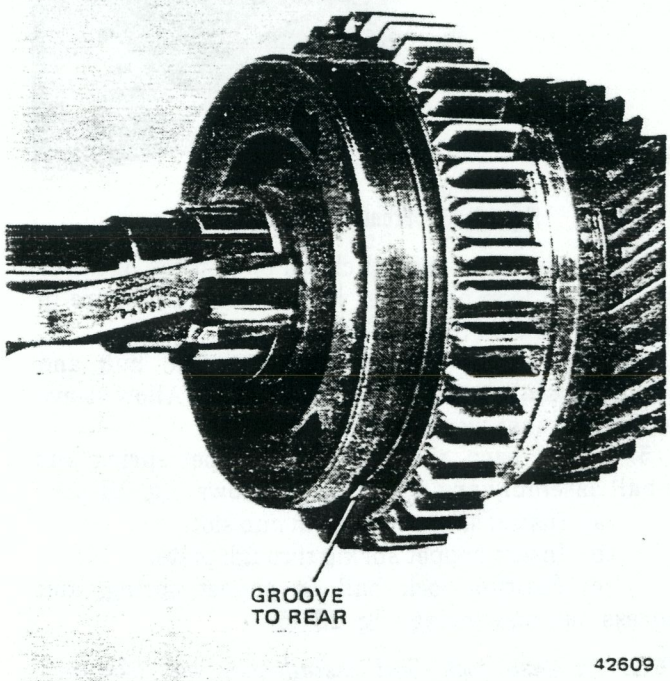


Fig. 2B-48 First-Second Synchronizer Installation

(5) Install third gear on mainshaft and install blocking ring on gear.

(6) Install third-fourth synchronizer assembly on mainshaft (fig. 2B-42).

NOTE: *The third-fourth synchronizer must be installed with the chamfered side of the hub facing the front of the mainshaft (fig. 2B-49).*

(7) Install third-fourth synchronizer retaining ring (fig. 2B-42).

(8) Install mainshaft bearing roller spacer on shaft pilot hub (fig. 2B-42).

Transmission Case Assembly

(1) Coat countershaft thrust washers with petroleum jelly and install washers in case. Index tab on large, bronze-faced washer in locating recess in front of case. Index notch in smaller, steel washer with locating lug at rear of case.

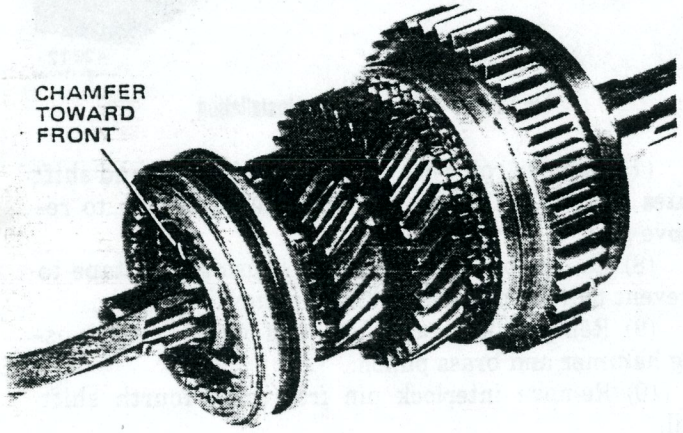


Fig. 2B-49 Third-Fourth Synchronizer Installation

(2) Install countershaft gear assembly.

(3) Install remaining countershaft thrust washer between rear of countershaft gear and smaller, steel thrust washer.

(4) Install countershaft from rear of case but do not install shaft completely. Stop installation when shaft just starts into case front bore.

CAUTION: *When installing the countershaft, keep the shaft and arbor tool in constant contact to avoid displacing any bearing rollers or bearing washers.*

(5) Install reverse idler gear. Larger gear end must face rear of case.

(6) Install reverse idler gear shaft from rear of case. Tap shaft forward until lock plate slot in shaft is aligned with lock plate slot in countershaft.

(7) Install lock plate in countershaft and reverse idler gear shaft slots.

(8) Tap ends of countershaft and reverse idler gear shafts alternately until shafts are fully installed.

(9) Insert assembled clutch shaft and fourth gear blocking ring in case front bearing bore. Insert shaft from case interior, not from front or outside of case.

(10) Install mainshaft and gear train assembly.

(11) Install mainshaft pilot bearing roller spacer on mainshaft pilot hub if not installed previously.

(12) Insert mainshaft pilot hub in clutch shaft bore. Be sure bearing rollers in clutch shaft are not displaced and that fourth gear blocking ring notches are aligned with shifting plates.

(13) Install front bearing cap temporarily to support clutch shaft.

(14) Install retaining snap ring on rear bearing and drive bearing onto mainshaft and into case rear bore. Seat snap ring against case.

CAUTION: *During rear bearing installation avoid wedging each blocking ring on its mating tapered surface.*

(15) Install replacement oil seal in transfer case adapter plate.

CAUTION: *The adapter plate oil seal must be installed correctly to prevent lubricant flow from the transfer case into the transmission. When correctly positioned, the seal lip will face the transfer case (fig. 2B-50).*

(16) Coat lip of adapter plate oil seal with petroleum jelly.

(17) Position replacement transmission-to-adapter gasket on transmission and install adapter plate. Apply nonhardening sealer to adapter plate attaching bolts and install bolts.

(18) Remove front bearing cap and install front bearing retaining washer on clutch shaft with dished side of washer facing mainshaft.

(19) Slide front bearing onto clutch shaft and tap bearing into case bore using section of pipe or driver sleeve (fig. 2B-51). Be sure to seat bearing against clutch shaft gear shoulder and front bearing retainer washer.

CAUTION: *During front bearing installation avoid wedging each blocking ring on its mating tapered surface.*

(20) Install thickest front bearing lock ring in clutch shaft ring groove.

NOTE: *The front bearing lock rings are available in four thicknesses.*

(21) Pull clutch shaft and front bearing forward just far enough to expose locating snap ring groove in bearing. Install locating snap ring and push clutch shaft rearward until locating snap ring seats against case.

(22) Position front bearing cap gasket on front bearing cap. Coat threads of bearing cap attaching bolts with

nonhardening sealer. Align oil return holes in cap, gasket and case, and install attaching bolts. Tighten bolts to 15 foot-pounds (20 N•m) torque.

(23) Check all synchronizer blocking rings for free movement. If blocking rings were wedged onto the tapered hubs of the clutch shaft, third and second speed gears during bearing installation, pry them free using screwdriver.

(24) Move synchronizer sleeves to Neutral position.

(25) Install fill and drain plugs and pour two pints of gear lubricant over all gears while rotating mainshaft.

(26) Coat shift control housing with RTV silicone sealer and install housing on case. Be sure shift forks engage synchronizer sleeves and that reverse shift arm engages flat on reverse shift rail.

(27) Coat shift lever housing attaching bolts with nonhardening sealer and install bolts. Tighten bolts to 12 foot-pounds (16 N•m) torque.

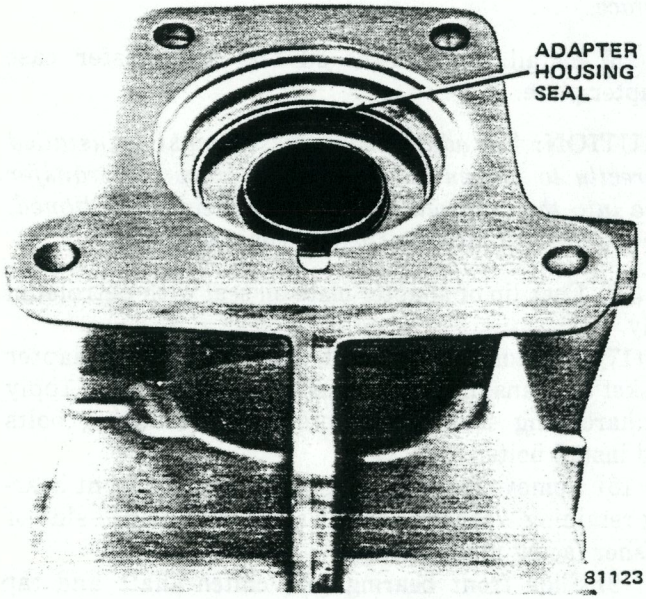


Fig. 2B-50 Adapter Plate Oil Seal Position

(28) Shift gears through all positions to check operation.

(29) Assemble transfer case and transmission and tighten attaching bolts to 30 foot-pounds (41 N•m) torque.

SHIFT CONTROL HOUSING

Disassembly

(1) Unthread shift lever cap and remove cap, gasket if equipped, spring seat, spring and shift lever as assembly (fig. 2B-52).

(2) Remove shift lever locating pins from housing (fig. 2B-52).

(3) Mount housing in vise with shift forks facing upward.

(4) Remove backup lamp switch.

(5) Remove shift rail bore plugs using hammer and punch.

(6) Move shift rails to Neutral position.

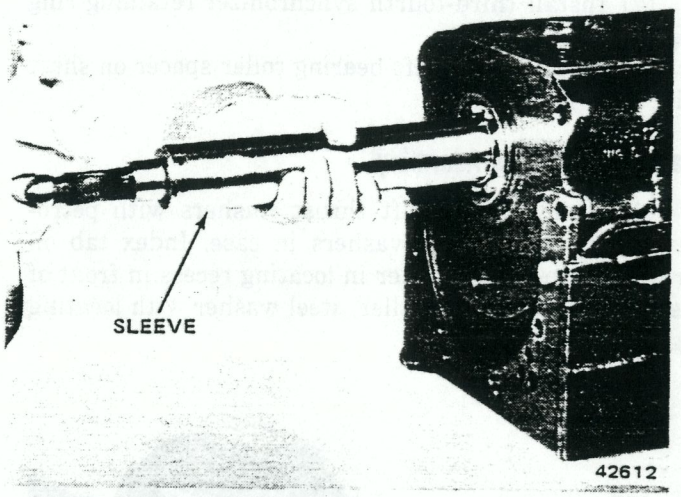


Fig. 2B-51 Front Bearing Installation

(7) Remove roll pins attaching shift forks and shift gates to shift rails. Use hammer and pin punch to remove pins.

(8) Cover poppet ball holes in housing with tape to prevent ball or spring loss during removal.

(9) Remove shift rails. Tap rails out of housing using hammer and brass punch.

(10) Remove interlock pin from third-fourth shift rail.

(11) Remove shift forks and shift gates. Be sure to mark or note position of forks and gates for assembly reference before removal.

(12) Remove poppet balls and springs from housing.

(13) Remove interlock plungers from housing.

(14) Remove retaining clip from reverse shift gate and remove spring and plunger from gate.

(15) Inspect housing breather. Remove breather if damaged or restricted in any way.

Assembly

(1) Install replacement breather in housing if removed.

(2) Install spring and plunger in reverse shift gate. Compress plunger and install plunger retaining clip.

(3) Insert reverse shift rail into housing. Install reverse shift fork on rail and slide rail up to but not into shift rail poppet bore.

(4) Install poppet spring and ball in reverse shift rail poppet bore. Compress ball and spring using punch and slide rail through bore.

(5) Install reverse shift gate on opposite end of shift rail and slide rail into housing until poppet ball engages rail notch. Install shift gate so plunger pin boss faces rear of housing (fig. 2B-53).

(6) Align and install roll pins that fasten reverse shift fork and shift gate to shift rail.

(7) Install interlock plungers in pockets located between housing shift rail poppet bores.

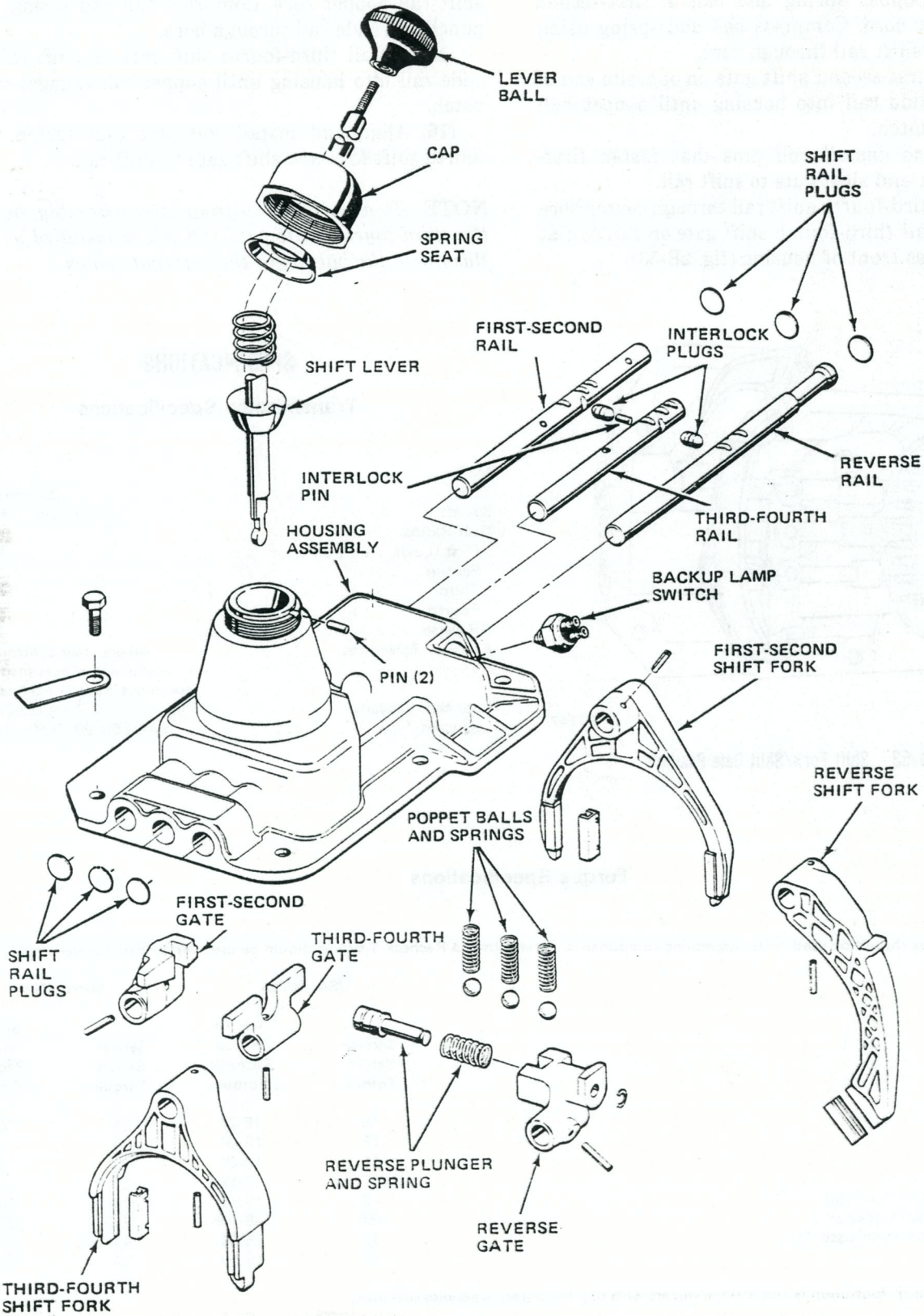


Fig. 2B-52 Shift Control Housing—Transmission Model T-18A

(8) Insert first-second shift rail into housing. Install first-second shift fork on rail so fork offset faces rear of housing (fig. 2B-53). Slide shift rail up to but not into shift rail poppet bore.

(9) Install poppet spring and ball in first-second shift rail poppet bore. Compress ball and spring using punch and slide shift rail through bore.

(10) Install first-second shift gate on opposite end of shift rail and slide rail into housing until poppet ball engages in rail notch.

(11) Align and install roll pins that fasten first-second shift fork and shift gate to shift rail.

(12) Insert third-fourth shift rail through center bore in housing. Install third-fourth shift gate on rail so flat tang on gate faces front of housing (fig. 2B-53).

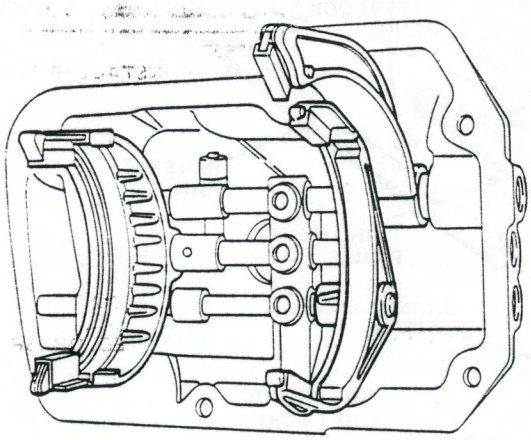
(13) Coat interlock pin with petroleum jelly (to hold it in place) and install pin in third-fourth shift rail pin bore.

(14) Install poppet spring and ball in third-fourth shift rail poppet bore. Compress ball and spring using punch and slide rail through bore.

(15) Install third-fourth shift fork on shift rail and slide rail into housing until poppet ball engages in rail notch.

(16) Align and install roll pins that fasten third-fourth shift fork and shift gate to shift rail.

NOTE: *To avoid hard shifting after assembly, be sure the third-fourth shift gate roll pin is installed so it is flush with the bottom of the shift gate notch.*



90147

Fig. 2B-53 Shift Fork/Shift Gate Position

SPECIFICATIONS

Transmission Specifications

Model	T18A
Type	Synchromesh
Speeds	4 Forward, 1 Reverse
Gear Ratios:	
First (Low)	6.32:1
Second	3.09:1
Third	1.69:1
Fourth	1.00:1
Reverse	7.44:1
End Play Tolerances	All end play controlled by selective thickness snap rings. Use thickest snap rings available.
Lubricant Capacity	6-1/2 Pints (3.07 liters)
Lubricant Type	SAE 85W-90 Gear Lubricant

80122

Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

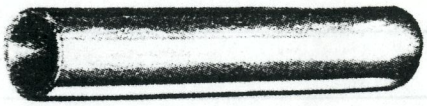
	USA (ft-lbs)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Backup Lamp Switch	18	15-20	24	20-27
Drain Plug	15	10-20	20	14-27
Fill Plug	15	10-20	20	14-27
Front Bearing Cap Bolt	15	12-18	20	16-24
Shift Control Housing-to-Case Bolt	12	10-15	16	14-20
Transfer Case Drive Gear Locknut	150	145-155	203	197-210
Transfer Case-to-Transmission Case Bolt	30	25-35	41	34-47
TCS Switch	18	15-20	24	20-27

All torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

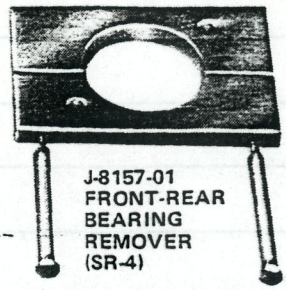
Refer to the Standard Torque Specifications and Capscrew Marking chart in Chapter A for torque values not listed above.

80123

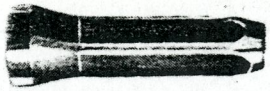
Tools



J-25234
BEARING INSTALLER TOOL (SR-4)



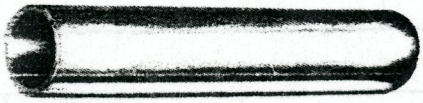
J-8157-01
FRONT-REAR
BEARING
REMOVER
(SR-4)



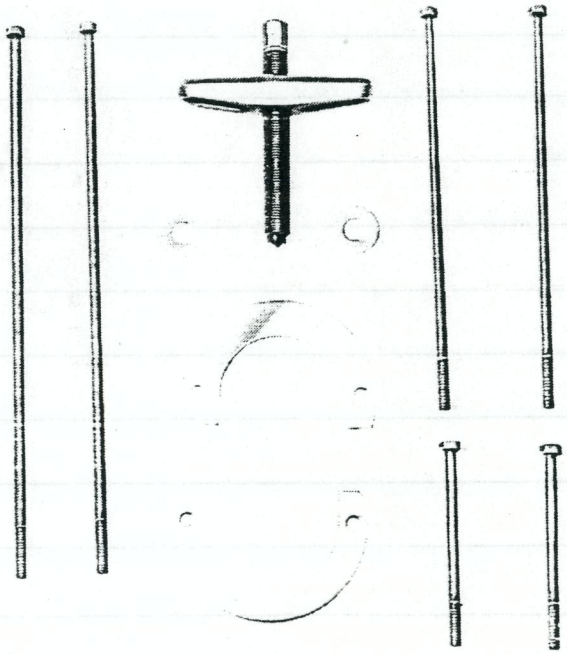
J-26625
FRONT BEARING CAP
SEAL INSTALLER (SR-4)

J-25233
FRONT BEARING CAP
SEAL INSTALLER (T-176)

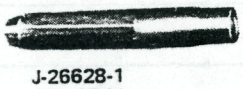
J-26624
COUNTERSHAFT
ARBOR TOOL (SR-4)



J-22697
BEARING INSTALLER (SR-4)



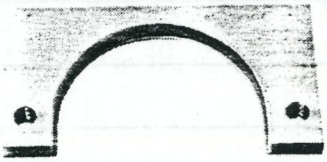
J-25152
BEARING PULLER SET



J-26628-1
OIL SEAL
INSTALLER (SR-4)

J-26628-2
OIL SEAL
PROTECTOR (SR-4)

J-29343
REVERSE IDLER SHAFT
ARBOR TOOL (T-176)



J-29344
FRONT BEARING
PULLER (T-176)

J-29342
COUNTERSHAFT
ARBOR TOOL (T-176)

J-29345
BEARING STARTER (T-176)

NOTES

AUTOMATIC TRANSMISSION 2C

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GENERAL INFORMATION

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Identification	2C-6	Transmission Components	2C-5

GENERAL

The automatic transmissions used in Jeep vehicles are fully automatic, three speed, hydraulically operated units with a compound planetary gear system. A three element torque converter is used for all applications. A manually operated column gearshift linkage is used to select the desired gear range. Transmission shift points are controlled by an externally mounted throttle linkage. The transmission case and converter housing consists of a one-piece aluminum casting. An aluminum adapter housing is used to connect the transmission to the various transfer case models.

Transmission Applications

Three automatic transmission models are used. They are models 904, 999 and 727 (figs. 2C-1 and 2C-2). Model 904 is used in CJ-7 models (only) equipped with a four-cylinder engine. This transmission has a wide ratio gear set with a low gear ratio of 2.74:1. Model 999 transmissions are used in CJ-7 models with either a six- or eight-cylinder engine. Model 727 is used in Cherokee, Wagoneer and Truck models with six- or eight-cylinder engines. An automatic transmission is not available in CJ-5 models equipped with the 2.5 liter four-cylinder engine.

Torque Converter Applications

Two different type torque converters are used for Jeep vehicles. CJ-5 models with a four-cylinder engine use a conventional torque converter. CJ-7, Cherokee, Wagoneer and Truck models with six- or eight-cylinder engine use a lockup torque converter. A high stall lockup torque converter is used with the model 727 transmission for six-cylinder engine applications. A low stall lockup torque converter is used with the model 727 transmission for eight-cylinder applications. The two converters are not interchangeable.

Conventional Torque Converter

The conventional torque converter is a three element unit consisting of a front cover, impeller, turbine, stator, and stator overrunning clutch. The impeller is connected to the engine crankshaft through the front cover which is welded to the impeller. The turbine is splined to the transmission input shaft, and the stator is splined to the reaction shaft.

Lockup Torque Converter

The lockup torque converter is similar to a conventional unit in that a turbine, impeller, and stator are employed. However, unlike a conventional unit, the lockup converter has an internal mechanism for locking

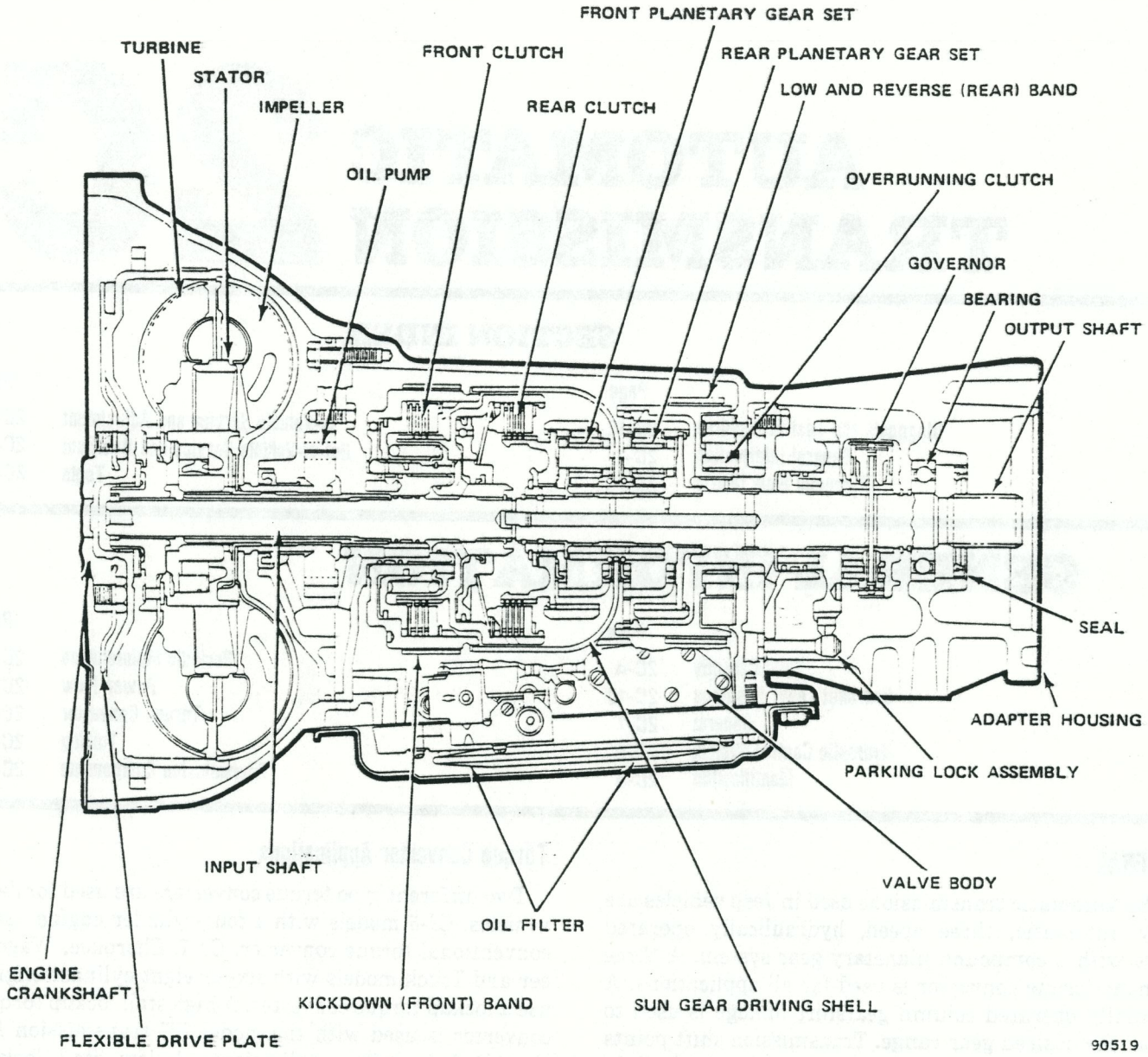

Fig. 2C-1 Automatic Transmission Model 904

improved fuel economy and reduced fluid operating temperatures.

The lockup system consists of a lockup mechanism within the converter, a lockup module attached to the valve body, and a switch valve in the valve body. The switch valve is actually the converter control valve which has been modified for lockup system use.

The converter internal lockup mechanism consists of a sliding clutch piston, torsion springs, and clutch friction material. The friction material is attached to the front cover, the clutch piston is mounted in the turbine, and the torsion springs are located on the forward side of the turbine. The torsion springs dampen out engine firing impulses and absorb shock loads that occur during lockup.

When the transmission shifts into direct drive and vehicle speed reaches approximately 38 mph (61 k/ph), transmission fluid is channeled through the input shaft and into the area between the clutch piston and turbine. At this point, fluid pressure extends the piston pressing it against the front cover friction material locking the turbine to the impeller (fig. 2C-4). When vehicle speed drops below 40 mph (64 k/ph) or the transmission shifts out of direct drive, fluid pressure is released, the clutch piston retracts, and the converter operates in a conventional manner again.

Torque Converter Service

The torque converter is a welded assembly and is not serviceable. If diagnosis indicates a malfunction has occurred or if the converter becomes contaminated with foreign material, replace the converter as an assembly only. Do not attempt to repair or flush the unit. In

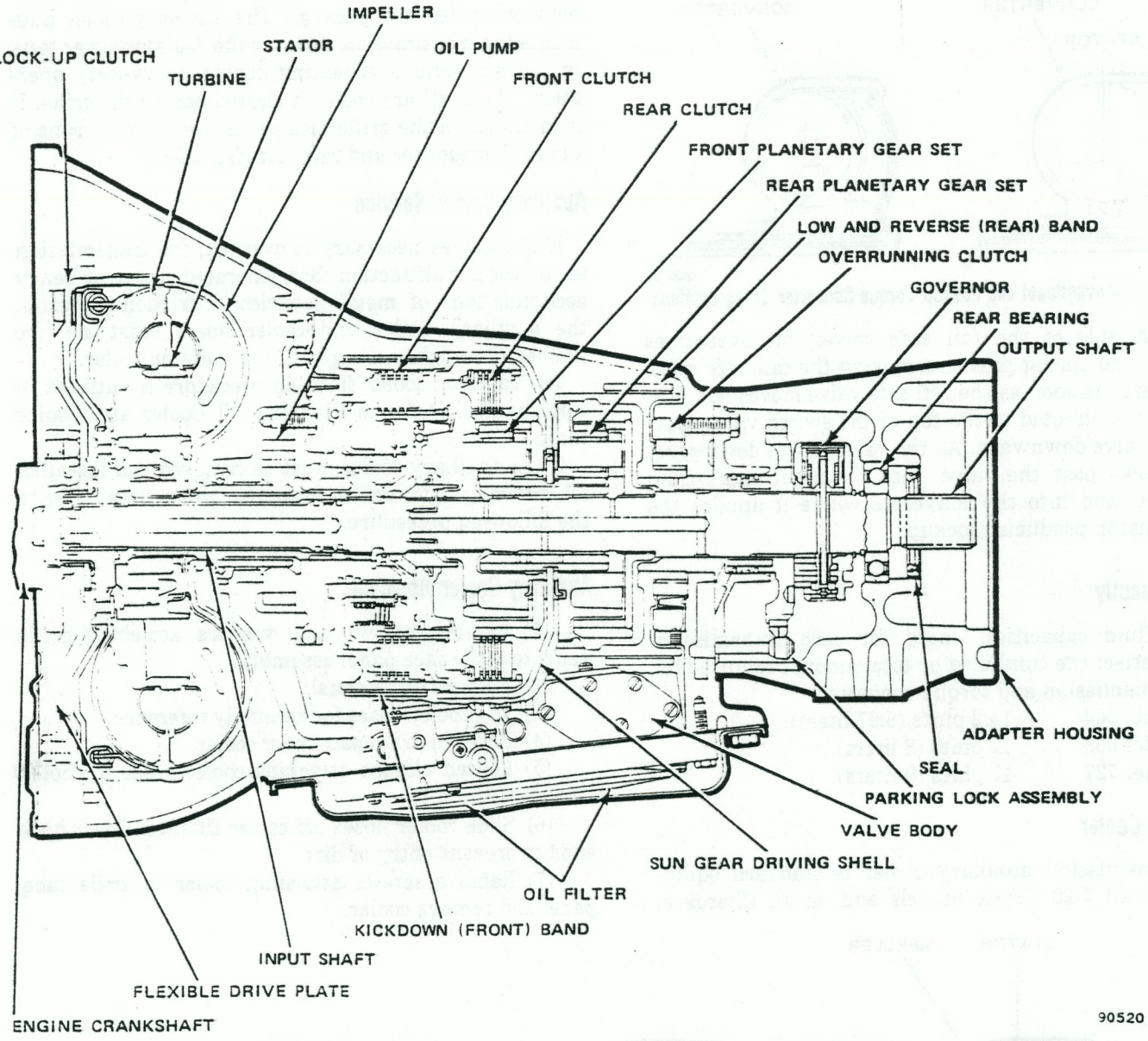

Fig. 2C-2 Automatic Transmission Models 999/727

addition, never attempt to interchange lockup and conventional converters. The transmission input shaft and valve body required for lockup operation are markedly different.

Lockup Converter Control System

The system controls consist of a lockup module attached to the valve body and a switch valve located within the valve body. The switch valve is actually the converter control valve which has been modified for lockup system use. The lockup module contains a fail safe valve and a lockup valve and is used for lockup converter applications only.

The lockup valve reacts to governor pressure and directs the switch valve to move in or out of lockup position (fig. 2C-5). The switch valve controls fluid flow to the converter clutch piston. The fail safe valve is a protective device in that it permits lockup only in direct drive and only if front clutch apply pressure (as received from the 2-3 shift valve) is sufficient.

The lockup control system is operative in direct drive only and system components are calibrated to produce lockup at a vehicle speed and governor pressure of approximately 40 mph (64 k/ph) and 38 psi (263 kPa). In operation, governor pressure reaches lockup point and overcomes lockup valve spring tension which moves the valve to the left (fig. 2C-5). This allows line pressure from the rear clutch circuit to enter the fail safe valve. As the lockup valve moves left, governor pressure against the 2-3 governor plug also moves the 2-3 shift valve into direct drive position. At this point, line pressure is channeled from the 2-3 shift to the shuttle valve, is further directed into and past the lockup valve, and to

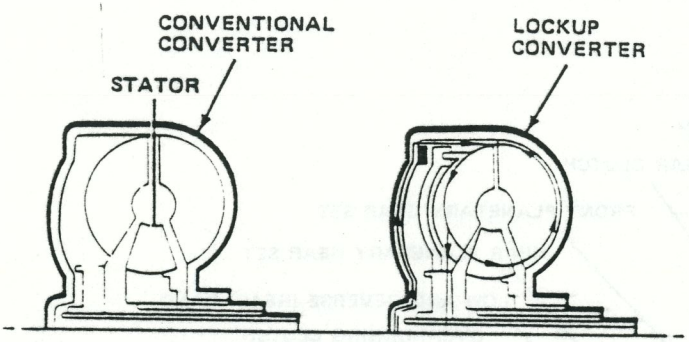

Fig. 2C-3 Conventional and Lockup Torque Converter Cross Sections

the right-side of the fail safe valve; this overcomes throttle and spring pressure moving the fail safe valve to the left. As soon as the fail safe valve moves left, line pressure is directed to the top of the switch valve moving the valve downward. As the valve moves downward, fluid flows past the valve, into the input shaft fluid channels, and into the converter where it applies the clutch piston producing lockup.

Fluid Capacity

The fluid capacities stated for each transmission model reflect the combined or total amount required for both transmission and torque converter.

- Model 904 14.2 pints (6.67 liters)
- Model 999 17 pints (8 liters)
- Model 727 17 pints (9 liters)

Auxiliary Cooler

A transmission auxiliary cooler is standard equipment on all J-20 Truck models and on all Cherokee, Wagoneer and J-10 Truck models equipped with a snow plow or trailer tow package. The auxiliary cooler augments the transmission cooler in the radiator lower tank to prevent fluid overheating during heavy-duty operation. The auxiliary cooler is located behind the grille. It is mounted on the grille face panel assembly in front of the A/C condenser and radiator (fig. 2C-6).

Auxiliary Cooler Service

If it becomes necessary to overhaul the transmission to correct a malfunction that generated sludge or heavy accumulations of metal particles or friction material, the auxiliary cooler and cooler hoses must also be flushed thoroughly along with the radiator cooler.

The radiator cooler flushing procedure is outlined in this chapter. Refer to Flushing Oil Cooler and Cooler Lines.

If the auxiliary cooler must be removed and installed for servicing or for access to another component, refer to the following procedure.

Auxiliary Cooler Removal

(1) Remove screws and washers attaching grille panel to grille face panel assembly.

(2) Remove grille panel.

(3) Tag cooler hoses for assembly reference.

(4) Position drain pan under cooler.

(5) Loosen clamps attaching cooler hoses to cooler fittings (fig. 2C-7).

(6) Slide cooler hoses off cooler fittings. Cover hose ends to prevent entry of dirt.

(7) Remove screws attaching cooler to grille face panel and remove cooler.

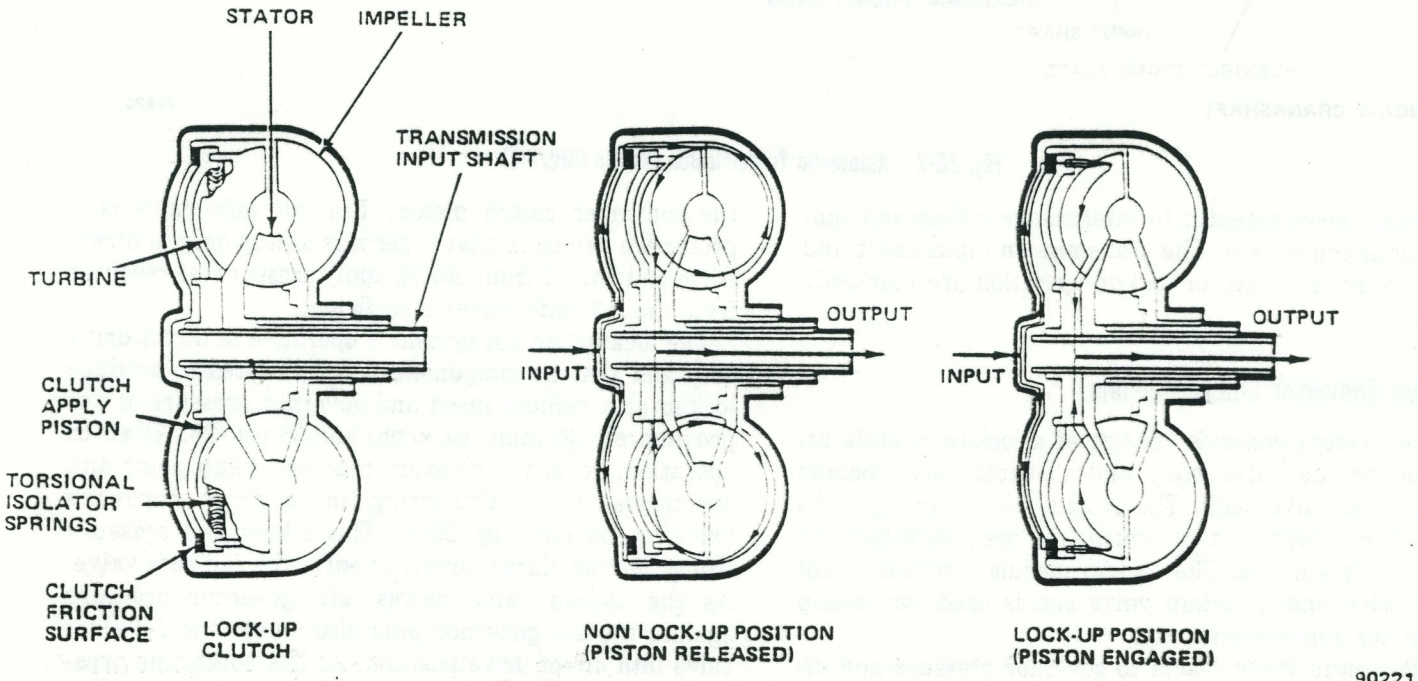

Fig. 2C-4 Lockup Torque Converter Operation

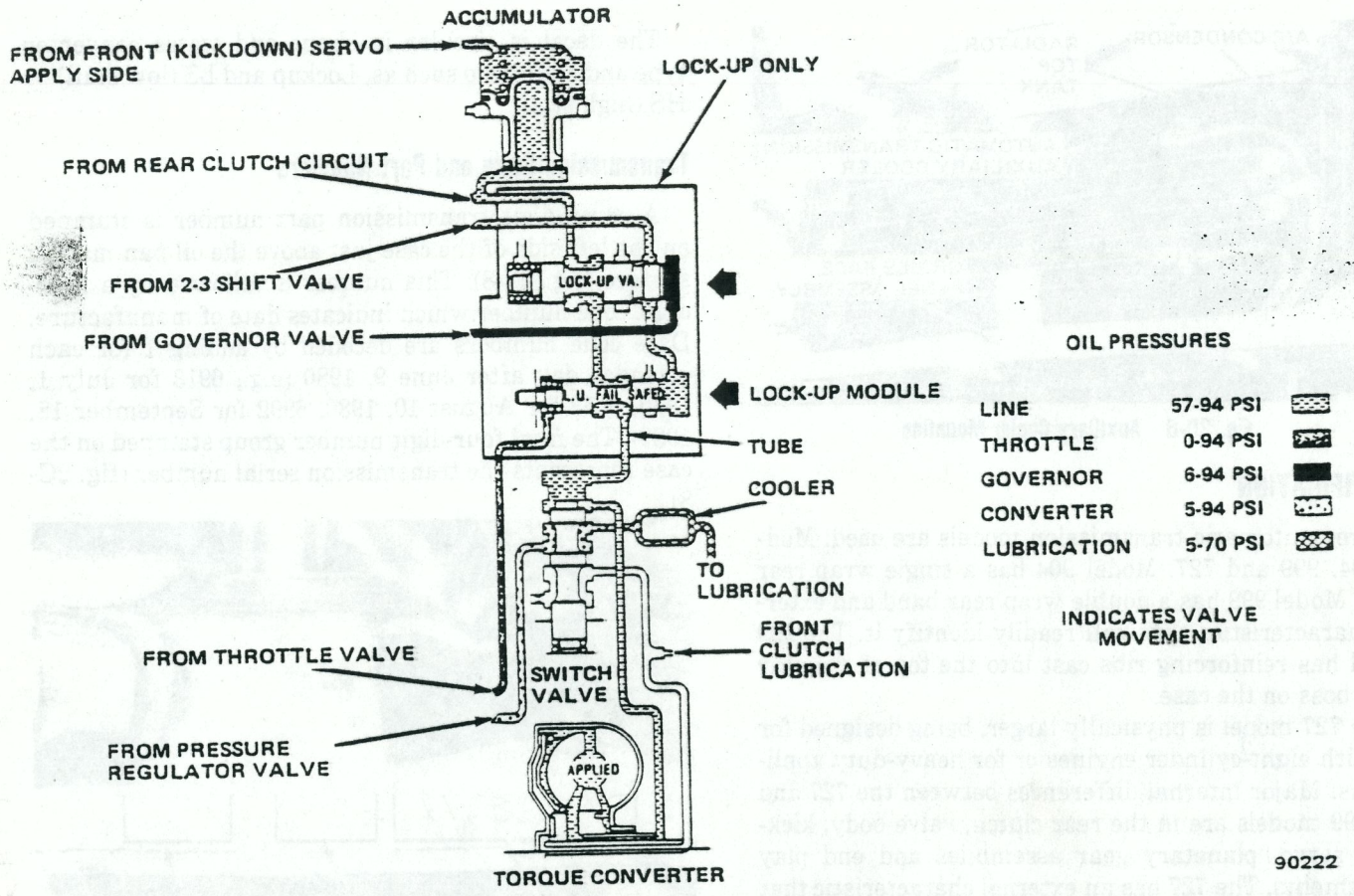

Fig. 2C-5 Lockup Torque Converter Control System

Auxiliary Cooler Installation

(1) Position cooler on grille face panel and install cooler attaching screws.

(2) Remove protective covering from ends of cooler hoses and install hoses on cooler fittings.

(3) Tighten cooler hose clamps securely.

(4) Position grille panel on grille face panel and install grille panel attaching screws.

(5) Check and correct transmission fluid level.

TRANSMISSION COMPONENTS

Clutch-Band-Gear System

Transmission models 999 and 727 each have two multiple disc clutches, two bands and actuating servos, an overrunning clutch and two planetary gear sets, all of which combine to provide one reverse and three forward gear ranges. The planetary gear sets are connected by a common sun gear. The sun gear is interconnected to the multiple disc clutches through the driving shell which is splined to the sun gear and front clutch retainer.

The model 904 transmission used on four-cylinder CJ models has a wide ratio planetary gear set. Ratios are:

- 1st Gear 2.74:1
- 2nd Gear 1.55:1
- 3rd Gear 1.00:1
- Reverse 2.20:1

Hydraulic System

The hydraulic system consists of a single oil pump, a valve body containing the pressure regulating shift control, and lockup control valves, a governor valve assembly, two band actuating servos as an accumulator.

Fluid Cooling and Filtration

The transmission fluid is cooled by circulating the fluid through an external cooler built into the radiator lower tank.

Transmission fluid is filtered by a Dacron element filter attached to the valve body. The filter is a serviceable component and can be replaced whenever diagnosis or service requirements indicate the need.

Transmission Venting

The transmission is vented through a passage drilled into the upper portion of the oil pump housing.

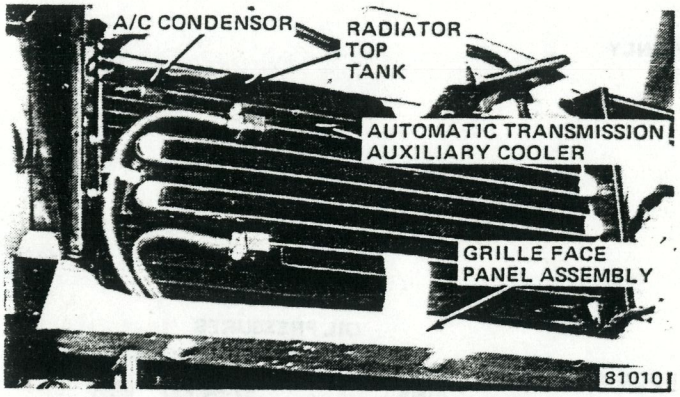

Fig. 2C-6 Auxiliary Cooler Mounting

IDENTIFICATION

Three automatic transmission models are used: Models 904, 999 and 727. Model 904 has a single wrap rear band. Model 999 has a double wrap rear band and external characteristics that will readily identify it. The 999 model has reinforcing ribs cast into the top of the rear servo boss on the case.

The 727 model is physically larger, being designed for use with eight-cylinder engines or for heavy-duty applications. Major internal differences between the 727 and 904/999 models are in the rear clutch, valve body, kickdown servo, planetary gear assemblies and end play adjustments. The 727 has an external characteristic that distinguishes it from the 999 models; the slope of the converter housing is much more gradual.

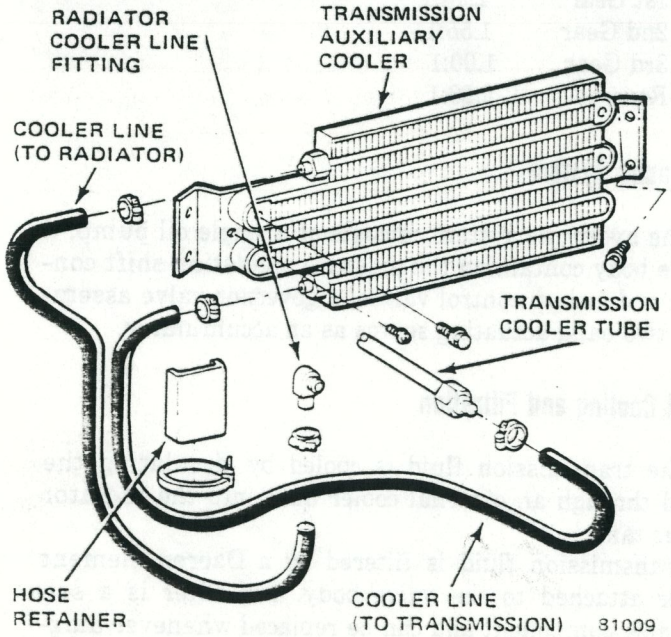

Fig. 2C-7 Auxiliary Cooler Assembly

Lockup Torque Converter Identification

Because the lockup mechanism is completely enclosed within the converter and not visible, lockup converters have an identifying decal attached to the front cover.

The decal is circular in shape and states converter type and stall ratio such as, Lockup and LS (low stall) or HS (high stall).

Transmission Code and Part Numbers

A seven-digit transmission part number is stamped on the left side of the case just above the oil pan mating surface (fig. 2C-8). This number is followed by a four-digit code number which indicates date of manufacture. Date code numbers are decoded by adding 1 for each calendar day after June 9, 1980 (e.g., 6913 for July 1, 1980, 6953 for August 10, 1980, 6992 for September 18, 1980). The final four-digit number group stamped on the case represents the transmission serial number (fig. 2C-8).

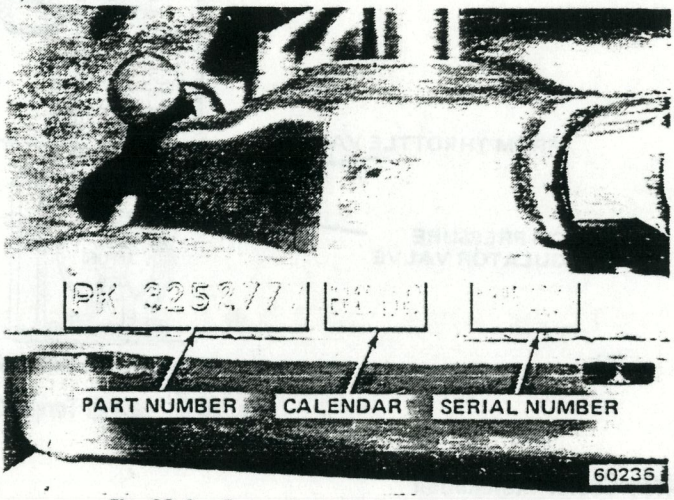

Fig. 2C-8 Transmission Code and Part Numbers

POWER FLOW

The torque converter front cover and impeller, which is welded to the cover (fig. 2C-9), are connected to the engine crankshaft by a drive plate and to the transmission input shaft by the converter overrunning clutch. In operation, power flow is as follows: Engine torque is transmitted to the torque converter front cover through the drive plate which connects the crankshaft and converter. The converter multiplies engine torque and transmits this torque directly to the input shaft and subsequently to the multiple disc clutches in the transmission.

The clutches then transfer engine torque through the two planetary gear sets and to the transmission output shaft. However, the actual torque flow path through the planetary gear sets is dependent on the clutch/band combination in effect at that point in transmission operation. Refer to the Clutch and Band Application Chart for details.

The torque transmitted through the planetary gear sets is applied to the transmission output shaft. Torque is then transferred through the transfer case and to the axles by the propeller shafts to complete the torque transfer cycle.

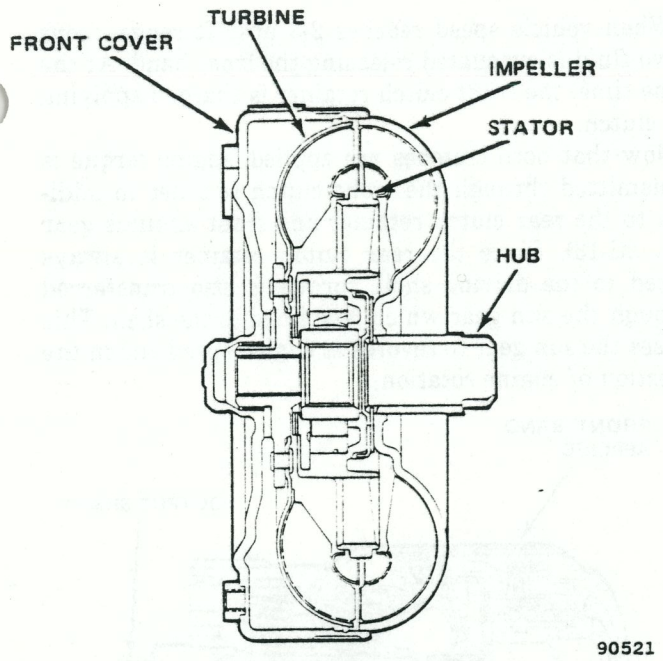

Fig. 2C-9 Three Element Torque Converter

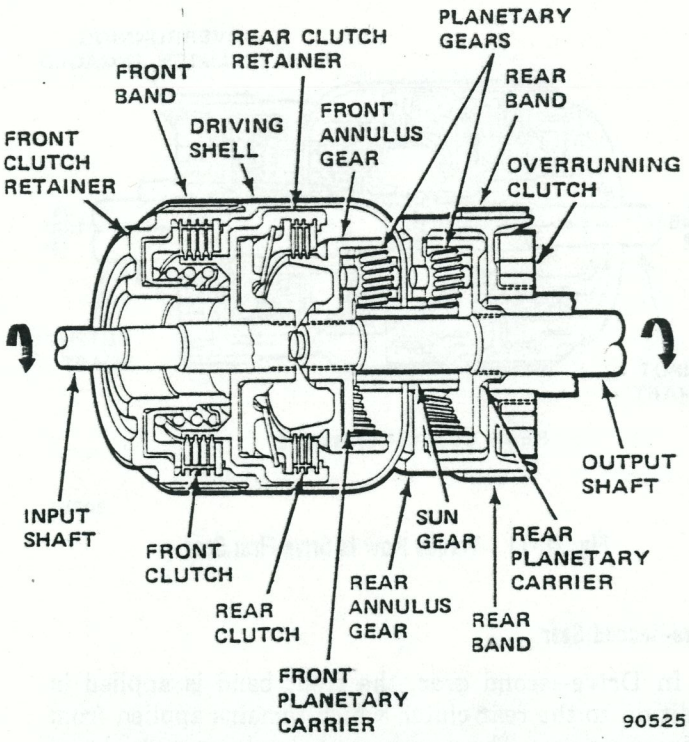

Fig. 2C-10 Clutch, Band and Gear System

Torque Flow

Neutral-Park Position

In Neutral and Park positions, none of the transmission clutches or bands are applied (fig. 2C-10).

With the engine running, torque is transmitted to the front clutch hub/rear clutch retainer by the input shaft. However, since clutch—band application has not occurred, torque flow stops at the rear clutch retainer. The rear clutch plates which are splined to the rear clutch retainer, rotate with the retainer at engine speed and direction of rotation. The rear clutch discs, which are splined to the front annulus gear, remain stationary.

Drive-First Gear

In Drive-first gear, the rear clutch is applied and the overrunning clutch holds the rear planetary gear carrier.

When shifted into Drive, the valve body directs fluid at operating pressure into the rear clutch retainer. Fluid pressure locks the rear clutch lined discs against the steel plates applying the clutch. Since the lined discs are splined to the front annulus gear, the rear clutch retainer and annulus gear are locked together (figs. 2C-10 and 2C-11). Engine torque is now transmitted through the rear clutch retainer to the front annulus gear, turning the gear at engine speed and in the direction of engine rotation. The front planetary gears, which are meshed with the front annulus gear, also rotate at engine speed and in the direction of engine rotation.

Both front and rear planetary gears are in mesh with the sun gear (fig. 2C-11). The sun gear has a reverse helix which causes it to revolve opposite engine rotation when turned by the front planetary gears. However, as a result of this helix, the sun gear causes the rear planetary gears to revolve in the same direction as engine rotation. At this point, torque flow is through the rear clutch and front annulus gear, into the front planetary gears and to the rear planetary gears through the counter-rotating sun gear (fig. 2C-11).

The rear annulus gear is splined to the output shaft. The rear planetary gear carrier is locked to the low-reverse drum which in turn is splined to the overrunning clutch inner race. The overrunning clutch permits carrier/drum rotation in the direction of engine rotation only; the clutch locks up if turned opposite to the direction of engine rotation.

With the rear annulus gear stationary, the action of the revolving rear planetary gears on the rear annulus gear causes the rear planetary carrier and low/reverse drum to rotate opposite engine direction. However, because the low/reverse drum is splined to the overrunning clutch, the clutch locks up preventing both drum and carrier from turning in a direction opposite to engine rotation.

Because the rear planetary carrier and low/reverse drum are held stationary by the overrunning clutch, torque is then transferred to the output shaft through the rear annulus gear which is splined to the shaft.

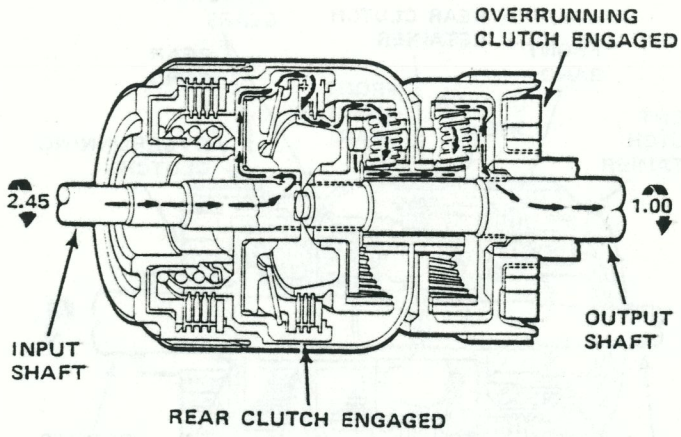

Fig. 2C-11 Torque Flow in Drive-First Gear

Drive-Second Gear

In Drive-second gear, the front band is applied in addition to the rear clutch which remains applied from Drive-first gear. The overrunning clutch is not employed in this gear and free wheels.

In response to increasing speed and pressure signals from the governor and throttle linkage, the transmission upshifts to second gear. The front servo is charged with fluid at operating pressure to apply the front band and complete the 1-2 upshift.

When the front band is applied, it holds the front clutch retainer preventing the retainer from turning. Because the retainer is locked to the driving shell, the shell and sun gear which is splined to the driving shell are also held stationary (fig. 2C-12).

Since the rear clutch is still applied, engine torque continues to flow through the rear clutch retainer to the front annulus gear turning the gear at engine speed and direction of rotation. However, because the sun gear is now stationary, front annulus gear rotation causes the front planetary gears to revolve in engine direction of rotation. This action causes the front planetary carrier to also rotate in engine direction but at a reduced speed.

Engine torque is then transferred directly to the output shaft through the front planetary carrier which is splined to the shaft (fig. 2C-12). Note that torque flow occurs through the front planetary gears only in Drive-second gear. The rear planetary gears are idling and the low/reverse drum is freewheeling with the overrunning clutch. Although the rear annulus gear revolves with the output shaft, it does so only because it is splined to the shaft.

Drive-Third Gear

In Drive-third gear, the front clutch is applied in addition to the rear clutch which remains applied from Drive-second gear.

When vehicle speed reaches 2-3 upshift range, front servo fluid is evacuated releasing the front band. At the same time, the front clutch retainer is charged applying the clutch.

Now that both clutches are applied, engine torque is transmitted through the front clutch retainer in addition to the rear clutch retainer and front annulus gear (fig. 2C-13). Since the rear clutch retainer is always locked to the driving shell, torque is also transferred through the sun gear which is splined to the shell. This causes the sun gear to revolve at engine speed and in the direction of engine rotation.

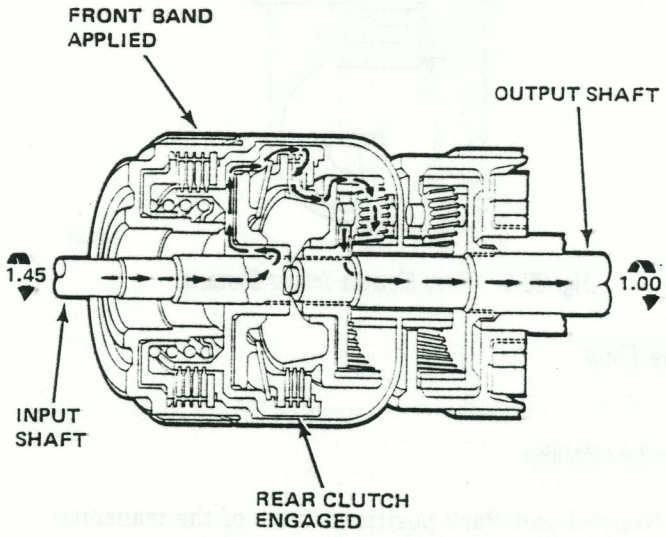

Fig. 2C-12 Torque Flow in Drive-Second Gear

Because torque is still transmitted through the rear clutch retainer, front annulus gear and front planetary gear carrier, the front planetary gears transmit torque to the output shaft through the front planetary carrier which is splined to the shaft. The rear planetary gears are locked to the sun gear and the rear annulus gear and low/reverse drum rotate with the output shaft but do not transmit torque.

The front and rear planetary gears are not rotating in Drive-third gear. The only rotation present is the input from the engine and the output shaft. All other connected parts rotate as one common unit.

Manual First Gear 1 Position

Torque flow in manual first gear is the same as in Drive-first gear except an additional element is employed. Along with the rear clutch, the rear band is also applied to provide engine braking action. The transmission will not upshift in manual first gear 1 position.

Torque flow is from the input shaft to the rear clutch retainer and front annulus gear (fig. 2C-14). The annulus gear revolves at engine speed and in the direction of engine rotation causing the front planetary gears to also rotate at engine speed and in the direction of engine rotation.

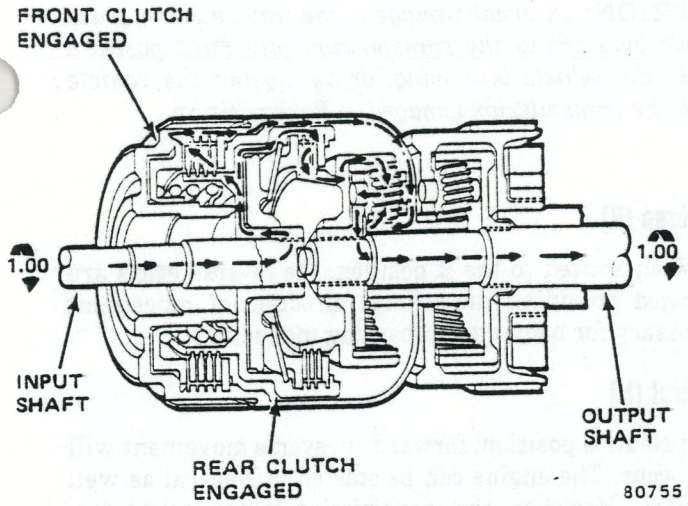

Fig. 2C-13 Torque Flow In Drive-Third Gear

The front planetary carrier, which is splined to the output shaft, is held stationary momentarily. This constition causes the front planetary gears to turn the sun gear and driving shell opposite engine rotation. Sun gear rotation then causes the rear planetary gears to rotate in engine direction. Since the rear planetary carrier is locked to the low/reverse drum, the rear band and overrunning clutch prevent the drum and carrier from rotating opposite engine direction. Rear planetary gear action causes the rear annulus gear to rotate in engine direction. Torque is transferred directly to the output shaft by the annulus gear which is splined to the shaft.

Manual Second Gear 2 Position

Torque flow and transmission elements employed in manual second gear are the same as described for drive-second gear. However, in this position, a 2-3 upshift does not occur. The transmission will perform a 1-2 upshift only. Refer to Drive-Second Gear and figure 2C-12 for a description of torque flow.

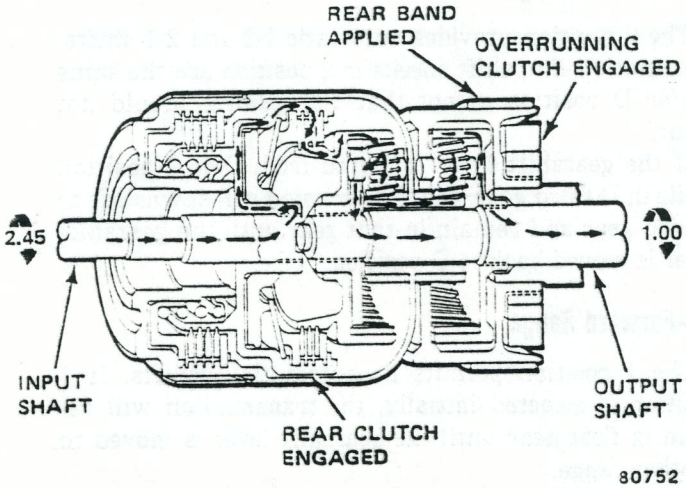

Fig. 2C-14 Torque Flow In Manual First Gear 1 Position

Reverse

In Reverse, the front clutch and rear band are applied. Engine torque input flows from the front clutch retainer to the driving shell which is locked to the retainer at all times (fig. 2C-15). Since the driving shell is also splined to the sun gear, it consequently turns the sun gear in engine rotation direction. Sun gear rotation then causes the planet pinions to rotate opposite engine direction.

The rear planetary gear carrier is held stationary by the rear band, as a result, torque is transmitted directly to the output shaft through the rear annulus gear which is splined to the shaft (fig. 2C-15).

In reverse, the front planetary gears are in an idling condition and all torque flows through the rear planetary gears.

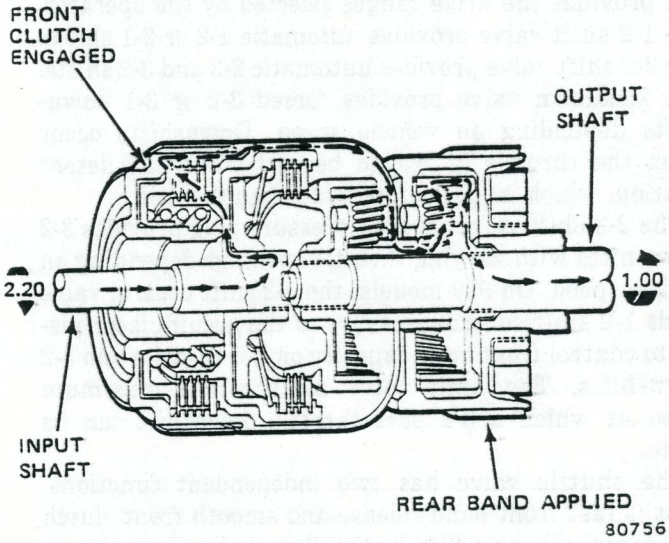

Fig. 2C-15 Torque Flow In Reverse

HYDRAULIC CONTROL SYSTEM

The hydraulic control system provides fully automatic operation of the transmission. The system performs five basic functions, which are:

- Pressure Supply
- Pressure Regulation
- Flow Control
- Clutch and Band Application
- Lubrication

Pressure Supply System

The single oil pump develops fluid pressure for operation and lubrication. The pump is driven by the engine through the torque converter.

Pressure Regulating System

The pressure regulator valve maintains transmission line pressure, however, the amount of line pressure developed is controlled by governor pressure which is dependent on the degree of throttle opening. The converter

control valve maintains both converter operating pressure and transmission lubrication pressure. The pressure regulator and converter control valves are located in the valve body.

The governor valve is operated by the output shaft and controls line pressure and shift speeds. Since the governor is operated by the output shaft, governor pressure increases in almost direct proportion to vehicle speed.

The throttle valve also controls upshift and downshift speeds by regulating pressure in conjunction with throttle position.

Shift Valves

The manual valve is actuated by the gearshift linkage and provides the drive ranges selected by the operator. The 1-2 shift valve provides automatic 1-2 or 2-1 shifts. The 2-3 shift valve provides automatic 2-3 and 3-2 shifts. The kickdown valve provides forced 3-2 or 3-1 downshifts depending on vehicle speed. Downshifts occur when the throttle is opened beyond downshift detent position, which is just before wide open throttle.

The 2-3 shift valve throttle pressure plug provides 3-2 downshifts with varying throttle openings depending on vehicle speed. On 999 models, the 1-2 shift control valve sends 1-2 shift control pressure to the accumulator piston to control front band capacity on 1-2 upshifts and 3-2 downshifts. The limit valve controls the maximum speed at which a 3-2 part throttle downshift can be made.

The shuttle valve has two independent functions. First is fast front band release and smooth front clutch engagement during "lift foot" 2-3 upshifts. Second is to regulate front servo and band application during 3-2 downshifts.

Clutches, Bands, Servos, Accumulator

The front and rear clutch pistons and servo pistons are actuated by line pressure. When line pressure is removed, the pistons are released by spring tension.

On 2-3 upshifts, the front servo piston is released by spring tension and hydraulic pressure. The accumulator controls hydraulic pressure on the apply side of the front servo during 1-2 shifts and serves to cushion front band application at all throttle openings.

GEARSHIFT LEVER POSITIONS

Park (P)

In Park position the transmission output shaft is mechanically locked by the internal parking linkage. The vehicle must be completely stopped before engaging the transmission in Park.

CAUTION: *Internal damage to the transmission could result by shifting the transmission into Park position while the vehicle is moving, or by moving the vehicle with the transmission engaged in Park position.*

Reverse (R)

When shifted to the R position, the reverse gears are engaged providing the reverse direction of movement necessary for backing and parking maneuvers.

Neutral (N)

In Neutral position, forward or reverse movement will not occur. The engine can be started in Neutral as well as Park. However, the transmission is not locked mechanically in Neutral as it is in Park position.

D—Forward Range

The D position provides automatically shifted forward ranges which are: 1-2 and 2-3 upshifts and 3-2 and 3-1 downshifts. The 3-2 and 3-1 downshifts occur at various vehicle speeds depending on throttle opening. Approximate shift speeds for various modes of operation are shown in the Automatic Shift Speed and Governor Pressure Chart.

For extra acceleration in D position third gear, above approximately 30 mph (48 km/h) and below approximately 70 mph (113 km/h), completely depress the accelerator. This forces a 3-2 downshift. The transmission will remain in second gear until full throttle automatic upshift speed is attained or the accelerator pedal is released. If the accelerator pedal completely depressed while in third gear below approximately 30 mph (48 km/h), a 3-1 downshift should occur. Upshifts to second and third gears occur at full throttle automatic upshift speeds or when the accelerator pedal is released.

2—Forward Range

The 2 position provides automatic 1-2 and 2-1 shifts. Automatic 1-2 upshift speeds in 2 position are the same as for D position except that 2-3 upshifts should not occur.

If the gearshift lever is moved from D to 2 position while in D third gear, the transmission will downshift to second gear and remain in that gear until the gearshift lever is moved back to D position.

1—Forward Range

The 1 position permits no automatic upshifts. If 1 position is selected initially, the transmission will remain in first gear until the gearshift lever is moved to another range.

If the gearshift lever is moved from D or 2 to 1 while the vehicle is in second gear at a speed below the full

throttle 1-2 upshift point, the transmission will downshift to first gear. If vehicle speed is above 1-2 full throttle shift point, the transmission will remain in second gear until speed is reduced to the 1-2 full throttle shift point.

If the gearshift lever is moved from D to 1 position at speeds below appproximately 30 mph (48 km/h), the transmission will downshift to first gear.

PERIODIC MAINTENANCE

For normal operation, the automatic transmission should be serviced every 25 months or 25,000 miles (40 000 km). Service should include changing the transmission fluid and filter and if necessary, adjusting the bands. For heavy-duty operation such as trailer towing, the transmission fluid and filter should be changed and the bands adjusted, if necessary, at 10 months or 10,000 mile (16 000 km) intervals.

TOWING

Emergency Towing

If the vehicle is to be towed with the front or rear wheels raised, towing speed must be limited to 30 mph (48 km/h) and the vehicle towed for a distance no greater than 15 miles (24 km).

Manual Transmission with Model 208 and Model 300 Transfer Case

Ignition Key Available: Shift transmission and transfer case into Neutral. Vehicle can now be towed with all four wheels on the ground or with front or rear wheels raised. Turn selective drive hubs to the 4 x 4/LOCK position. Turn ignition key to Off position to unlock steering.

Ignition Key Not Available and Vehicle is Unlocked: Shift transmission and transfer case into Neutral and tow vehicle with front wheels raised.

Ignition Key Not Available and Vehicle is Locked: Place dolly under rear wheels and tow vehicle with front end raised. Or, disconnect rear propeller shaft at rear axle yoke (be sure to mark the prop shaft and yoke for proper alignment at reassembly), secure shaft to underside of vehicle and tow with front end raised.

Automatic Transmission with Model 208 and Model 300 Transfer Case

Ignition Key Available: Turn ignition key to Off position to unlock steering column and gearshift selector linkage. Move gearshift lever to Park and transfer case shift lever to Neutral.

Ignition Key Not Available: Place dolly under rear wheels and tow vehicle with front end raised. Or, disconnect rear propeller shaft at rear axle yoke (index mark for correct assembly later), secure shaft to underside of vehicle and tow with front wheels raised.

Automatic Transmission with Quadra-Trac®

Ignition Key Available: Vehicle can be towed with all four wheels on the ground without disconnecting propeller shafts. Turn ignition key to Off position to unlock steering wheel. Move gearshift lever to Park and shift transfer case shift lever to Neutral position.

Recreational Towing

Jeep vehicle can be towed behind a recreational vehicle such as a motor home, however, the following instructions must be followed explicitly in order to avoid damaging drive line components. In addition, be sure to check and comply with federal, state and local requirements/ordinances regarding vehicle lighting, tow bars and trailer hitches.

With Manual Transmission and Model 208 or Model 300 Transfer Case

(1) Turn ignition switch to Off position to unlock steering wheel.

(2) Shift transmission into gear and the transfer case into Neutral.

(3) Turn front drive hubs to 4 x 4 or LOCK position, for axle lubrication.

With Automatic Transmission and Model 208 or Model 300 Transfer Case

(1) Turn ignition switch to Off position to unlock steering wheel.

(2) Shift automatic transmission into Park.

(3) Shift Transfer Case into Neutral position.

(4) Turn front drive hubs to 4 x 4 or LOCK position for axle lubrication.

With Automatic Transmission and Quadra-Trac®

(1) Turn ignition switch to Off position to unlock steering wheel.

(2) Shift automatic transmission into Park.

(3) Shift Transfer Case into Neutral position.

DIAGNOSIS AND TEST PROCEDURES

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Fluid Level and Condition	2C-12	Road Test	2C-13
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GENERAL

Automatic transmission malfunctions are generally the result of poor engine performance, incorrect fluid level, incorrect linkage, band or hydraulic control pressure adjustments, hydraulic system malfunctions or mechanical component malfunctions.

In all automatic transmission repair, the logical and proper procedure is diagnosis before disassembly. A systematic diagnosis procedure is important in avoiding repair delays caused by incorrect or unnecessary repairs. The diagnosis and test procedures outlined in this section should be performed in the following sequence to realize maximum effect: (1) preliminary diagnosis, (2) road test, (3) hydraulic pressure test, (4) air pressure test, (5) stall test, (6) analyze test results and consult diagnosis guides and charts for cause of malfunction.

PRELIMINARY DIAGNOSIS

Two basic procedures are required. One procedure for vehicles that are driveable and an alternate procedure for vehicles that will not back up or move forward.

Vehicle Is Driveable

(1) Check fluid level and condition.

(2) Adjust throttle and gearshift linkage before road testing if complaint was based on delayed, erratic, or harsh shifts.

(3) Perform stall test if complaint was based on sluggish, low-speed acceleration or abnormal throttle opening requirements to maintain highway speeds with engine in good tune.

(4) Road test vehicle and analyze results.

(5) Perform hydraulic pressure tests.

(6) Perform air pressure test to check clutch and band operation.

Vehicle Will Not Back Up or Move Forward

(1) Check fluid level and condition.

(2) Check for broken or disconnected throttle linkage.

(3) Check for broken cooler lines and loose or missing pressure port plugs.

(4) Raise vehicle, start engine, shift transmission into gear and note following:

(a) If propeller shafts turn but wheels do not, problem is in differential or axle shafts.

(b) If propeller shafts do not turn and transmission is noisy, stop engine, remove oil pan, and check for debris. If debris is not found, remove transmission and check for broken drive plate or drive plate-to-converter bolts, broken converter hub, broken input or output shaft or broken oil pump.

(c) If propeller shafts do not turn and transmission is not noisy, perform hydraulic pressure test to determine if problem is malfunction of hydraulic or mechanical component.

FLUID LEVEL AND CONDITION

Check fluid level and condition as follows:

(1) Drive vehicle until transmission fluid is at normal operating temperature of approximately 175°F (79.4°C).

NOTE: *To avoid false readings, which could result in an over or under-fill condition, do not check the fluid level until the fluid is at operating temperature.*

(2) Shift transmission into Neutral.

NOTE: *The transmission fluid level is checked in Neutral because the converter fills more rapidly in this position.*

(3) Apply parking brake.

(4) Operate engine at idle speed.

(5) Wipe dirt from filler cap and tube before removing dipstick.

WARNING: *Be sure to keep hands or loose articles of clothing away from the fan, accessory drive belts, or other rotating engine parts. Contact with these components or hot engine components can result in personal injury.*

(6) Remove dipstick and check fluid level. Fluid level is correct when between ADD ONE PINT and FULL marks on dipstick.

(7) Add or drain fluid as necessary to bring fluid to correct level. If level was low, check transmission for leaks.

(8) Check condition of fluid.

(a) Fluid should be dark red in color and free of dirt or debris.

(b) If fluid is discolored or smells burnt, but transmission operation is OK, fluid and filter should be replaced.

(c) If fluid is badly discolored, smells burnt, contains metal or frictional material particles and transmission problems were experienced, transmission may require overhaul.

A low fluid level allows the pump to take in air along with the fluid. As in any hydraulic system, aerated fluid will cause hydraulic pressures to be low and develop slower than normal.

If the transmission is overfilled, the gears churn the fluid into foam aerating the fluid and causing the same conditions that occur with a low fluid level. In either case, air bubbles cause fluid overheating, oxidation and varnish buildup which interferes with valve, clutch and servo operation. Foaming can also result in fluid escaping from the transmission vent where it may be mistaken for a leak.

Along with fluid level, it is also important to check fluid condition. When the fluid is dark, smells burnt or is contaminated with metal or frictional material particles, an overhaul may be necessary. Examine the fluid on the dipstick closely. If there is any doubt about its condition, drain out a sample for further inspection.

After checking fluid level and condition, seat the dipstick fully to seal out water and dirt.

NOTE: *After completing any repairs that required draining the transmission fluid, add 8 pints (4.5 liters) of Jeep, Dexron, or equivalent automatic transmission fluid to the transmission before starting the engine.*

FLUSHING OIL COOLER AND COOLER LINES

If a transmission or lockup clutch failure has contaminated the fluid, the oil cooler(s) should be reverse flushed to insure that metal particles or sludged oil are not later transferred back into the reconditioned transmission.

(1) Disconnect both cooler lines at radiator.

(2) Dislodge any foreign material at inlet side of cooler with small screwdriver.

(3) Reverse flush cooler with combination of mineral spirits and pulsating air under pressure (shop air).

(4) Treat cooler lines separately and insure they are clear by flowing mineral spirits or automatic transmission fluid through them.

(5) Remove leftover mineral spirits from cooler and cooler lines by flowing automatic transmission fluid through them.

(6) Cooler flow should now be checked by connecting cooler tubes and placing rear cooler tube into 1 quart container. Overfill transmission by 1 quart. Watching a clock, start engine (run at curb idle) and run in neutral for exactly 20 seconds. If cooler flow is less than 1 quart in 20 seconds, replace radiator or have radiator bottom cooler professionally reconditioned.

THROTTLE LINKAGE

The throttle linkage adjustment is important to proper operation. This adjustment positions a valve which controls shift speed, shift quality, and part throttle downshift sensitivity. If the setting is too short, early shifts and slippage between shifts may occur. If the linkage setting is too long, shifts may be delayed and part throttle downshifts may be very sensitive.

This adjustment is so critical that the use of a throttle lever holding spring is necessary to remove slack in the linkage during adjustment. Refer to Throttle Linkage Adjustment in In-Vehicle Service and Adjustment.

GEARSHIFT LINKAGE

The gearshift linkage adjustment is important because the linkage positions the manual valve in the valve body. Incorrect adjustment will result in creeping in Neutral, premature clutch wear, delayed engagement in any gear or a no-start in Park or Neutral condition.

Proper operation of the neutral start switch will provide a quick check of linkage adjustment as follows:

(1) Insert key in ignition lock and turn lock to On position to unlock column and gearshift lever.

(2) Move gearshift lever slowly upward until it clicks into Park detent in shift selector gate.

(3) Turn ignition lock cylinder to Start position and start engine. If starter operates, Park position is correct.

(4) Stop engine.

(5) Move gearshift lever slowly toward Neutral until lever engages in edge of Neutral detent in shift selector gate.

(6) Turn ignition lock cylinder to Start position and start engine. If starter operates, Neutral position is correct and linkage is properly adjusted.

(7) If starter failed to operate in Park or Neutral, or if gearshift lever had to be moved back and forth to achieve start in either position, linkage adjustment is required. Refer to Gearshift Linkage Adjustment in In-Vehicle Service and Adjustment section.

ROAD TEST

Before road testing, be sure fluid level, throttle and gearshift linkage adjustments have been checked and corrected if necessary.

Observe engine performance during the test. An engine malfunction will have an adverse effect on transmission operation. In addition, operate the transmission

in all gearshift positions to check for slippage and shift variations. Note whether the shifts are harsh or spongy, and check the speeds at which upshifts and downshifts occur.

Watch closely for slippage or engine speed flare-up which usually indicates clutch, band or overrunning clutch problems. If the condition is advanced, an overhaul may be necessary to restore normal operation.

In most cases, a slipping clutch or band can be determined by noting transmission operation in all gearshift lever positions and by comparing which internal units are applied in those positions. The Clutch and Band Application Chart provides a basis for analyzing road test results.

Clutch and Band Application Chart

Drive Elements	Gearshift Lever Position								
	P	R	N	D			2		1
				1	2	3	1	2	
Front Clutch		•				•			
Front Band					•			•	
Rear Clutch				•	•	•	•	•	•
Rear Band		•							•
Overrunning Clutch				•			•		•

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Analyzing the Road Test

Refer to the Clutch and Band Application Chart and note which elements are in use in the various gear ranges. The rear clutch is applied in all forward ranges (D, 2, 1). The overrunning clutch is applied in first gear D and 2 range only and the front band is applied in 1 and R range only.

For example, if slippage occurs in D and 2 range first gear but not in 1 range, the overrunning clutch is slipping. Similarly, if slippage occurs in any two forward gears, the rear clutch is slipping.

Applying the same method of analysis, note that both clutches are applied in D third gear only. If the transmission slips in third gear, either the front clutch or the rear clutch is slipping. By selecting another gear which does not use one of these units, the slipping clutch can be determined. For example, if the transmission also slips in reverse, the front clutch is slipping. If the transmission does not slip in reverse, the rear clutch is slipping.

This process of elimination can be used to determine the slipping unit and to check operation. The key is proper use of the Clutch and Band Application Chart.

Although road test analysis will help determine the slipping unit, the actual cause of a malfunction usually cannot be ascertained until hydraulic and air pressure tests are performed. Practically any condition can be caused by leaking hydraulic circuits or sticking valves.

Unless the condition is obvious, such as no drive in D range first gear only, do not disassemble the transmission until hydraulic and air pressure tests have been performed.

HYDRAULIC PRESSURE TESTS

The hydraulic pressure tests are performed using Test Set J-24027. The set consists of five color-coded pressure hoses, a 400 psi (2 758 kPa) capacity pressure gauge and a 100 psi (689 kPa) capacity pressure gauge (fig. 2C-16). The high pressure gauge is used to record rear servo pressure on R and 1 positions only and the low pressure gauge is used for all other readings. The test set permits simultaneous connection to all the pressure ports and allows sequential or independent pressure readings as desired.

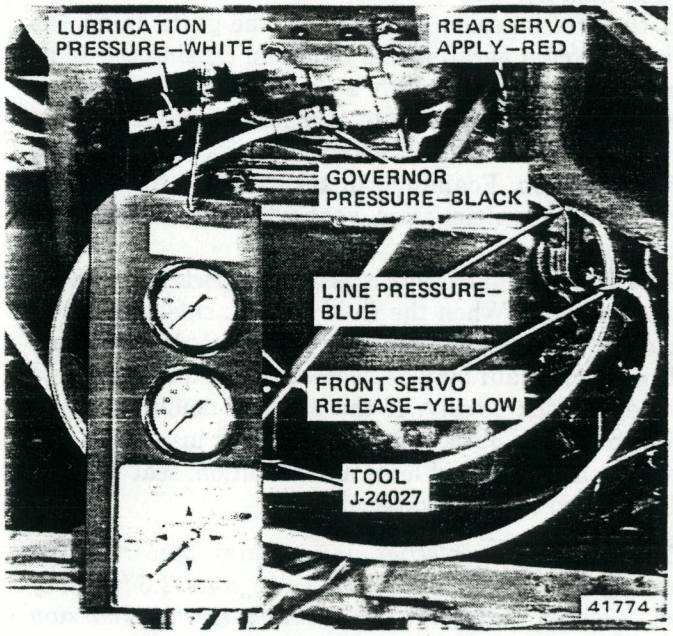

Fig. 2C-16 Pressure Test Set J-24027

Pressure Test Port Location

The accumulator line pressure port is located on the right side of the case between the front and rear servo castings just above the oil pan mating surface (fig. 2C-17).

The front servo release pressure port is located on the right side of the case just behind the filler tube opening just above the oil pan mating surface (fig. 2C-17).

The rear servo apply pressure port is on the right rear side of the case, facing rearward and just above the oil pan mating surface (fig. 2C-18).

The governor pressure port faces to the left side in the front lower center section of the adaptor housing (fig. 2C-18).

Lubrication pressure is measured by installing a T-fitting in the fluid cooler return line on the left side at

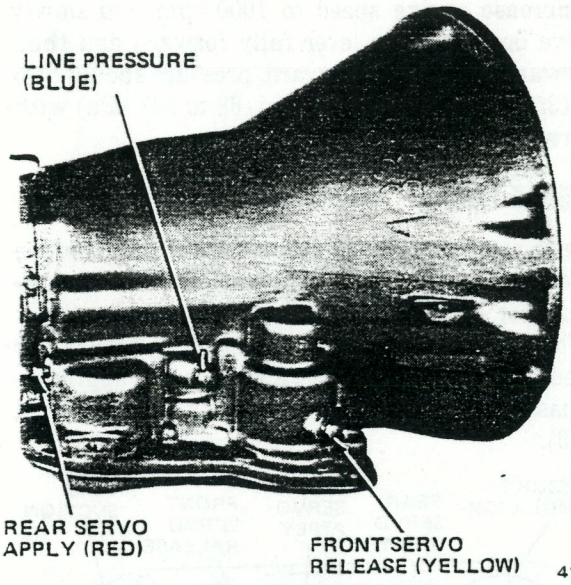

Fig. 2C-17 Pressure Port Locations

the rear edge of the case halfway to the top of the case (fig. 2C-18). If inaccessible, use T-fitting at radiator cooler return line.

Hydraulic Pressure Test Procedure

Before the test, check and correct fluid level and control linkage adjustments, and connect a tachometer to the engine. Raise the vehicle on a hoist that will allow the wheels to rotate freely and connect the test gauge hoses to the appropriate transmission pressure ports.

Test One

This test checks pump output, pressure regulator valve operation, front/rear clutch and oil filter condition by measuring transmission operating pressure at the accumulator and front servo pressure ports in range.

(1) Turn test gauge selector handle to line pressure position.

(2) Start and operate engine at idle speed, move gearshift lever to D range and note line pressure.

(3) At idle, pressure should be 54 to 60 psi (372 to 414 kPa).

(4) Increase engine rpm to 1600 and slowly move valve body throttle lever fully forward then fully rearward. With throttle lever in forward position, pressure should be 54 to 60 psi (372 to 414 kPa) and gradually increase to 94 psi (648 kPa) when lever is moved rearward.

(5) Turn test gauge selector handle to front servo apply position.

(6) Operate engine at 1000 rpm, allow transmission to upshift into third gear, and note servo pressure. Pressure should not vary from previously noted line pressure by more than 3 psi (21 kPa).

(7) Slowly move throttle linkage to full throttle position and note servo pressures just prior to and after

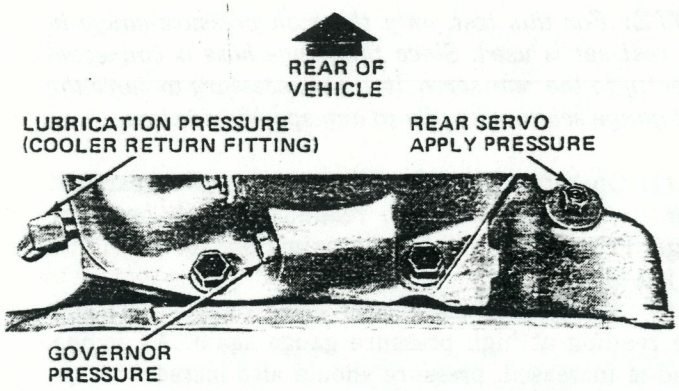

Fig. 2C-18 Pressure Port Locations

transmission downshifts. Servo pressure should increase then drop to 0 psi after downshift.

Test Two

This test checks pump output, pressure regulation, and front clutch/rear servo condition by measuring and comparing operating pressures at the rear servo and accumulator pressure ports in gear ranges 1 and 2.

(1) Turn test gauge selector handle to line pressure position.

(2) Move gearshift lever to 1 range, operate engine at 1000 rpm, and slowly move valve body throttle lever fully forward then fully rearward. With lever in forward position, pressure should be 54 to 60 psi (372 to 414 kPa) and gradually increase to 90 to 96 psi (621 to 662 kPa) as lever is moved rearward.

(3) Turn test gauge selector handle to rear servo apply position.

(4) Operate engine at 1000 rpm. Slowly move valve body throttle lever fully forward then fully rearward. Compare pressure registered at servo with line pressure recorded at accumulator port. Servo pressure should not vary from line pressure by more than 3 psi (21 kPa).

(5) Turn test gauge selector handle to line pressure position.

(6) Place gearshift lever in 2 range and operate engine at 1000 rpm.

(7) Slowly move valve body throttle lever fully forward then fully rearward and note pressures. With lever in forward position, pressure should be 54 to 60 psi (372 to 414 kPa) and gradually increase to 90 to 96 psi (621 to 662 kPa) as lever is moved rearward.

Test Three

This test checks pump output, pressure regulation, and front clutch/rear servo condition by measuring and comparing operating pressure at the rear servo pressure port in Reverse.

NOTE: *For this test, only the high pressure gauge in the test set is used. Since the gauge hose is connected directly to the rear servo, it is not necessary to move the test gauge selector handle to any specific position.*

(1) Operate engine at idle speed, move gearshift lever to Reverse, and note reading on high pressure gauge. Pressure should be approximately 160 psi (1 103 kPa) at idle.

(2) Slowly increase engine speed to 1600 rpm and note reading at high pressure gauge again. As engine speed is increased, pressure should also increase to approximately 270 psi (1 862 kPa).

(3) Operate engine at idle speed, move gearshift lever from Reverse to Drive, and note reading at high pressure gauge. Pressure should drop to 0 psi when gearshift lever is moved to Drive. This test checks for leakage into rear servo which can cause rear band burnout.

Test Four

This test checks governor operation by measuring governor pressure response to changes in engine speed. It is usually not necessary to check governor operation unless shift speeds are incorrect or if the transmission will not downshift.

(1) Turn test gauge selector handle to governor pressure position.

(2) Move gearshift lever to D range, operate engine at idle speed, and note pressure. Pressure should be 0 to 1-1/2 psi (10 kPa) maximum. If pressure exceeds maximum, governor valve or weights are sticking open.

(3) Slowly increase engine speed and observe speedometer and test gauge pressure. Governor pressure should increase in proportion to vehicle speed (approximately 1 psi per 1 mph). Pressure rise should be smooth and drop back to 0 to 1-1/2 psi (10 kPa) when throttle is closed.

Test Five

This test checks lubrication pressure which is measured by connecting the white test gauge hose to a T-fitting that has been inserted in the left-side cooler line. This test is especially important when the transmission is noisy, or unexplained rear clutch failure has occurred, or when fluid is forced out the fill tube and fluid level was known to be correct.

(1) Install T-fitting in transmission cooler line.

(2) Connect white test gauge hose to T-fitting and turn test gauge selector handle to lubrication pressure position.

(3) Start and operate engine at idle speed, move gearshift lever to D range, and note pressure.

(4) Pressure at idle speed should be 5 to 15 psi (35 to 103 kPa).

(5) Increase engine speed to 1000 rpm and slowly move valve body throttle lever fully forward and then fully rearward. With lever forward, pressure should be 5 to 15 psi (35 to 103 kPa) 10 to 30 psi (68 to 207 kPa) with lever rearward.

AIR PRESSURE TEST

Air pressure testing is used as a diagnostic tool before transmission removal and also as a method of confirming proper clutch, band and servo operation after repair. The tests involve substituting air pressure for fluid pressure by applying air pressure to the appropriate case passages after the valve body has been removed (fig. 2C-19).

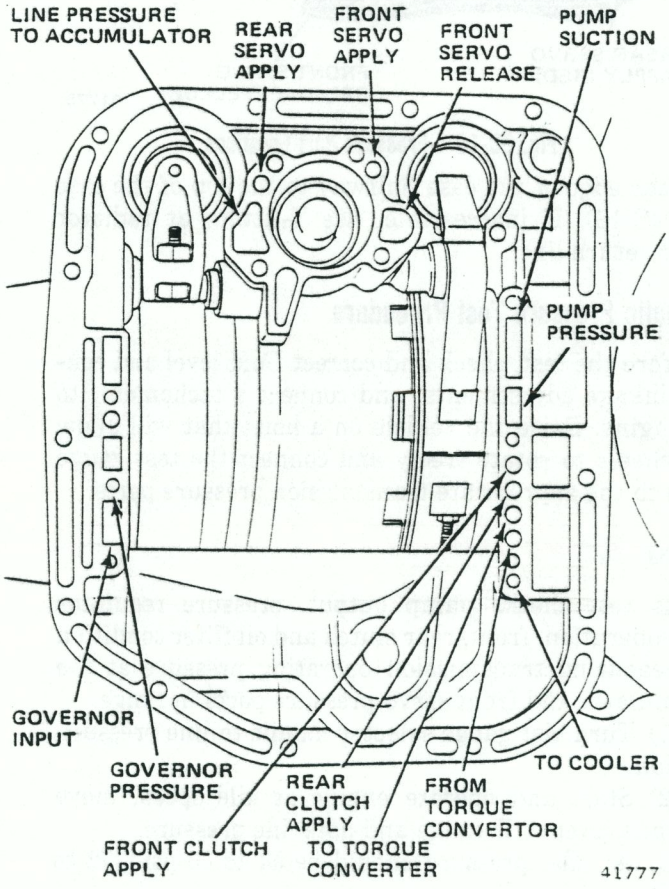

Fig. 2C-19 Transmission Case Channels

CAUTION: *Use dry, filtered compressed air only when performing air pressure tests. Pressures of 30 to 100 psi (207 to 689 kPa) are required to perform the tests.*

Front Clutch Test

Place one or two fingers on the clutch housing and apply air pressure to the front clutch apply passage. Movement of the piston can be felt and a soft thud may be heard as the clutch applies. While air pressure is applied, check for excessive air leakage.

Rear Clutch Test

Place one or two fingers on the clutch housing and apply air pressure to the rear clutch apply passage. Movement of the piston can be felt and a soft thud may be heard as the clutch applies. While air pressure is applied, check for excessive or unusual air leakage.

Front Servo Test

Apply air pressure to the front servo apply passage. The servo rod should extend and cause the band to tighten around the drum. While air pressure is applied, check for excessive air leakage. Spring tension should release the servo when air pressure is removed.

Rear Servo Test

Apply air pressure to the rear servo apply passage. The servo rod should extend and cause the band to tighten around the drum. While air pressure is applied, check for excessive air leakage. Spring tension should release the servo when air pressure is removed.

CONVERTER HOUSING FLUID LEAK DIAGNOSIS

When diagnosing converter housing fluid leaks, two facts must be established before attempting repair. First, it must be verified that a leak condition does actually exist and second, the real source of the leak must be determined. Failure to establish these facts beforehand can result in incorrect or unnecessary repairs.

In some cases, suspected converter housing fluid leaks may not be leaks at all. They may be the result of residual fluid in the converter housing or excess fluid spilled during factory filling or initial transmission operation. These conditions may be incorrectly diagnosed as fluid leaks.

Converter housing area leaks may have several sources. Through careful observation, it is possible to pinpoint the leak source before removing the transmission. The paths various types of fluid leaks follow are shown in figure 2C-20 and are described below.

- Oil Pump Seal—leaks past the seal lip tend to move along the drive hub and onto the rear of the converter housing. However, if total seal failure occurs, fluid will be deposited inside the converter housing only, near the outside diameter of the housing.
- Oil Pump Body—leaks past the pump body follow the same path as an oil pump seal leak or fluid may travel down the pump face into the converter housing.
- Oil Pump-to-Case Bolt—leaks past any one of these bolts are deposited on the inside of the converter housing only and not on the converter itself.
- Oil Pump-to-Case Gasket—leaks past the gasket are deposited inside the converter housing only.

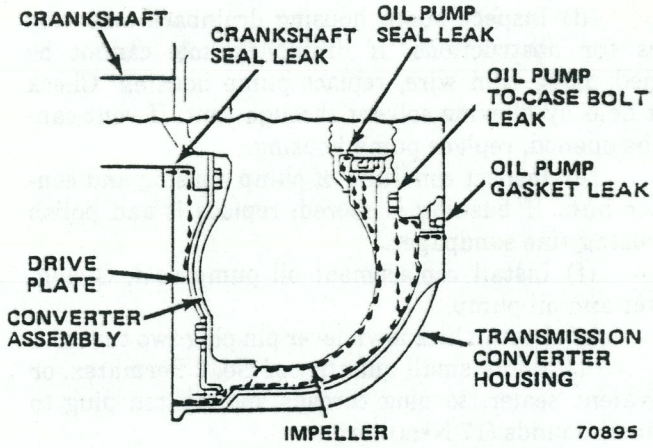

Fig. 2C-20 Converter Housing Fluid Leak Diagram

- Front Band Lever Pin Plug—leaks past the plug threads are deposited inside the housing and not on the converter.

Leak Diagnosis Procedure

(1) Check fluid level and condition. If fluid level is high or low, adjust to proper level.

(2) Raise and support vehicle.

(3) Inspect transmission and correct any external leaks from oil pan gasket, filler tube, governor line to TCS switch, if equipped, cooler line fittings, pressure test port plugs and case-to-adaptor housing gasket.

(4) Remove converter housing spacer plate.

(5) Wipe all fluid from converter housing area.

(6) Operate engine at 2000 rpm for 2 minutes and observe converter housing for fluid accumulation pattern.

(7) If fluid accumulation pattern is not evident, proceed to next step.

(8) If a circular pattern develops, it indicates a defective or damaged torque converter. Correct leak by replacing converter.

(9) If a trickle develops, it indicates an oil pump leak caused by one or more of the following conditions:

- Pump drainback hole obstructed.
- Pump housing vent obstructed.
- Pump bushing or converter hub scored, nicked, pitted or burred.
- Defective oil pump O-ring, gasket, or seal.
- Front band lever pin plug loose or plug threads in case are stripped.

(10) Correct these conditions as outlined in following steps.

(a) Remove transmission and converter.

(b) Tighten front band adjusting screw until band is tight around front clutch retainer. This will prevent front clutch assembly from also coming out when oil pump is removed and prevent damaging clutch discs.

(c) Remove oil pump and oil seal.

(d) Inspect pump housing drainback and vent holes for obstructions. If drainback hole cannot be opened using thin wire, replace pump housing. Check vent hole by blowing solvent through vent. If vent cannot be opened, replace pump housing.

(e) Inspect condition of pump housing and converter hub. If bushing is scored, replace it and polish hub using fine sandpaper.

(f) Install replacement oil pump seal, O-ring, gasket and oil pump.

(g) Loosen kickdown lever pin plug two turns.

(h) Apply small quantity of No. 2 Permatex, or equivalent sealer, to plug threads and tighten plug to 150 inch-pounds (17 N•m) torque.

(i) Adjust front band.

(11) Install transmission and converter.

(12) Install converter housing spacer plate.

(13) Remove supports and lower vehicle.

GOVERNOR

Governor operational problems should be diagnosed using the road test and hydraulic pressure test procedures.

STALL TEST

Stall testing determines the maximum engine rpm obtainable at full throttle with the rear wheels locked and the transmission in Drive. Stall testing also checks the holding ability of the converter-stator overrunning clutch and both transmission clutches. When stall testing is completed, refer to the Stall Speed Specifications Chart and diagnosis guides.

WARNING: *Never allow anyone to stand in front of the vehicle when performing a stall test. In addition, always block the front wheels and have the parking and service brakes fully applied during the test.*

(1) Connect tachometer to engine.

(2) Check and adjust transmission fluid level as necessary.

(3) Start and operate engine until transmission fluid reaches operating temperature.

(4) Block front wheels.

(5) Fully apply parking brakes.

(6) Fully apply service brakes.

(7) Open throttle completely and record maximum engine rpm registered on tachometer.

CAUTION: *Do not hold the throttle open any longer than necessary and never longer than five seconds at a time. If more than one stall test is required, operate the engine at 1000 rpm with the transmission in Neutral for at least 20 seconds to cool the transmission fluid.*

(8) If engine speed exceeds maximum shown in stall speed chart, release accelerator immediately. This indicates that transmission clutch slippage is occurring.

(9) Shift transmission into Neutral, operate engine for 20 seconds, stop engine, shift transmission into Park, and release brake.

(10) Compare test results with stall speed chart and refer to stall test diagnosis.

Stall Test Diagnosis

Stall Speed Too High

If stall speed exceeds specifications by more than 200 rpm, transmission clutch slippage is indicated.

Stall Speed Too Low

Low stall speeds with a properly tuned engine indicate a torque converter stator clutch problem. The condition should be confirmed by road testing prior to converter replacement. If stall speeds are 250-350 rpm below the minimum specified in the chart, and the vehicle operates properly at highway speeds but has poor low speed acceleration, the stator overrunning clutch is slipping and the torque converter should be replaced.

Stall Speed Normal

If stall speeds are normal but road testing shows that abnormally high throttle opening is required to maintain highway speeds even though low speed acceleration is normal, the stator overrunning clutch is seized and the torque converter must be replaced.

Noise

A whining or siren-like noise caused by fluid flow is normal during a stall test. Loud metallic noises from loose internal parts or interference within the assembly indicates a defective torque converter. To confirm that a noise is originating from within the converter, operate the vehicle at light throttle in Drive and Neutral on a hoist and listen for noise coming from the torque converter housing.

When the stall test is completed, compare the test speeds recorded with those listed in the Stall Speed Specifications Chart.

SERVICE DIAGNOSIS

General

The diagnosis charts provide a quick reference for transmission diagnosis. A step-by-step approach to diagnosing and correcting transmission malfunctions is used.

The In-Vehicle Procedures chart lists problem conditions that can be corrected with the transmission in the vehicle. The Out-Of-Vehicle Procedures chart lists problems that require transmission removal and disassembly.

Stall Speed Specifications Chart

Transmission Model	Engine RPM
999	1700-2000
727	1700-2000
904	2050-2350

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The In-Vehicle Procedures should always be performed first. Do not remove the transmission unless the In-Vehicle Procedures fail to correct the problem.

How to Use the Charts

The *Condition* columns in each chart describes the most frequently encountered malfunctions. Each problem condition is cross-referenced to the necessary service procedures.

The code letters in the boxes at the top of each chart identify the individual service procedures. These code letters correspond to descriptions of the various procedures, which appear on the pages immediately following the charts.

Capital letters A through T denote In-Vehicle Procedures. Lower case letters a through j denote Out-Of-Vehicle Procedures.

The numbers in the boxes adjacent to the *Condition* column cross-reference each problem condition to the necessary service procedures. These numbers also show the order in which the various service procedures should be performed.

As an example, assume that the problem condition is Harsh Engagement in R-D-2-1. First, locate the problem description in the *Condition* column; then note which service procedures are indicated. As shown in the chart, procedures B, D, E, G, N, Q are required. Next, note the numbers which indicate the sequence in which these procedures are to be performed. In this case, the correct order will be D, B, E, G, Q, N. Finally, refer to the service procedure descriptions, which appear on the pages immediately following the charts, for details of each procedure.

Become familiar with both charts and the procedures required. Some conditions require in-vehicle service only, others require out-of-vehicle service only, and some require a combination of both.

In-Vehicle Procedures

A—Fluid Level and Condition: Fluid should be at full mark with engine idling. Fluid should not be milky, full of bubbles, or dark and burnt smelling. Use AMC, Dexron, or equivalent, transmission fluid only.

B—Throttle Linkage: Check for smooth travel. Clean, but do not lube, linkage pivot points as necessary, then adjust to specifications.

C—Gearshift Linkage: Adjust to specifications.

D—Engine Idle Adjustment: Set to specifications.

E—Hydraulic Pressures: Perform hydraulic pressure test to determine if operating pressures are within specifications. Repair hydraulic components as necessary. Check and correct throttle and line pressure settings if required.

F—Front Band: Adjust to specifications.

G—Rear Band: Adjust to specifications.

H—Neutral Start Switch: Check wires and connections. Test switch. See if valve body manual lever grounds switch in P and N positions. If not OK, check ground strip at valve body manual lever. If OK, check starting circuit.

I—Park Lock: Check condition of lock rod, lock rod ball, sprag reaction plug, governor support and sprag shaft. Replace parts as required.

J—Transmission Oil Cooler: Check lines and cooler for obstructions or leaks (look for transmission fluid in radiator coolant or milky colored transmission fluid which indicates coolant in fluid).

K—Output Shaft Bearing, Bushing or Seal: Remove extension housing, inspect parts, and replace parts as necessary.

L—Governor Valve: Clean and inspect all parts. Check weights, shaft and valve for burrs, nicks, scores or binding. Check spring for collapsed or distorted coils and snap rings for distortion. Check filter for dirt and debris. Inspect body for cracks or warpage. Check torque on governor and output shaft support bolts.

M—Oil Filter: Inspect and replace if clogged.

N—Valve Body: Remove, disassemble, clean thoroughly, and inspect valves and plugs for nicks, scratches, burrs, and rounded edges on valve lands. Check bores for scratches, springs for collapsed coils, and all mating surfaces for nicks, burrs or warpage. Reassemble and install, tightening all screws to exact specifications.

O—Front Servo and Linkage: Inspect piston for wear, cracks, and worn or broken seal rings. Check springs for collapsed or broken coils. Check servo bore for scratches, nicks or wear. Check lever, strut, and band for damage. Check lever shaft for wear, being loose in case, or for leaking O-ring.

P—Rear Servo and Linkage: Inspect piston for wear, cracks, worn or broken seal ring or damaged seal. Check springs for collapsed or broken coils. Check servo bore for scratches, nicks or wear. Check lever and band for damage. Check lever shaft for wear or looseness in case.

Q—Accumulator: Clean and inspect for broken seal rings, scratched bore, broken or collapsed spring. Check piston for cracks or evidence of piston cocking in bore.

R—Air Pressure Test: Remove valve body and use air pressure to apply clutches and bands to check operation.

S—Engine Tune and Performance: Verify proper engine operation. Be sure compression meets specifications and fuel and ignition systems are functioning properly.

T—Stall Test: Perform stall test to check holding ability of converter and transmission clutches.

Out-Of-Vehicle Procedures

a—Converter Drive Plate: Check plate for flatness, cracks at mounting bolt holes, loose attaching bolts or damaged ring gear teeth. Broken drive plate may indicate engine-to-transmission caused by loose, missing or misaligned dowels.

b—Oil Pump: Clean pump and check all clearances. Inspect rotors for scoring and the seal and bushings for wear. Inspect pump housing and reaction shaft support mating surfaces for flatness.

c—Transmission Vent: Make sure vent is open and not obstructed.

d—Front Clutch: Clean and inspect all parts. Examine retainer and piston for scores and scratches, discs and plates for wear, return springs for collapsed coils, and the seal rings for damage. The vent check ball in the retainer must operate freely.

e—Rear Clutch: Inspect all rear clutch parts as outlined under front clutch procedure.

f—Planetary Gear Set: Clean and inspect annulus gear, planet pinion carrier assembly, and sun gear for worn thrust washers, damaged gear teeth, and excessive pinion end clearance. Examine the bushings in the sun gear for excessive wear.

g—Rear Band: Inspect the band for wear and for good bond of lining to band. Inspect lining for burn marks, glazing, uneven wear patterns, flaking, or if band

Service Diagnosis

OUT OF VEHICLE PROCEDURES

CONDITIONS	a	b	c	d	e	f	g	h	i	j
HARSH ENGAGEMENT R, D, 2, 1				1	2					
SLOW TO ENGAGE N, R, D, 2, 1		1		2	3					4
NO UPSHIFT, STUCK IN LOW GEAR		1		2						
DELAYED, ERRATIC SHIFTS (HARSH AT TIMES)		1								
SLIPS IN FORWARD DRIVE RANGES		1		2	3		4			5
SLIPS IN REVERSE ONLY		1		2			3			
SLIPS IN LOW GEAR "D" ONLY BUT NOT IN "1" POSITION								1		
WILL NOT MOVE IN FORWARD OR REVERSE	1	2				3				
REVERSE OK, WILL NOT MOVE FORWARD IN D, 2, 1					1					
NO REVERSE				1			2			
MOVES IN NEUTRAL POSITION (CREEPS IN "N")					1					
DRAGS OR LOCKS UP				1	2	3	4	5		
GROWLING, GRATING OR SCRAPING NOISES	1	2		3		4		5	6	
BUZZING NOISE		1							2	
OIL BLOWS OUT FILLER TUBE		1	2							
OVERHEATS	1									
SLUGGISH ACCELERATION, EXCESSIVE THROTTLE NEEDED TO MAINTAIN SPEED					2				1	

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grooves are worn away at any portion of band. Replace band if it exhibits any of these conditions.

h—Overrunning Clutch: Clean and inspect clutch parts for brinnelled clutch rollers or cam, or improperly assembled rollers or springs. Check for collapsed springs and bent spring retainer tabs.

i—Torque Converter: If the converter hub seal surface or drive slots are damaged or if the converter contains foreign material, burnt-oxidized fluid or debris, replace the converter. Do not attempt to clean or flush the converter.

j—Seal Rings: Inspect seal rings on reaction shaft support and governor support for wear, cracks or breakage. Inspect ring grooves on both support assemblies for nicks, burrs or distortion. Inspect bores in front clutch retainer and output shaft support for nicks, grooves, wear, cracks or scratches.

Service Diagnosis

IN VEHICLE PROCEDURES

CONDITIONS	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
HARSH ENGAGEMENT R, D, 2, 1		2		1	3		4							6			5			
SLOW TO ENGAGE N, R, D, 2, 1	1		2	3	4		6						5	9			8	7		
NO UPSHIFT, STUCK IN LOW GEAR	1	2	3		4	7						5		6	8			9		
NO LOW GEAR MOVES IN 2ND or 3RD GEAR												1		2						
NO KICKDOWN OR NORMAL DOWNSHIFT	1	2	3		5	4						6		7	8			9		
DELAYED ERRATIC SHIFTS (HARSH AT TIMES)	1	2	3		4	5						6	7	8	9	10				
SLIPS IN FORWARD DRIVE RANGES	1	2	3		4	5								6	7	8	9	10		
SLIPS IN REVERSE ONLY	1		2		3		4							5		6		7		
WILL NOT MOVE IN FORWARD OF REVERSE	1		2		3								4	5				6		
REVERSE OK, WILL NOT MOVE FORWARD IN D, 2, 1			1		2									3				4		
NO REVERSE			1		2		3									4		5		
MOVES IN NEUTRAL POSITION (CREEPS IN "N")			1											2						
DRAGS OR LOCKS UP					1	2	3		4					5	6	7	8			
GROWLING, GRATING OR SCRAPING NOISES	1								2		3		4							
BUZZING NOISE	1											2		3				4		
OIL BLOWS OUT FILLER TUBE	1									2			3	4						
OVERHEATS	1			2	5	4	7			3			6	8						
WILL NOT START IN N OR P POSITION			1					2						4					3.	
SLUGGISH ACCELERATION, EXCESSIVE THROTTLE NEEDED TO MAINTAIN SPEED	1	3			5														2	4

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SPECIFICATIONS

Hydraulic Pressure Test Specifications

Lube Pressure	Closed throttle Full throttle	5-30 psi (34-207 kPa) 5-30 psi (34-207 kPa)
Line Pressure	Closed throttle 1000 rpm	54-60 psi (372-414 kPa) 57-94 psi (393-648 kPa)
Front Servo Release	Third gear only	No more than 3 psi (21 kPa) lower than line pressure
Rear Servo Apply	1 Range R Range	No more than 3 psi (21 kPa) lower than line pressure 160 psi (1103 kPa) at idle, builds to 270 psi (1862 kPa) at 1600 RPM.
Governor	D Range Closed throttle	Pressure should respond smoothly to changes in MPH and return to 0 to 1-1/2 PSI (0-7 kPa) when stopped with transmission in D, 1, 2. **Pressure above 1-1/2 PSI (7 kPa) at standstill will prevent transmission from downshifting.**

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Hydraulic Pressure Test Diagnosis

Condition	Indication
Line pressure OK during any one test	Pump and regulator valve OK
Line pressure OK in R but low in D, 2, 1	Leakage in rear clutch area (servo, clutch seals, governor support seal rings)
Pressure OK in 1, 2 but low in D3 and R	Leakage in front clutch area (servo, clutch seals, retainer bore, pump seal rings)
Pressure OK in 2 but low in R and 1	Leakage in rear servo
Front servo pressure in 2	Leakage in servo; broken servo ring or cracked servo piston
Pressure low in all positions	Clogged filter, stuck pressure regulator valve, worn or defective pump
Governor pressure high at idle (over 0 to 1-1/2 psi)	Governor valve sticking open
Governor pressure zero or below specifications at all mph figures	Governor valve sticking in closed position
Lubrication pressure low at all throttle positions	Clogged oil cooler or lines, seal rings leaking, output shaft plugged with debris, worn bushings in pump or clutch retainer

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Lockup Torque Converter Service Diagnosis

Condition	Possible Cause	Correction
NO LOCKUP	(1) Faulty oil pump.	(1) Replace oil pump.
	(2) Sticking governor valve.	(2) Repair or replace as necessary.
	(3) Valve body malfunction.	(3) Repair or replace valve body or its internal components as necessary.
	(a) Stuck switch valve.	
	(b) Stuck lockup valve.	
	(c) Stuck fail-safe valve.	
	(4) Faulty torque converter.	(4) Replace torque converter.
	(5) Failed locking clutch.	(5) Replace torque converter.
	(6) Leaking turbine hub seal.	(6) Replace torque converter.
	(7) Faulty input shaft or seal ring.	(7) Repair or replace as necessary.
WILL NOT UNLOCK	(1) Sticking governor valve.	(1) Repair or replace as necessary.
	(2) Valve body malfunction.	(2) Repair or replace valve body or its internal components as necessary.
	(a) Stuck switch valve.	
	(b) Stuck lockup valve.	
	(c) Stuck fail-safe valve.	
STAYS LOCKED UP AT TOO LOW A SPEED IN DIRECT	(1) Sticking governor valve.	(1) Repair or replace as necessary.
	(2) Valve body malfunction.	(2) Repair or replace valve body or its internal components as necessary.
	(a) Stuck switch valve.	
	(b) Stuck lockup valve.	
	(c) Stuck fail-safe valve.	
LOCKS UP OR DRAGS IN LOW OR SECOND	(1) Faulty oil pump.	(1) Replace oil pump.
	(2) Valve body malfunction.	(2) Repair or replace valve body or its internal components as necessary.
	(a) Stuck switch valve.	
	(b) Stuck fail-safe valve.	
SLUGGISH OR STALLS IN REVERSE	(1) Faulty oil pump.	(1) Replace oil pump as necessary.
	(2) Plugged cooler, cooler lines or fittings.	(2) Flush or replace cooler and flush lines and fittings.
	(3) Valve body malfunction.	(3) Repair or replace valve body or its internal components as necessary.
	(a) Stuck switch valve.	
	(b) Faulty input shaft or seal ring.	

Lockup Torque Converter Service Diagnosis (cont.)

Condition	Possible Cause	Correction
LOUD CHATTER DURING LOCKUP ENGAGEMENT (COLD)	(1) Faulty torque converter.	(1) Replace torque converter.
	(2) Failed locking clutch.	(2) Replace torque converter.
	(3) Leaking turbine hub seal.	(3) Replace torque converter.
VIBRATION OR SHUDDER DURING LOCKUP ENGAGEMENT	(1) Faulty oil pump.	(1) Repair or replace oil pump as necessary.
	(2) Valve body malfunction.	(2) Repair or replace valve body or its internal components as necessary.
	(3) Faulty torque converter.	(3) Replace torque converter.
	(4) Engine needs tune-up.	(4) Tune engine.
VIBRATION AFTER LOCKUP ENGAGEMENT	(1) Faulty torque converter.	(1) Replace torque converter.
	(2) Exhaust system strikes underbody.	(2) Align exhaust system.
	(3) Engine needs tune-up.	(3) Tune engine.
	(4) Throttle linkage misadjusted.	(4) Adjust throttle linkage.
VIBRATION WHEN REVVED IN NEUTRAL	(1) Torque converter out of balance.	(1) Replace torque converter.
OVERHEATING: OIL BLOWS OUT OF DIP STICK TUBE OR PUMP SEAL	(1) Plugged cooler, cooler lines or fittings.	(1) Flush or replace cooler and flush lines and fittings.
	(2) Stuck switch valve.	(2) Repair switch valve in valve body or replace valve body.
SHUDDER AFTER LOCKUP ENGAGEMENT	(1) Faulty oil pump.	(1) Replace oil pump.
	(2) Plugged cooler, cooler lines or fittings.	(2) Flush or replace cooler and flush lines and fittings.
	(3) Valve body malfunction.	(3) Repair or replace valve body or its internal components as necessary.
	(4) Faulty torque converter.	(4) Replace torque converter.
	(5) Fail locking clutch.	(5) Replace torque converter.
	(6) Exhaust system strikes underbody.	(6) Align exhaust system.
	(7) Engine needs tune-up.	(7) Tune engine.
	(8) Throttle linkage misadjusted.	(8) Adjust throttle linkage.

Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (in-lbs)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Cooler Line Fitting	160 in-lb	120-200 in-lb	18	14-23
Cooler Line Nut	150 in-lb	130-180 in-lb	17	15-20
Converter Drive Plate to Crankshaft Bolts - 4 Cylinder	58	50-56	79	68-89
Converter Drive Plate to Crankshaft Bolts - 6 Cylinder	105	95-120	142	129-163
Converter Drive Plate to Torque Converter Bolts - 4 Cylinder	40	35-40	54	47-54
Converter Drive Plate to Torque Converter Bolts - 6 Cylinder	26	22-30	35	30-44
Adapter Housing-to-Transmission Case Bolt	24	—	33	—
Governor Body Bolt	100 in-lb	—	11	—
Front Band Adjusting Screw Locknut	35	—	47	—
Kickdown Lever Shaft Plug	150 in-lb	—	17	—
Rear Band Adjusting Screw Locknut	35	—	47	—
Neutral Starter Switch	24	—	33	—
Oil Filler Tube Bracket Bolt	150 in-lb	—	17	—
Oil Pan Bolt	150 in-lb	9-13	17	12-18
Oil Pump Housing-to-Transmission Case Bolt	175 in-lb	—	20	—
Output Shaft Support Bolt	150 in-lb	—	17	—
Overrunning Clutch Cam Setscrew	40 in-lb	—	4	—
Pressure Test Port Plug	110 in-lb	—	12	—
Reaction Shaft Support to Oil Pump Bolt	160 in-lb	—	18	—
Transmission-to-Engine Bolt	28	22-30	38	30-41
Valve Body Screw	35 in-lb	—	4	—
Valve Body-to-Transmission Case Screw	100 in-lb	—	11	—

All Torque values given in inch-pounds and Newton-meters with dry fits unless otherwise specified.

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Fluid Level

Fill to "Add One Pint" mark on dipstick. Use AMC, Dexron, or equivalent Automatic transmission fluid.

NOTE: Check fluid level with gearshift selector lever in N (neutral) position and with fluid at normal operating temperature.

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Fluid Capacity and Gear Ratios

Fluid Capacity — Transmission and Torque Converter
- 904-999 ..... 17 pints (8 liters)
- 727 ..... 19 pints (9 liters)

Cooling Method ..... Water-Heat Exchanger in Radiator Lower Tank

Fluid Pressure and Lubrication — All Models ..... Rotor-Type Pump

Gear Ratios — 999-727
- First 2.45:1
- Second 1.45:1
- Third 1.00:1
- Reverse 2.20:1

Gear Ratios — 904
- First 2.74:1
- Second 1.55:1
- Third 1.00:1
- Reverse 2.20:1

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IN-VEHICLE SERVICE AND ADJUSTMENT

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GEARSHIFT LINKAGE ADJUSTMENT

(1) Raise vehicle.

(2) Loosen shift rod trunnion jamnuts.

(3) Remove lockpin retaining shift rod trunnion to bell crank and disengage trunnion and shift rod at bell crank.

(4) Place gearshift lever in Park position and lock steering column.

(5) Move valve body manual lever rearward into Park detent. Be sure lever is moved rearward as far as possible. Park detent is last rearward detent.

(6) Check for positive engagement of park lock by attempting to rotate propeller shaft. Shaft will not rotate if park lock pawl is fully engaged in park gear.

(7) Adjust shift rod trunnion to obtain free pin fit in bell crank arm and tighten trunnion jamnuts. Prevent shift rod from turning while tightening jamnuts.

NOTE: *Gearshift linkage lash must be eliminated in order to obtain a proper adjustment. Eliminate lash by pulling downward on the shift rod and pressing upward on the outer bell crank.*

(8) Move gearshift lever to Park and Neutral positions and check engine starting. Engine should start in these positions only. Engine must not start in any gear position other than Park or Neutral. If engine does not start or starts in R, D, 2, or 1, adjustment is incorrect or neutral switch is defective.

(9) Check steering lock for ease of operation.

(10) Lower vehicle.

FRONT BAND ADJUSTMENT

The front band adjusting screw is located on the left side of the transmission case just above the manual valve and throttle control levers (fig. 2C-21).

Adjustment Procedure

(1) Raise vehicle.

(2) Loosen adjusting screw locknut and back off locknut five turns.

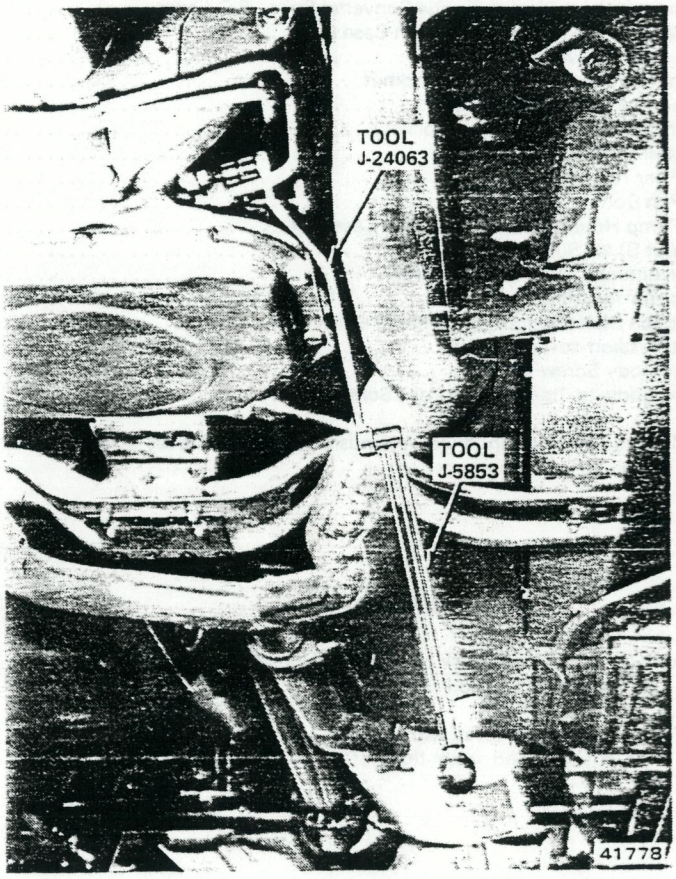

Fig. 2C-21 Front Band Adjustment

(3) Check adjusting screw rotation. Screw must turn freely in case. Lubricate adjusting screw threads if screw binds.

(4) Tighten adjusting screw to 36 inch-pounds (4 N•m) torque using Torque Wrench J-5853, Adapter Tool J-24063 and 5/16 square socket (fig. 2C-21).

CAUTION: *If Adapter Tool J-24063 is not used, the band adjusting screw must be tightened to 72 inch-pounds (8 N•m) torque.*

(5) Back off adjusting screw two turns.

(6) Tighten adjuster screw locknut to 35 foot-pounds (47 N•m) torque. Do not allow adjuster screw to rotate when tightening locknut.

(7) Lower vehicle.

REAR BAND ADJUSTMENT

The rear band adjustment is an internal adjustment. The transmission oil pan must be removed to gain access to the band adjusting screw (fig. 2C-22).

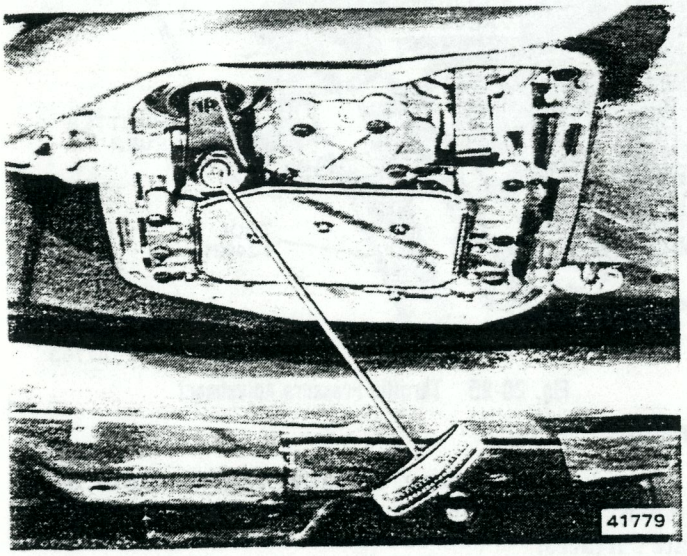

Fig. 2C-22 Rear Band Adjustment

Adjustment Procedure

(1) Raise vehicle.
(2) Remove oil pan and drain fluid.
(3) Inspect fluid and filter for heavy accumulation of friction material or metal particles which indicate worn or damaged parts. However, a very light accumulation of this material is normal.
(4) Adjust band as follows (fig. 2C-22):
(a) Remove adjusting screw locknut.
(b) Tighten adjusting screw to 41 inch-pounds (5 N•m) using torque wrench and 1/4 hex-head socket wrench.
(c) On Model 999, back off adjusting screw four turns.
(d) On Model 727, back off adjusting screw two turns.
(e) Hold adjusting screw in position and install locknut. Tighten locknut to 35 foot-pounds (47 N•m) torque.
(5) Install oil pan and replacement pan gasket. Tighten oil pan bolts to 150 inch-pounds (17 N•m) torque.
(6) Lower vehicle.
(7) Fill transmission with Jeep, Dexron, or equivalent automatic transmission fluid. Refer to Fluid Level and Condition for refill procedure.

OIL FILTER REPLACEMENT

(1) Raise vehicle.
(2) Remove oil pan and drain fluid.
(3) Inspect fluid and filter for heavy accumulation of friction material or metal particles which indicate worn or damaged parts.
(4) Remove three screws attaching filter to valve body and remove filter.
(5) Install replacement filter and tighten filter attaching screws to 35 inch-pounds (4 N•m) torque.
(6) Clean and install oil pan and replacement pan gasket. Tighten pan bolts to 150 inch-pounds (17 N•m) torque.
(7) Lower vehicle
(8) Fill transmission with Jeep, Dexron, or equivalent automatic transmission fluid. Refer to Fluid Level and Condition for refill procedure.

VALVE BODY SERVICE

Removal

(1) Raise vehicle.
(2) Remove oil pan and drain fluid.
(3) Loosen clamp bolts and remove throttle and manual valve control levers from valve body shafts.
(4) Remove neutral switch from case.
(5) Remove valve body attaching screws (fig. 2C-23).
(6) Lower valve body, pull valve body forward to disengage park lock rod, and remove valve body.

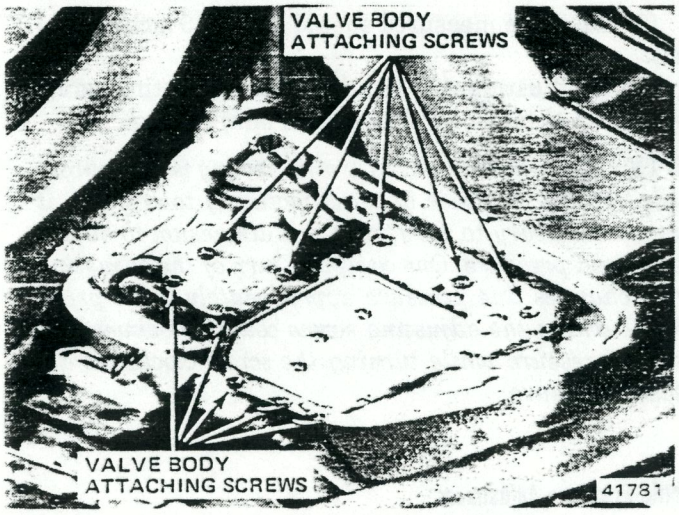

Fig. 2C-23 Valve Body Attaching Screw Location

NOTE: *It may be necessary to rotate the output shaft before the park lock rod will clear the park sprag.*

(7) Remove oil filter.
(8) Mount valve body on Support Stand J-24043.
(9) Refer to Out-of-Vehicle Service and Overhaul section for valve body service procedures.

Valve Body Hydraulic Control Pressure Adjustments

There are two hydraulic control pressure adjustments that can be performed on the valve body, they are: Line Pressure and Throttle Pressure adjustment.

Because line and throttle pressure are interdependent (each affects shift quality and timing), both adjustments must be performed properly and in the correct sequence which is; line pressure adjustment first—throttle pressure adjustment last.

Line Pressure Adjustment

(1) Measure distance from valve body to inner edge of adjusting screw using accurate steel scale (fig. 2C-24).

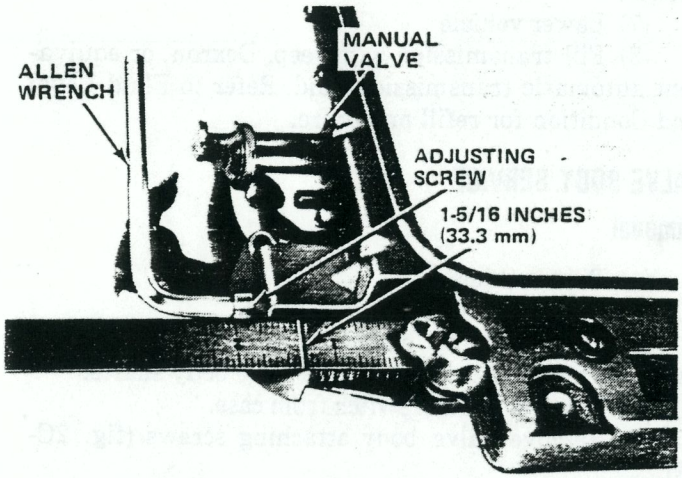

Fig. 2C-24 Line Pressure Adjustment

(2) Distance measured should be 1-5/16 inches (33.4 mm).

(3) If adjustment is required, turn adjusting screw in or out to obtain 1-5/16 inch (33.4 mm) setting.

NOTE: *The 1-5/16 inch (33.4 mm) setting is an approximate setting. Because of manufacturing tolerances, it may be necessary to vary from this dimension to obtain the desired pressure. One complete turn of the adjusting screw changes line pressure approximately 1-2/3 psi (9 kPa). Turning the adjusting screw counterclockwise increases pressure while turning the screw clockwise decreases pressure.*

Throttle Pressure Adjustment

(1) Insert Gauge Tool J-24031 between throttle lever cam and kickdown valve (fig. 2C-25).

(2) Push gauge tool inward to compress kickdown valve against spring and to bottom throttle valve in valve body.

(3) Maintain pressure against kickdown valve spring and turn throttle lever stop screw until screw head touches throttle lever tang and throttle lever cam touches gauge tool.

NOTE: *The kickdown valve spring must be fully compressed and the kickdown valve completely bottomed in the valve body to obtain a correct adjustment.*

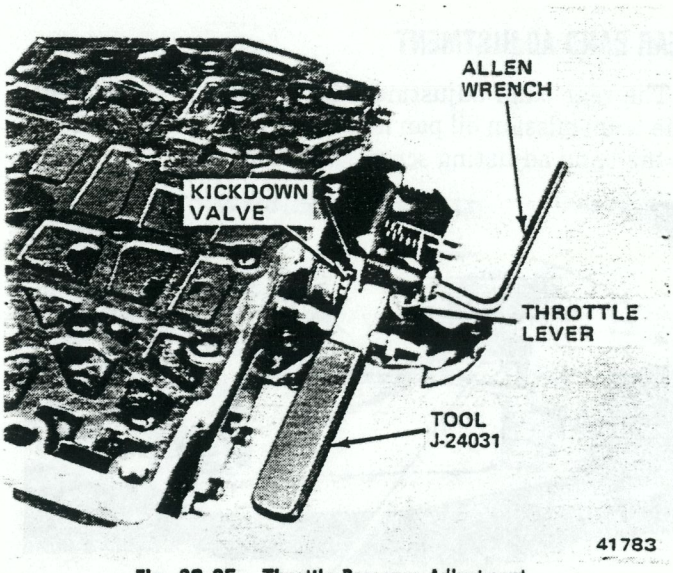

Fig. 2C-25 Throttle Pressure Adjustment

Installation

(1) Clean all mating surfaces. Be sure burrs are removed from transmission case and valve body steel plate surfaces.

(2) Position accumulator spring on valve body.

(3) Insert park lock rod through opening in rear of case.

(4) Position knob on end of lock rod against reaction plug in sprag and exert rearward pressure on rod to move rod past sprag. Rotate output shaft, if necessary.

(5) Align and install valve body. Install attaching screws finger-tight only.

(6) Install neutral switch.

(7) Move manual valve (in valve body) to neutral position. Align valve body as necessary to align neutral finger of manual lever with neutral switch plunger.

(8) Tighten valve body attaching screws alternately and evenly to 100 inch-pounds (11 N•m) torque.

(9) Install oil filter. Tighten attaching screws to 35 inch-pounds (4 N•m) torque.

(10) Install manual and throttle valve control levers and tighten clamp bolts. Check both shafts for binding after tightening bolts.

(11) Install oil pan and replacement gasket. Tighten oil pan bolts to 150 inch-pounds (17 N•m) torque.

(12) Lower vehicle.

(13) Fill transmission with Jeep, Dexron, or equivalent automatic transmission fluid. Refer to Fluid Level and Condition for refill procedure.

(14) Adjust gearshift and throttle linkage.

Front and Rear Servos

The front and rear servos may be removed, reconditioned and installed with the transmission in the vehicle.

For removal, inspection and installation procedures, refer to Out-Of-Vehicle Service and Overhaul section.

GOVERNOR VALVE SERVICE

Removal

(1) Raise vehicle.

(2) Mark propeller shaft yokes for assembly alignment reference.

(3) Disconnect front-rear propeller shafts at transfer case.

(4) Disconnect speedometer cable at transfer case.

(5) Place support stand under transmission converter housing.

(6) Remove rear crossmember.

(7) Disconnect parking brake cable at equalizer and disconnect exhaust pipe support brackets, if necessary.

(8) Remove bolts attaching transfer case to transmission adapter housing and remove transfer case.

(9) Remove bolts attaching adapter housing to transmission and remove adapter housing.

(10) Rotate transmission output shaft until governor weight faces downward (fig. 2C-26).

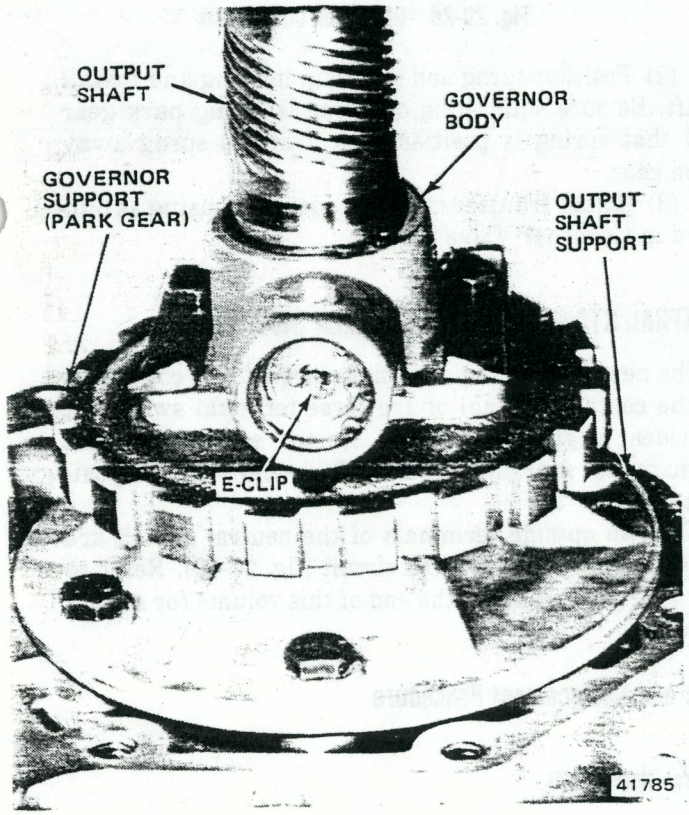

Fig. 2C-26 Governor Weight E-Clip Location

(11) Remove E-clip from weight end of governor valve shaft (fig. 2C-26).

(12) Remove governor valve and shaft from governor body (fig. 2C-27).

(13) Remove snap ring that retains governor body-park gear assembly on output shaft.

(14) Remove governor body-park gear assembly from output shaft.

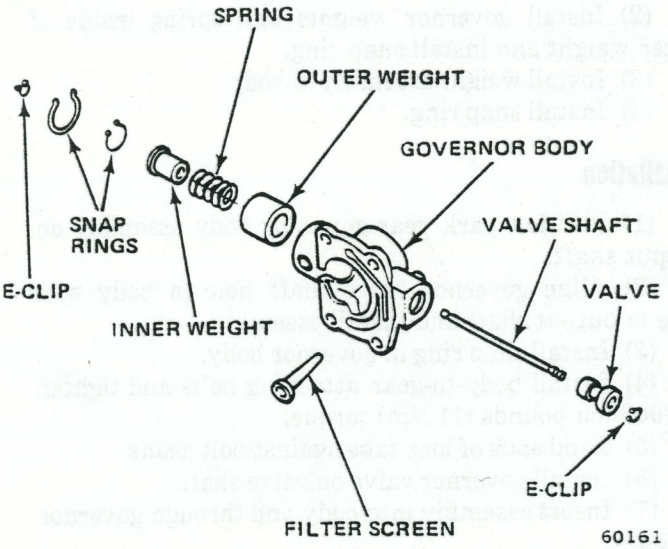

Fig. 2C-27 Governor Valve Assembly

Disassembly

(1) Remove large snap ring from weight end of governor body (fig. 2C-27).

(2) Remove weight assembly.

(3) Remove snap ring from governor weight assembly.

(4) Separate inner weight, spring, and outer weight. Identify spring with tag.

(5) If park gear or governor body is to be replaced, straighten lock tabs and remove bolts attaching body to gear.

(6) Remove governor filter.

Cleaning and Inspection

Thoroughly clean all governor parts in a suitable cleaning solution but do not use any type of caustic cleaning solution.

The weights and valves should fall freely in their bores when clean and dry. Rough surfaces and burrs may be polished using crocus cloth.

Inspect the governor weight spring for distortion. Replace the spring, if damaged.

Clean the filter in solvent and dry it with compressed air. Replace the filter, if damaged.

Inspect the park gear for chipped or worn gear teeth or damaged ring grooves. Replace the gear, if damaged.

Check the bolt torque on the output shaft support attaching bolts. If loose, cross-leakage and loss of governor pressure can occur.

Assembly

(1) If governor body was separated from park gear, install filter, assemble body and support, and install attaching bolts finger-tight.

NOTE: *Do not tighten the bolts to specified torque until the assembly is installed on the output shaft.*

(2) Install governor weights and spring inside of outer weight and install snap ring.
(3) Install weight assembly in body.
(4) Install snap ring.

Installation

(1) Position park gear-governor body assembly on output shaft.
(2) Align governor valve shaft hole in body with hole in output shaft and install assembly.
(3) Install snap ring in governor body.
(4) Install body-to-gear attaching bolts and tighten to 100 inch-pounds (11 Nm) torque.
(5) Bend ends of lock tabs against bolt heads.
(6) Install governor valve on valve shaft.
(7) Insert assembly into body and through governor weights.
(8) Install retaining E-clip.
(9) Install and tighten adapter housing bolts to 24 foot-pounds (32 N•m) torque.
(10) Install transfer case.
(11) Install rear crossmember.
(12) Connect speedometer cable.
(13) Connect exhaust support brackets and brake cable, if removed.
(14) Connect propeller shafts. Align assembly reference marks and tighten clamp bolts to 14 foot-pounds (19 N•m) torque.
(15) Adjust gearshift and throttle linkage.
(16) Lower vehicle.
(17) Fill transmission with Jeep, Dexron, or equivalent transmission fluid. Refer to Fluid Level and Condition for refill procedure.

PARK LOCK COMPONENT REPLACEMENT

Disassembly

(1) Remove adapter housing and transfer case as outlined in Governor Valve Service.
(2) Slide shaft out of housing and remove park sprag and spring (fig. 2C-25).
(3) Remove snap ring and slide reaction plug and pin assembly out of housing.
(4) To replace park lock control rod, refer to Valve Body in Out-of-Vehicle Service and Overhaul section.

Inspection

Check the sprag shaft for scores and for free movement in the housing and sprag. Check the sprag and control rod springs for loss of tension or distortion. Check the square lug on the sprag for broken edges. Check the lugs on the governor support (park gear) for broken edges. Check the knob on the end of the control rod for nicks, burrs, and free turning.

Assembly

(1) Install reaction plug and pin assembly in housing and install snap ring (fig. 2C-28).

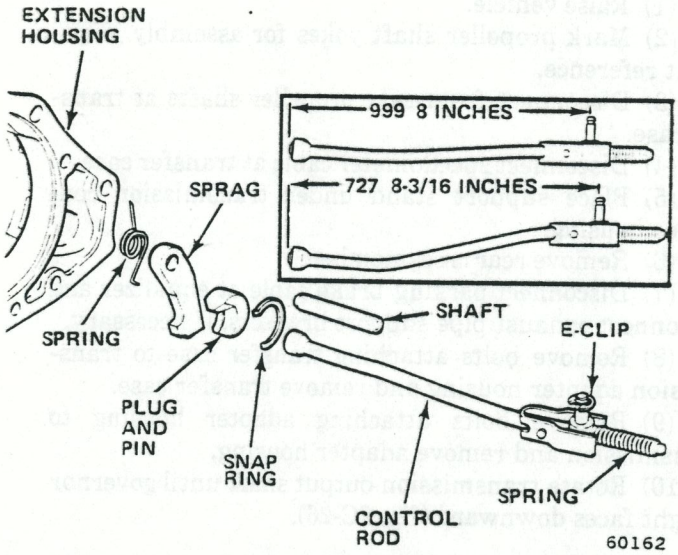

Fig. 2C-28 Park Lock Components

(2) Position sprag and spring in housing and install shaft. Be sure square lug on sprag is facing park gear and that spring is positioned so it moves sprag away from gear.
(3) Install transfer case and adapter housing as outlined in Governor Valve Service.

NEUTRAL START AND BACKUP LAMP SWITCH

The neutral starting section of the switch is contained in the center terminal of the three terminal switch. It provides a ground for the starter solenoid circuit through the gearshift lever in Park and Neutral positions only.

The two outside terminals of the neutral switch are for the backup lamp switch circuit (fig. 2C-29). Refer to the wiring diagrams at the end of this volume for switch circuitry.

Test and Replacement Procedure

Neutral Start Circuit

(1) Remove wiring connector from switch and test for continuity between center terminal pin and transmission case. Continuity should exist only when transmission is in Park or Neutral.
(2) If tests show switch may be defective, check gearshift linkage adjustment before replacing switch.
(3) Remove switch from transmission. Allow transmission fluid to drain into container.
(4) Move gearshift lever to Park and Neutral positions. Inspect switch operating lever fingers and manual

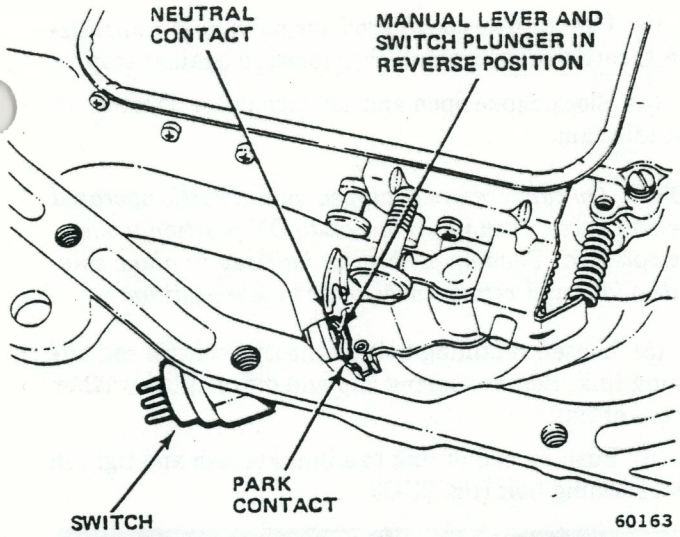

Fig. 2C-29 Neutral Start and Backup Lamp Switch

lever and shaft for proper alignment with switch opening in case.

(5) Install switch and switch seal in transmission case. Tighten switch to 24 foot-pounds (33 N•m) torque.

(6) Test switch continuity.

(7) Correct transmission fluid level as required. Refer to Fluid Level and Condition for refill procedure.

Backup Lamp Circuit

(1) Remove wiring connector from switch and test for continuity between two outside pins.

(2) Continuity should exist when transmission is in reverse only.

(3) Continuity should not exist from either pin to transmission case in reverse.

(4) Replace switch if tests prove switch is defective.

THROTTLE CABLE AND LINKAGE ADJUSTMENT

Throttle Cable Adjustment—Four-Cylinder Engine

(1) Remove air cleaner.

(2) Remove spark plug wire separator from throttle cable bracket and move separator and wires aside.

(3) Raise vehicle.

(4) Hold throttle control lever **rearward** against its stop. Use spare spring to hold lever. Hook one end of spring to lever and hook opposite end of spring to convenient attachment point.

(5) Lower vehicle.

(6) Block choke open and set carburetor linkage completely off fast idle cam.

(7) On four-cylinder vehicles without air conditioning, turn ignition key to On position to energize throttle stop solenoid.

(8) Unlock throttle control cable by releasing T-shaped cable adjuster clamp (fig. 2C-30). Release clamp by lifting upward with small screwdriver.

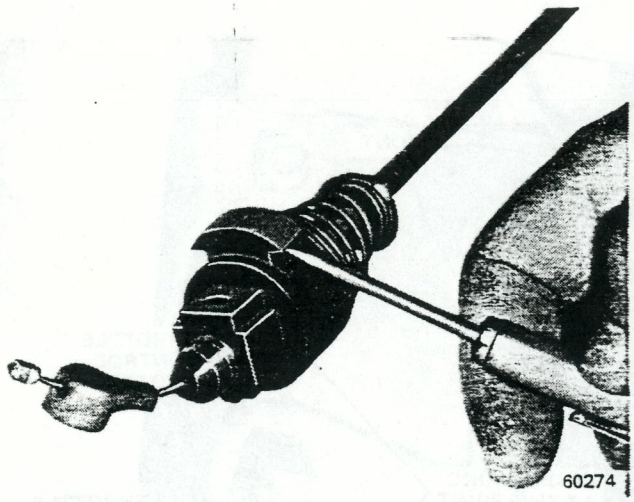

Fig. 2C-30 Throttle Cable/Linkage Adjustment

(9) Grasp cable outer sheath and move cable and sheath forward to remove any cable load on throttle cable bell crank.

NOTE: *The bell crank is part of the carburetor throttle linkage.*

(10) Adjust cable by moving cable and sheath rearward until there is zero lash between plastic cable end and bell crank ball.

(11) When zero lash between cable end and bell crank is achieved, lock cable by pressing T-shaped cable adjuster clamp downward until clamp snaps into place.

(12) Turn ignition off. Install spark plug wires and separator, connect throttle stop solenoid on air conditioned vehicles and install air cleaner.

(13) Raise vehicle. Remove holding spring from transmission throttle control lever and lower vehicle.

(14) Road test vehicle and check transmission operation. Readjust throttle cable, if necessary.

Throttle Linkage Adjustment—Six-Cylinder Engine

(1) Disconnect throttle control rod spring at carburetor.

(2) Raise vehicle.

(3) Use throttle control rod spring to hold transmission throttle control lever forward against stop (fig. 2C-31). Hook one end of spring on throttle control lever and other end on throttle linkage bell crank bracket attached to converter housing.

(4) Block choke open and set carburetor throttle off fast idle cam.

NOTE: *On carburetors equipped with a throttle operated solenoid valve, turn the ignition lock to the ON position to energize the solenoid. Then open the throttle halfway to allow the solenoid to lock and return the carburetor to idle position.*

(5) Loosen retaining bolt on throttle control adjusting link. **Do not remove spring clip and nylon washer.**

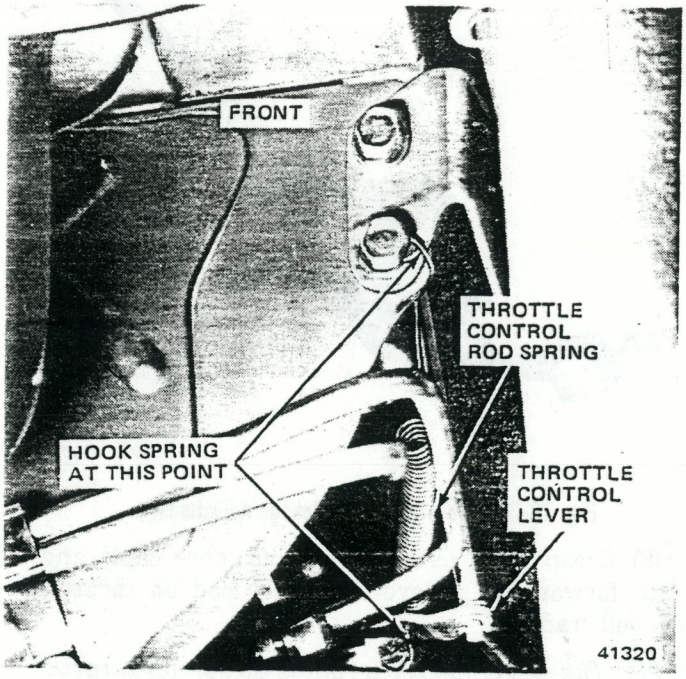

Fig. 2C-31 Installing Throttle Control Lever Spring

(6) Pull on end of link to eliminate lash and tighten link retaining bolt (fig. 2C-32).

(7) Remove throttle control rod spring from linkage and install it on control rod.

(8) Lower vehicle.

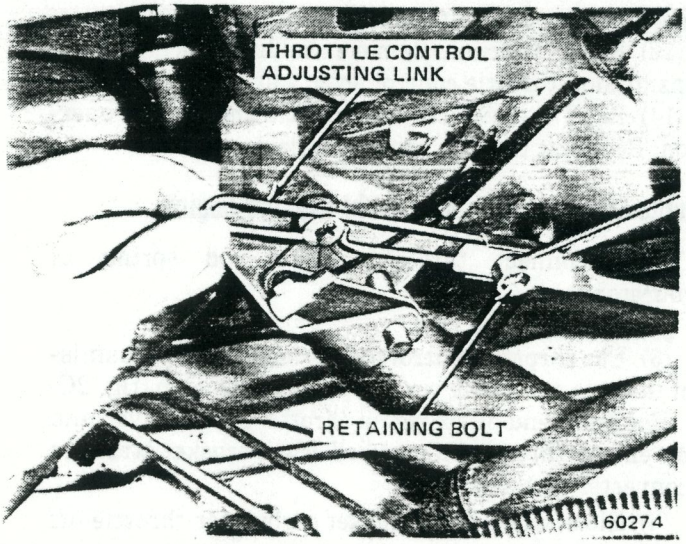

Fig. 2C-32 Tightening Link Retaining Bolt—Six-Cylinder Engine

Throttle Linkage Adjustment—Eight-Cylinder Engine

(1) Disconnect throttle control rod spring at carburetor.

(2) Raise vehicle.

(3) Use throttle control rod spring to hold transmission throttle valve control lever forward against stop.

(4) Block choke open and set carburetor throttle off fast idle cam.

NOTE: *On carburetors equipped with throttle operated solenoid valve, turn ignition lock to ON position to energize solenoid. Then open throttle halfway to allow solenoid to lock and return carburetor to idle position.*

(5) Loosen retaining bolt on throttle control rod adjusting link. Remove spring clip and move nylon washer to rear of link.

(6) Push on end of link to eliminate lash and tighten link retaining bolt (fig. 2C-33).

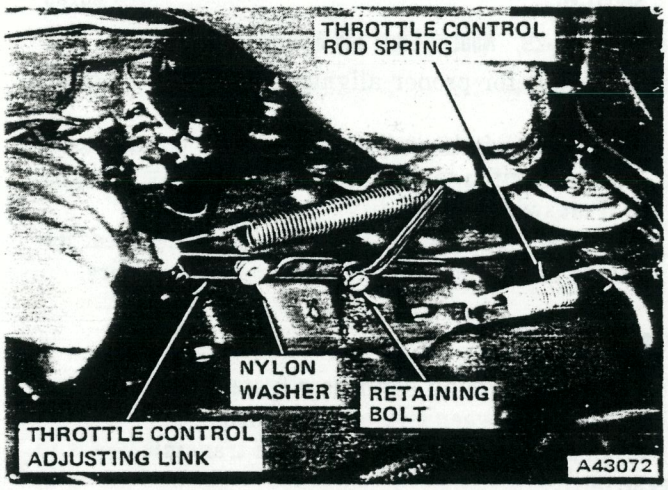

Fig. 2C-33 Tightening Link Retaining Bolt—Eight-Cylinder Engine

(7) Install nylon washer and spring clip (fig. 2C-34).

(8) Remove throttle control rod spring from linkage and install it on rod.

(9) Lower vehicle.

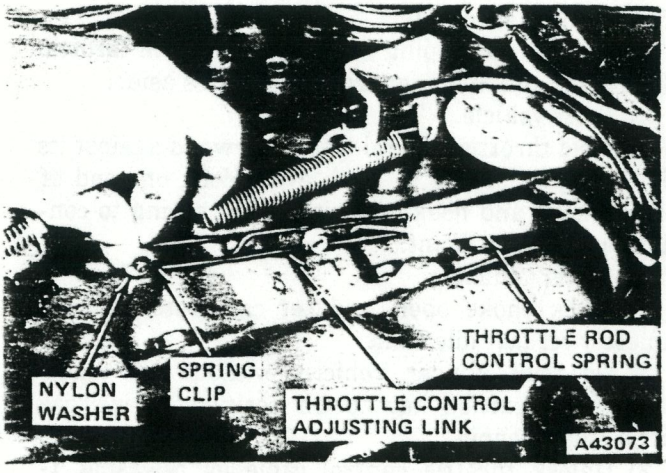

Fig. 2C-34 Installing Nylon Washer and Spring Clip—Eight-Cylinder Engine

SPECIFICATIONS

Band Adjustments

	904	999	727
Front Band Turns*	2.5	2	2-½
Rear Band Turns*	7	4	2

NOTE: * 904 backed off from 41 in-lbs (5 N.m); 999/727 models backed off from 72 in-lb (8 N.m).

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Fluid Levels

Fill to "Add One Pint" mark on dipstick. Use Jeep, Dexron, or equivalent Automatic transmission fluid.

NOTE: Check fluid level with gearshift selector lever in N (neutral) position and with fluid at normal operating temperature.

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Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (in-lbs)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Cooler Line Fitting	160 in-lb	120-200 in-lb	18	14-23
Cooler Line Nut	150 in-lb	130-180 in-lb	17	15-20
Converter Drive Plate to Crankshaft Bolts - 4 Cylinder	58	50-56	79	68-89
Converter Drive Plate to Crankshaft Bolts - 6 Cylinder	105	95-120	142	129-163
Converter Drive Plate to Torque Converter Bolts - 4 Cylinder	40	35-40	54	47-54
Converter Drive Plate to Torque Converter Bolts - 6 Cylinder	26	22-30	35	30-44
Adapter Housing-to-Transmission Case Bolt	24	—	33	—
Governor Body Bolt	100 in-lb	—	11	—
Front Band Adjusting Screw Locknut	35	—	47	—
Kickdown Lever Shaft Plug	150 in-lb	—	17	—
Rear Band Adjusting Screw Locknut	35	—	47	—
Neutral Starter Switch	24	—	33	—
Oil Filler Tube Bracket Bolt	150 in-lb	—	17	—
Oil Pan Bolt	150 in-lb	9-13	17	12-18
Oil Pump Housing-to-Transmission Case Bolt	175 in-lb	—	20	—
Output Shaft Support Bolt	150 in-lb	—	17	—
Overrunning Clutch Cam Setscrew	40 in-lb	—	4	—
Pressure Test Port Plug	110 in-lb	—	12	—
Reaction Shaft Support to Oil Pump Bolt	160 in-lb	—	18	—
Transmission-to-Engine Bolt	28	22-30	38	30-41
Valve Body Screw	35 in-lb	—	4	—
Valve Body-to-Transmission Case Screw	100 in-lb	—	11	—

All Torque values given in inch-pounds and Newton-meters with dry fits unless otherwise specified.

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OUT-OF-VEHICLE SERVICE AND OVERHAUL

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Specifications	2C-68
Subassembly Overhaul	2C-37
Transmission Assembly	2C-64
Transmission Disassembly	2C-35
Transmission Installation	2C-34
Transmission Removal	2C-33

TRANSMISSION REMOVAL

(1) Disconnect fan shroud, if equipped.

(2) Disconnect transmission fill tube at upper bracket.

(3) Raise vehicle.

(4) Remove inspection cover from converter housing.

(5) Remove transmission fill tube.

(6) Remove starter.

(7) Mark propeller shafts and axle yokes for assembly alignment reference.

(8) Disconnect propeller shafts at transfer case yokes. Secure shafts to frame rails with wire.

(9) On eight-cylinder vehicles, disconnect exhaust pipes at exhaust manifolds.

(10) Drain transfer case lubricant from Cherokee, Wagoneer and Truck models and disconnect speedometer cable at transfer case.

(11) Disconnect gearshift and throttle linkage.

(12) Disconnect wires at neutral start switch.

(13) Mark converter drive plate and converter for assembly alignment reference.

(14) Remove bolts attaching converter to drive plate. Rotate crankshaft and drive plate using ratchet handle and socket on crankshaft front pulley bolt to gain access to drive plate bolts.

(15) Support transmission-transfer case assembly using transmission jack. Retain transmission on jack with safety chain.

(16) Remove bolts attaching rear crossmember to transmission.

(17) Remove rear crossmember.

(18) Lower transmission slightly and disconnect oil cooler lines at transmission.

(19) Remove bolts attaching transmission to engine.

(20) Move transmission and converter rearward to clear crankshaft.

(21) Hold converter in position and lower transmission assembly until converter housing clears engine.

(22) Remove transfer case from transmission.

(23) If necessary, the following items can now be serviced:

- Torque Converter
- Torque Converter Drive Plate
- Oil Pump Seal (figs. 2C-35 and 2C-36)
- Engine Core Hole Plugs
- Engine Oil Galley Plugs

CAUTION: *If the transmission was removed to correct a malfunction that generated sludge or heavy accumulations of metal particles or friction material, the oil cooler and cooler lines must be flushed thoroughly and the torque converter replaced. Do not attempt to flush the converter if it is contaminated. Refer to Diagnosis—Test Procedures in this chapter for procedure for flushing oil cooler and lines.*

TRANSMISSION INSTALLATION

(1) Install transfer case on transmission.

(2) If torque converter was removed, insert Pump Aligning Tool J-24033 (Models 904/999) or J-24045 (Model 727) in pump rotor until rotor drive lugs engage slots in tool.

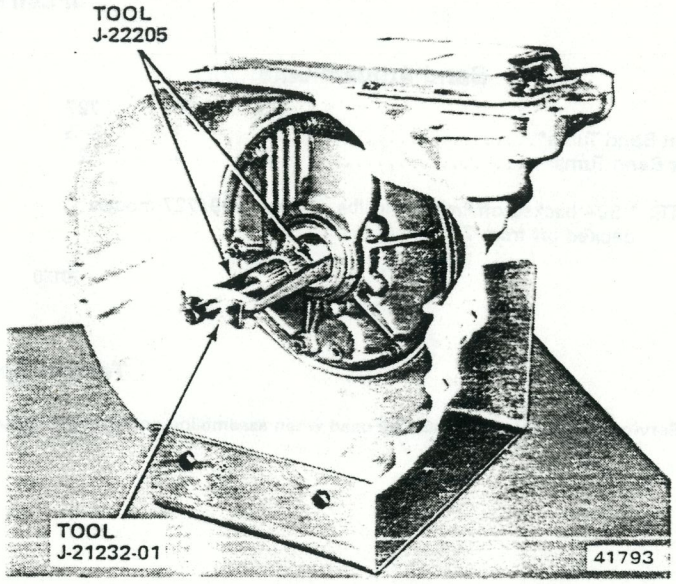

Fig. 2C-35 Oil Pump Seal Removal

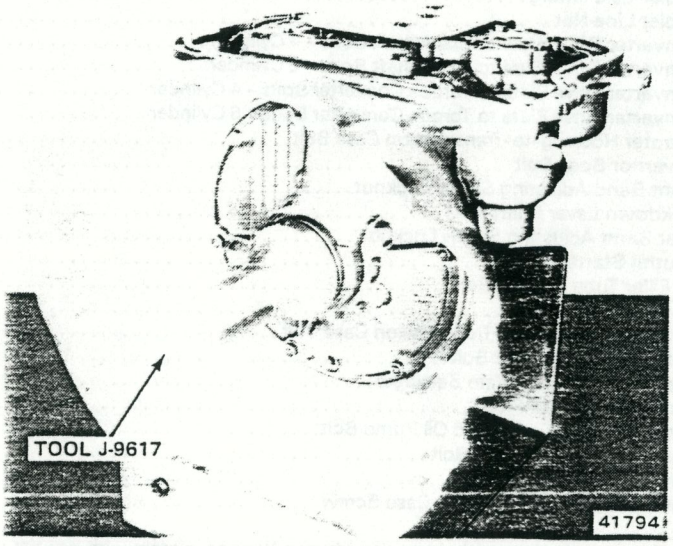

Fig. 2C-36 Oil Pump Seal Installation

(3) Rotate tool until drilled hole in tool is vertical and remove tool.

(4) Rotate converter until pump drive slots in converter hub are vertical and carefully insert converter hub into pump. Be sure drive lugs of pump inner rotor are properly engaged in drive slots of converter hub.

(5) Raise transmission and align converter with drive plate. Refer to assembly alignment marks.

(6) Move transmission forward.

(7) Raise, lower or tilt transmission to align converter housing pilot holes with dowels in engine.

(8) Install two converter housing lower attaching bolts and tighten bolts to pull housing to engine.

(9) Install drive plate-to-converter attaching bolts.

(10) Install remaining converter housing-to-engine attaching bolts. Tighten all bolts to 28 foot-pounds (38 N•m) torque.

(11) Connect oil cooler lines.
(12) Install rear support cushion on transmission.
(13) Raise transmission and install rear crossmember.
(14) Remove transmission jack.
(15) Install speedometer cable.
(16) Install inspection cover.
(17) Install exhaust pipes and support brackets, if removed.
(18) Install starter.
(19) Connect wires to neutral switch.
(20) Connect gearshift and throttle linkage.
(21) Install propeller shafts. Refer to alignment marks made during removal.
(22) Connect front exhaust pipes and catalytic converter support bracket bolts, if removed.
(23) Fill transfer case to correct level with specified lubricant.
(24) Lower vehicle.
(25) Fill transmission to correct level as described in Fluid Level and Condition.
(26) Adjust gearshift linkage.
(27) Road test to check transmission operation.

TRANSMISSION DISASSEMBLY

CAUTION: *Cleanliness during disassembly and assembly is necessary to avoid a further malfunction after assembly. Before removing any of the transmission subassemblies, plug all openings and thoroughly clean the transmission exterior. Steam cleaning equipment is preferable for this purpose. During disassembly, clean all parts in a suitable solvent and dry each part using compressed air. Do not use cloth or paper towels to dry any parts after cleaning, use compressed air only.*

End Play Measurement

NOTE: *Measuring end play before disassembly will indicate whether a thrust washer change is required and save time at assembly.*

(1) Mount transmission in Holding Fixture J-24026 (fig. 2C-37).
(2) Remove one pump attaching bolt and thread Dial Indicator Support Rod J-5864 into bolt hole.
(3) Attach Dial Indicator J-8001 to rod.
(4) Position indicator stylus against forward end of input shaft (fig. 2C-38).
(5) Move input shaft rearward and set dial indicator at zero.
(6) Pull input shaft forward to obtain end play reading.
(7) Record reading for assembly reference.
(8) Remove dial indicator and rod.

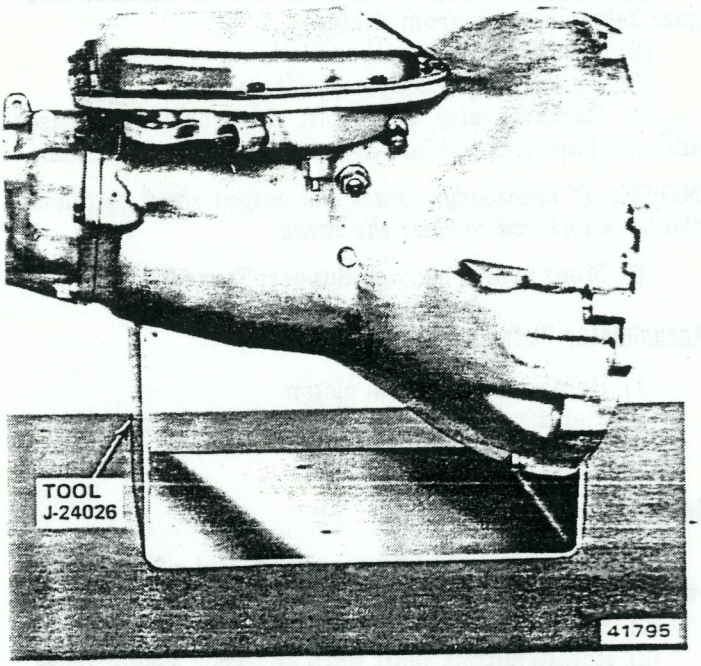

Fig. 2C-37 Transmission Holding Fixture

Oil Pan

Remove pan attaching bolts and remove oil pan and gasket. Be sure that any dirt which remained around bolts does not fall into transmission.

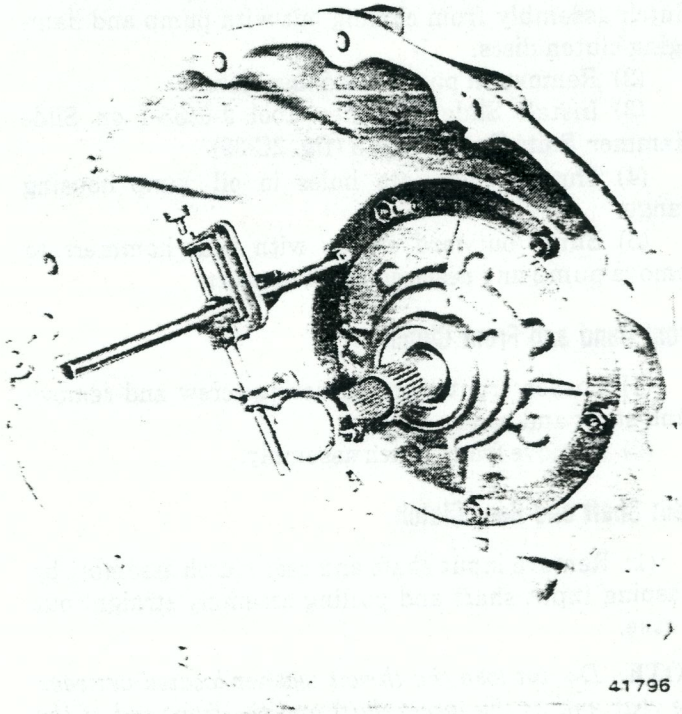

Fig. 2C-38 Measuring End Play

Valve Body

(1) Loosen clamp bolts and remove throttle and gear selector levers from shafts.
(2) Remove neutral start switch.
(3) Remove valve body attaching screws.
(4) Remove valve body. Lift valve body from case and pull park lock rod forward out of case at same time.

NOTE: *If necessary, rotate the output shaft to allow the park lock rod to clear the sprag.*

(5) Mount valve body on Support Stand J-24043.

Accumulator Piston and Spring

(1) Remove spring from piston.
(2) Identify spring with tag for assembly reference.
(3) Remove piston from case.

Governor and Support

(1) Remove E-clip from weight end of governor valve (fig. 2C-26).
(2) Remove valve and shaft from governor body.
(3) Rotate output shaft until governor weight faces downward.
(4) Remove snap ring retaining governor on output shaft.
(5) Remove governor body and park gear from output shaft.

Oil Pump and Reaction Shaft Support

(1) Tighten front band adjusting screw until band is tight around front clutch retainer. This prevents front clutch assembly from coming out with pump and damaging clutch discs.
(2) Remove oil pump attaching bolts.
(3) Install Slide Hammer Tool J-6585-1 on Slide Hammer Bolts Tool J-7004-3 (fig. 2C-39).
(4) Thread bolts into holes in oil pump housing flange.
(5) Bump outward evenly with slide hammers to remove pump and reaction shaft support.

Front Band and Front Clutch

(1) Loosen front band adjusting screw and remove band strut and band.
(2) Remove front clutch assembly.

Input Shaft and Rear Clutch

(1) Remove input shaft and rear clutch assembly by grasping input shaft and pulling assembly straight out of case.

NOTE: *Do not lose the thrust washer located between the rear end of the input shaft and the front end of the output shaft.*

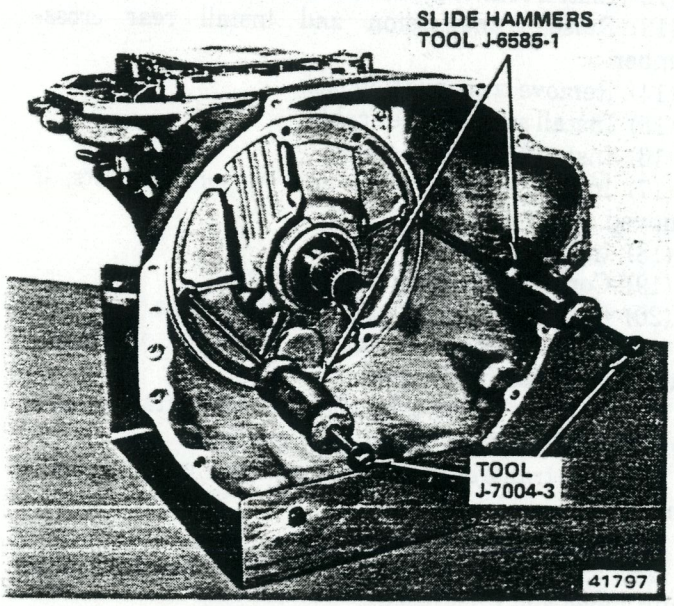

Fig. 2C-39 Oil Pump Removal

Output Shaft—Planetary Gears

(1) Carefully remove driving shell and output shaft assembly.

CAUTION: *Be very careful to protect the machined surfaces on the output shaft during removal.*

Rear Band and Drum

(1) Pull drum forward and out of case.
(2) Loosen band adjusting screw.
(3) Thread 1/4-inch (6 mm) bolt into actuating lever pivot pin.
(4) Grip bolt with pliers and remove pivot pin.
(5) Remove lever, linkage and band.

Overrunning Clutch

Carefully remove clutch hub, rollers, springs and store parts where they will not be lost or damaged.

Front Servo

(1) Remove front servo pressure port plug.
(2) Compress servo piston rod guide until it bottoms in case bore.
(3) Insert No. 2 Phillips screwdriver into pressure port (fig. 2C-40).
(4) Slowly release rod guide against screwdriver (fig. 2C-40).
(5) Remove servo retaining snap ring.
(6) Compress rod guide and remove screwdriver.
(7) Slowly release rod guide and remove rod guide, springs and piston rod.

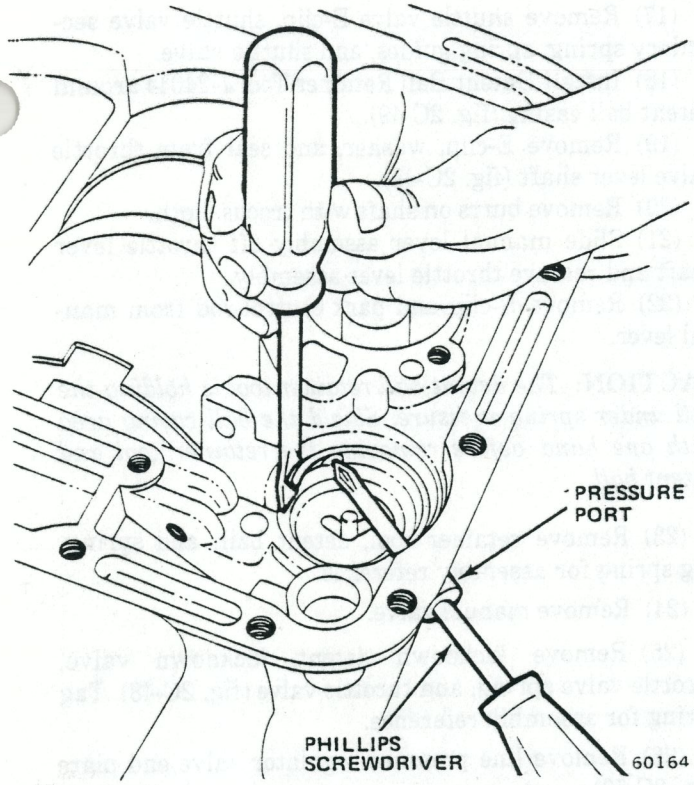

Fig. 2C-40 Front Servo Removal

CAUTION: *Do not grasp the rod with pliers to remove it. If the rod sticks in the case, tap it gently to release it.*

(8) Identify servo spring(s) with tag(s) for assembly reference.

(9) Remove servo piston.

Rear Servo

(1) Compress piston spring and remove snap ring (fig. 2C-41).

(2) Remove spring retainer, spring, piston and plug assembly. Identify spring with tag for assembly reference.

SUBASSEMBLY OVERHAUL

Valve Body

Disassembly

CAUTION: *Do not clamp any part of the valve body or transfer plate in a vise. Any slight distortion of the body or plate will cause sticking valves or excessive leakage or both. When removing and installing valves or plugs, slide them in or out very carefully. Do not use force to remove or install valves.*

(1) Mount valve body on Repair Stand Tool J-24043.

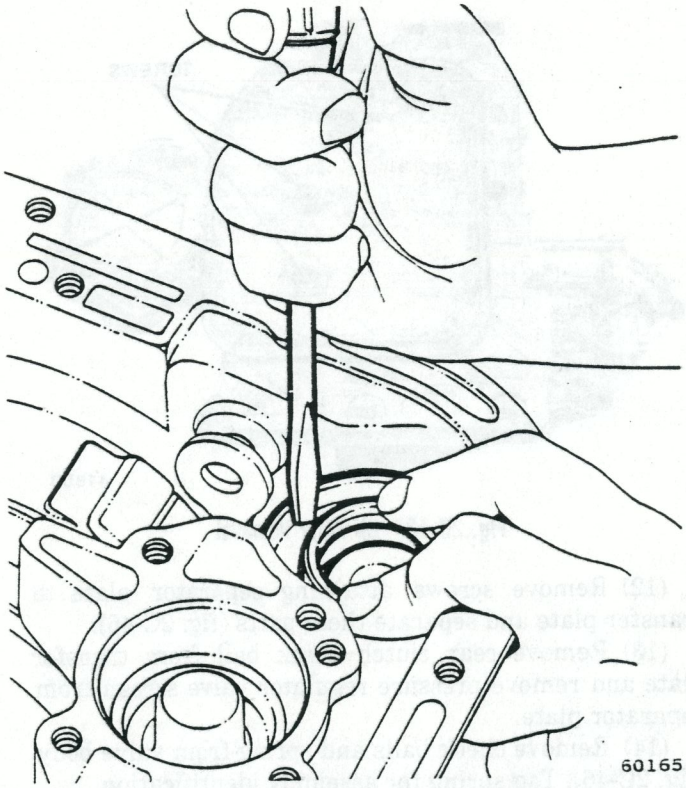

Fig. 2C-41 Rear Servo Spring and Snap Ring Removal

NOTE: *When disassembling the valve body, identify all valve springs with a tag for assembly reference.*

(2) Remove oil filter attaching screws and oil filter (fig. 2C-42).

NOTE: *Oil filter screws are longer than transfer plate screws.*

(3) Remove screws attaching lockup module to valve body (fig. 2C-43).

(4) Slide lockup module oil tube out of valve body and remove tube and module as an assembly.

(5) Remove end plate from module.

(6) Remove lockup valve and spring.

(7) Remove fail-safe valve and spring.

NOTE: *Tag springs and valves for reassembly reference.*

(8) Remove upper and lower screws from spring retainer and adjustment screw bracket (fig. 2C-44). Hold spring retainer firmly against spring force while removing last screw.

(9) Remove spring retainer, line and throttle pressure adjusting screws. Do not disturb screw settings. Remove line pressure and torque converter valve regulator springs. Tag springs for assembly reference.

(10) Remove line pressure regulator and torque converter control valves (fig. 2C-44).

(11) Remove transfer plate assembly retaining screws and remove transfer plate assembly.

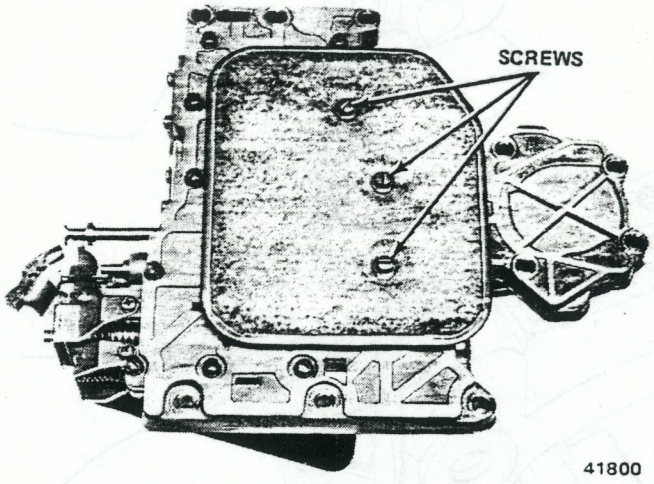

Fig. 2C-42 Oil Filter Removal

(12) Remove screws attaching separator plate to transfer plate and separate these parts (fig. 2C-45).

(13) Remove rear clutch check ball from transfer plate and remove pressure regulator valve screen from separator plate.

(14) Remove check balls and spring from valve body (fig. 2C-46). Tag spring for assembly identification.

(15) Turn valve body over and remove shuttle valve cover plate (fig. 2C-47).

(16) Remove governor plug end plate (fig. 2C-48), shuttle valve throttle plug and spring, and 1-2 and 2-3 shift valve governor plugs.

(17) Remove shuttle valve E-clip, shuttle valve secondary spring, spring guides, and shuttle valve.

(18) Install Detent Ball Retainer Tool J-24044 around detent ball casing (fig. 2C-49).

(19) Remove E-clip, washer, and seal from throttle valve lever shaft (fig. 2C-48).

(20) Remove burrs on shaft with crocus cloth.

(21) Slide manual lever assembly off throttle lever shaft and remove throttle lever assembly.

(22) Remove E-clip and park control rod from manual lever.

CAUTION: *The detent ball retainer tool is holding the ball under spring pressure. Shield the ball casing area with one hand before removing the retainer tool and detent ball.*

(23) Remove retainer tool, detent ball, and spring. Tag spring for assembly reference.

(24) Remove manual valve.

(25) Remove kickdown detent, kickdown valve, throttle valve spring, and throttle valve (fig. 2C-48). Tag spring for assembly reference.

(26) Remove line pressure regulator valve end plate (fig. 2C-50).

(27) Remove sleeve, line pressure regulator valve plug, and throttle pressure regulator valve plug.

(28) On model 999, remove downshift valve housing end plate.

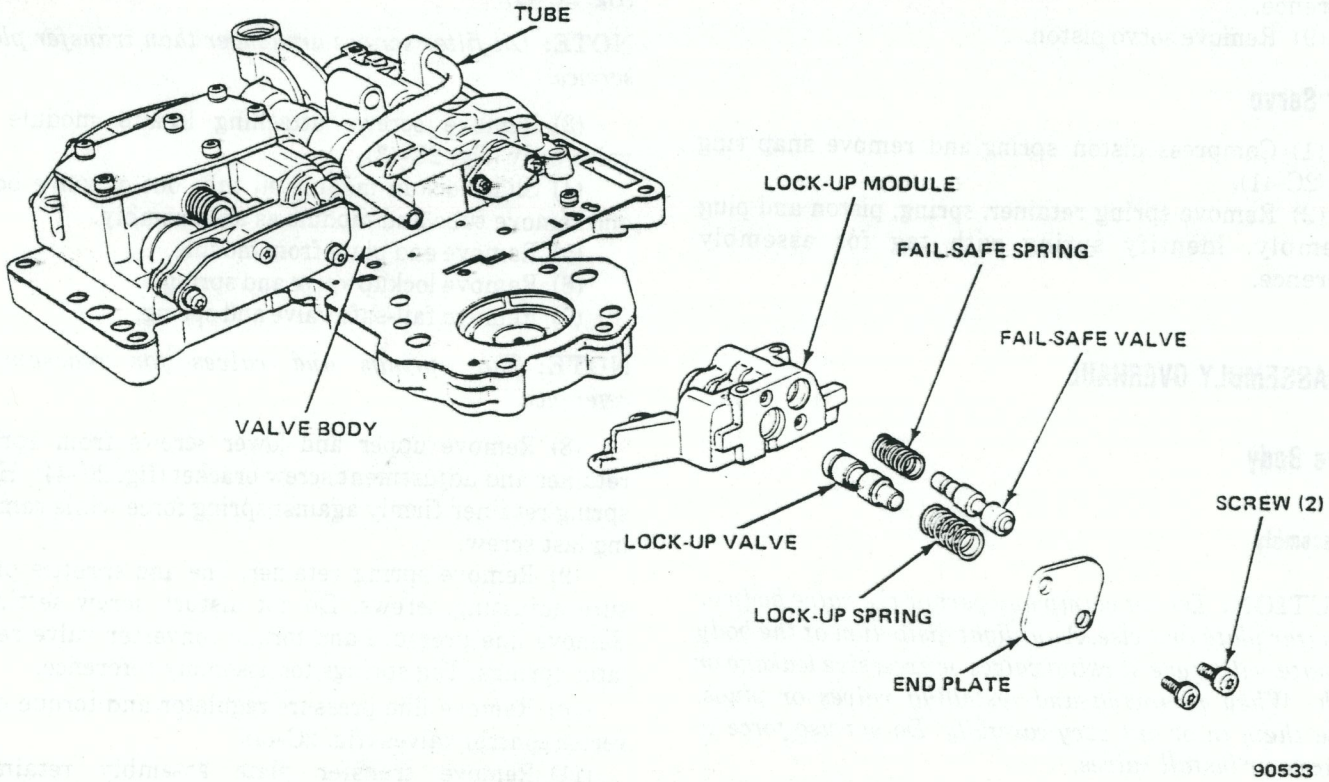

Fig. 2C-43 Lockup Module—Models 999/727

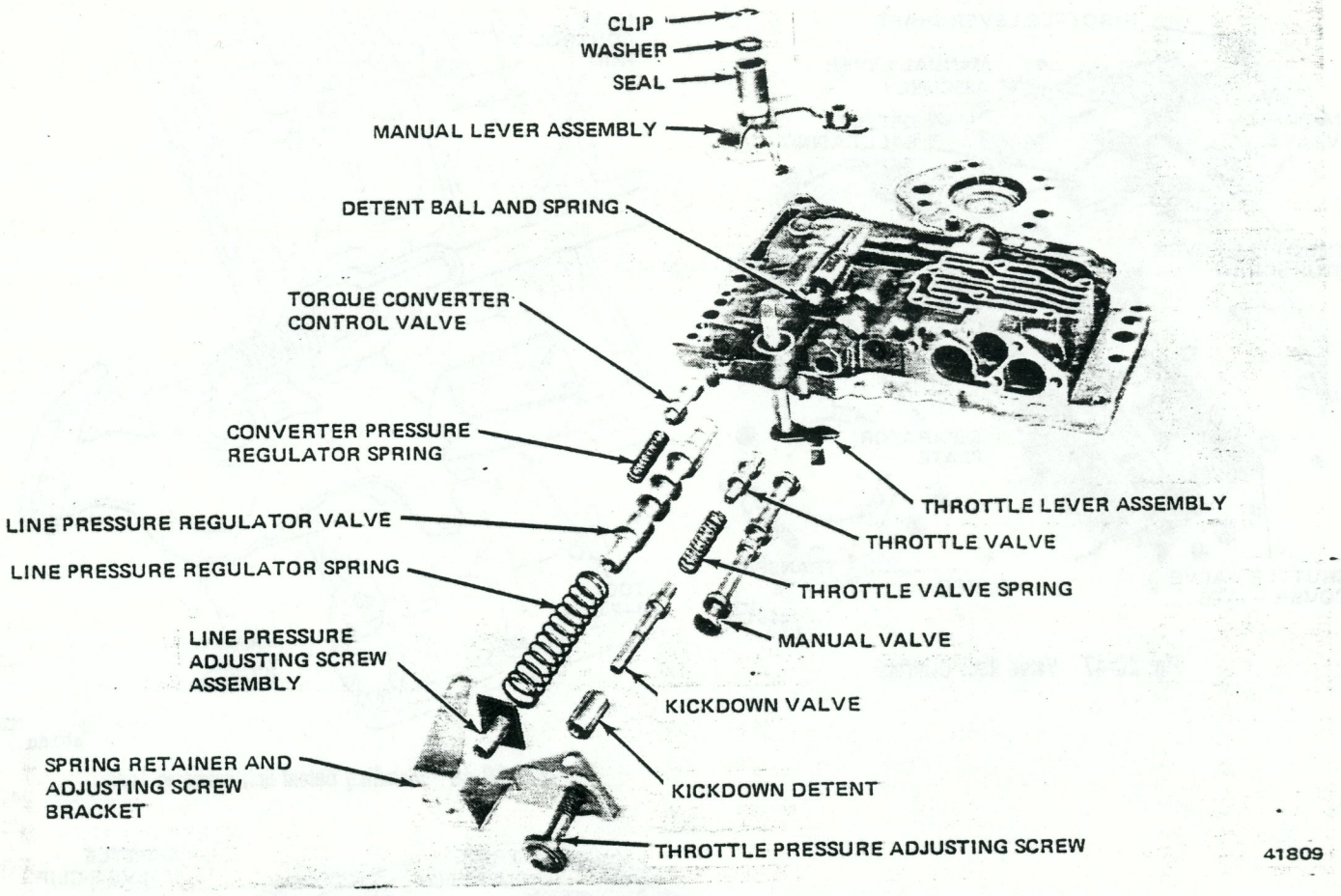

Fig. 2C-44 Pressure Regulator and Manual Controls

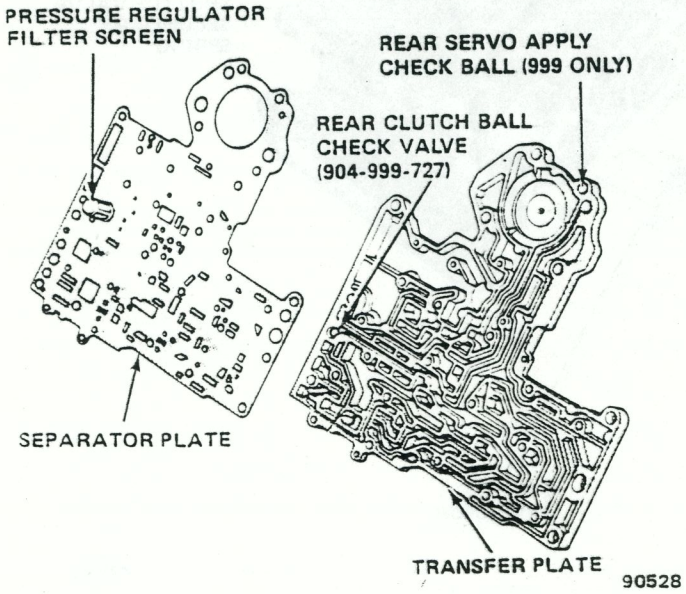

Fig. 2C-45 Transfer Plate Assembly

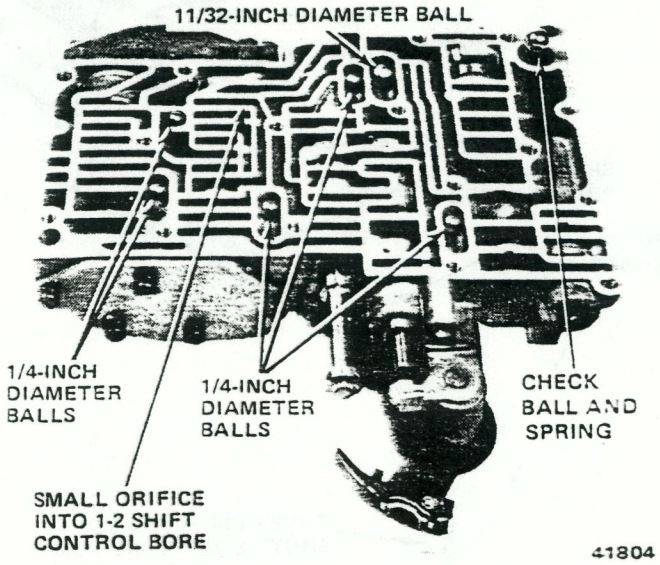

Fig. 2C-46 Check Ball Location

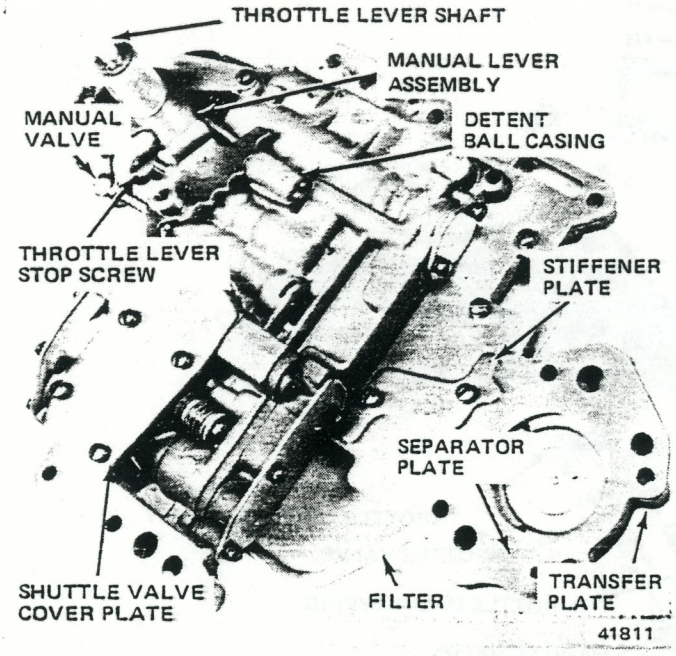

Fig. 2C-47 Valve Body Controls

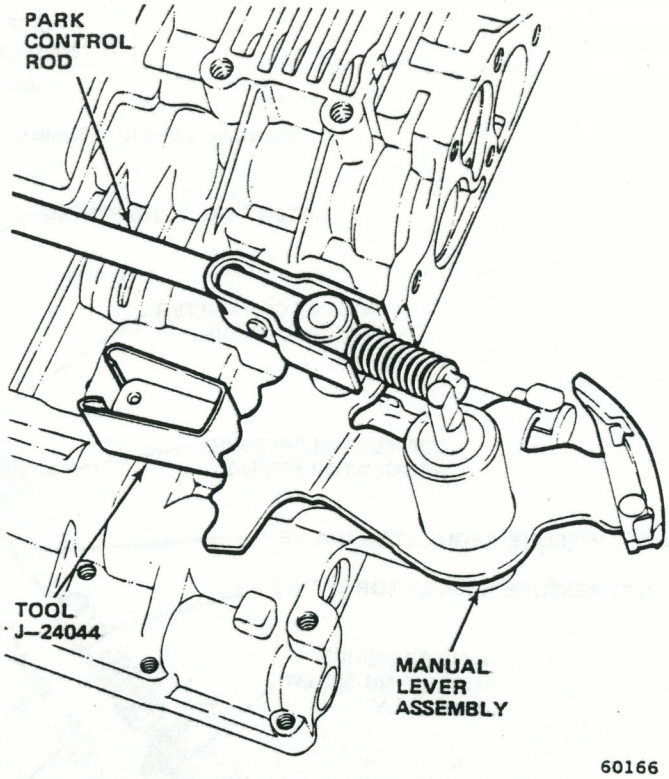

Fig. 2C-49 Installing Detent Ball Retaining Tool

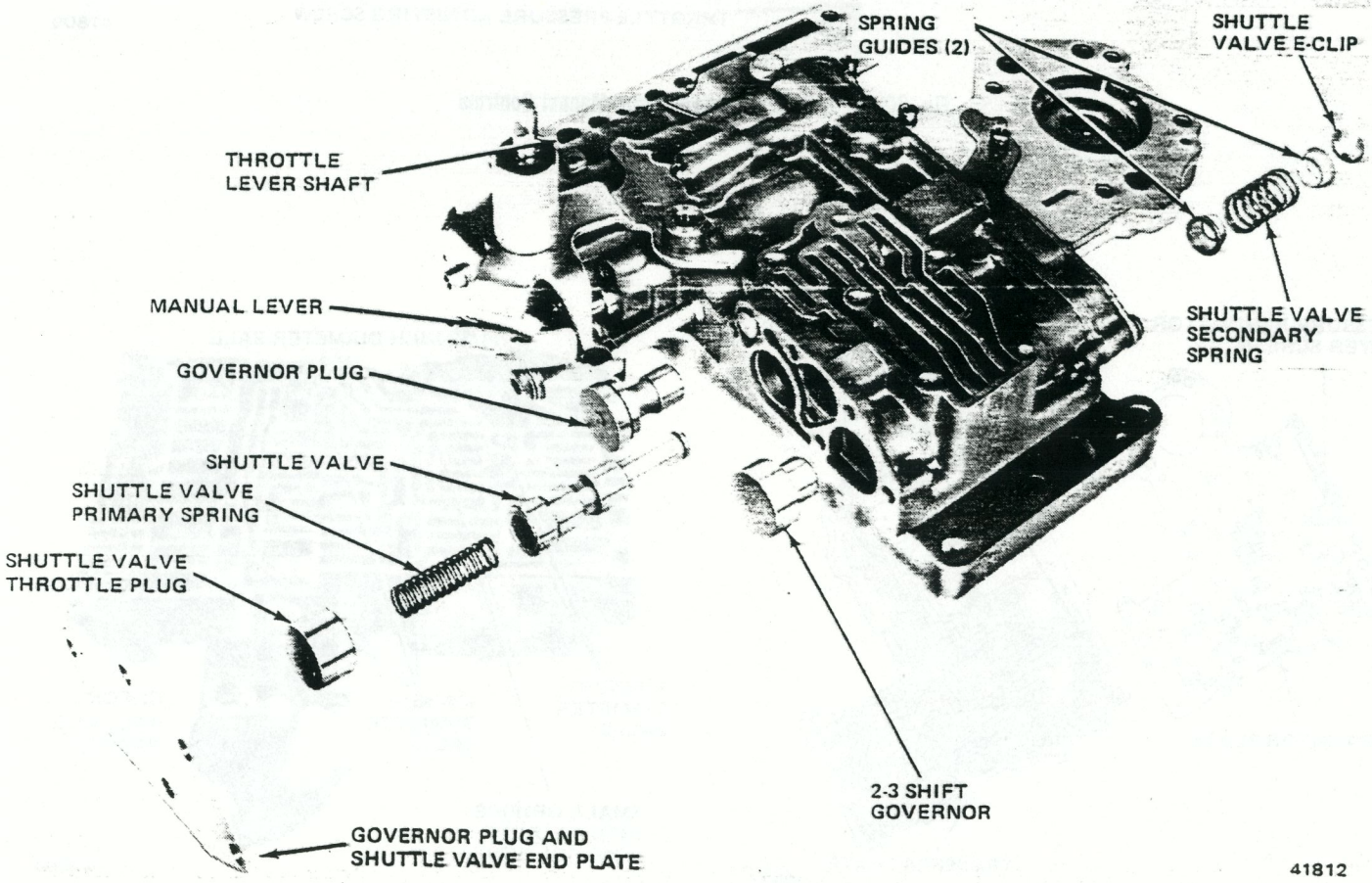

Fig. 2C-48 Shuttle Valve and Governor Plugs

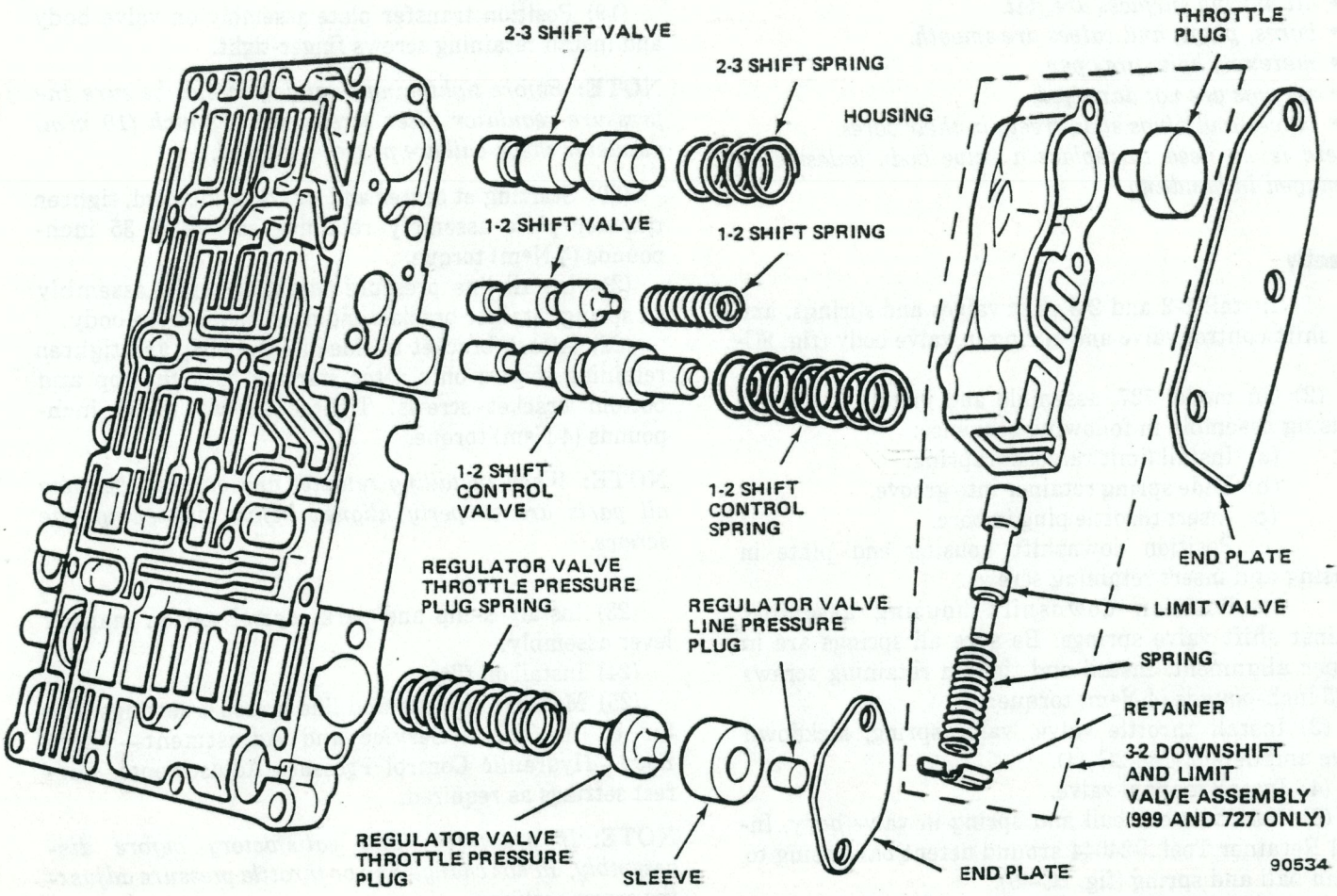

Fig. 2C-50 Shift Valves and Pressure Regulator Valves

(29) On model 727 only, remove downshift valve housing, remove throttle plug from downshift valve retainer, and remove spring, and limit valve from housing (fig. 2C-50). Tag spring for assembly reference.

(30) Remove 1-2 shift control valve and spring, 1-2 shift valve and spring, and 2-3 shift valve and spring. Tag all springs for assembly reference.

Cleaning and Inspection

Thoroughly wash and air dry all parts.

Do not use any type of caustic cleaning solution. Be sure all passages are clean and free from obstructions.

Clean the regulator filter in solvent and air dry. Replace the filter, if damaged.

Inspect the manual and throttle valve levers and shafts for being bent, worn or excessively loose. If a lever is loose on a shaft, it may be repaired by silver soldering or by replacing the lever and shaft assembly. If a lever or shaft is bent, replace the assembly.

Inspect all mating surfaces for burrs, nicks and scratches. Remove minor irregularities using crocus cloth and very light pressure.

Use a straightedge and inspect all mating surfaces for warpage or distortion. Very slight warpage or distortion may be corrected by abrading the surface on a sheet of crocus cloth. Position the cloth on a surface plate or flat piece of glass and use very light pressure.

Be sure all metering holes in the separator plate and valve body are open. Use a penlight to inspect the bores in the valve body for corrosion, scores, burrs, scratches, pits, and other irregularities.

Inspect all valve springs for distortion or collapsed coils.

Inspect all valves and plugs for burrs, nicks, and scores. Remove slight irregularities using crocus cloth but do not round off the sharp edges. The sharpness of these edges is vitally important because it prevents foreign matter from lodging between the valve and the body bore.

Inspect all valves and plugs for freedom of operation in the valve body bores. When the bores, valves, and plugs are clean and dry, the valves and plugs fall freely in the bores. Make sure the orifice into the 1-2 shift control bore in the valve body is open (fig. 2C-44). Verify this by inserting a 1/32-inch (.79 mm) diameter drill through the orifice and into the 1-2 shift control bore.

NOTE: *A valve body that functioned properly when the vehicle was new will operate correctly after cleaning, reconditioning, assembly, and adjustment if:*

- *all mating surfaces are flat.*
- *bores, plugs, and valves are smooth.*
- *metering holes are open.*
- *springs are not damaged.*
- *valves and plugs slide freely in their bores.*

There is no need to replace a valve body unless it is damaged in handling.

Assembly

(1) Install 1-2 and 2-3 shift valves and springs, and 1-2 shift control valve and spring in valve body (fig. 2C-50).

(2) On model 727, assemble and install downshift housing assembly in following sequence:

(a) Install limit valve and spring.

(b) Slide spring retainer into groove.

(c) Insert throttle plug in bore.

(d) Position downshift housing end plate in housing and insert retaining screws.

(e) Position downshift housing assembly against shift valve springs. Be sure all springs are in proper alignment. Install and tighten retaining screws to 35 inch-pounds (4 N•m) torque.

(3) Install throttle valve, valve spring, kickdown valve and detent (fig. 2C-44).

(4) Install manual valve.

(5) Insert detent ball and spring in valve body. Install Retainer Tool J-24044 around detent ball casing to retain ball and spring (fig. 2C-49).

(6) Install throttle lever assembly (fig. 2C-44).

(7) Install manual lever assembly on throttle lever shaft. Position manual lever assembly so it engages manual valve and detent ball.

(8) Install seal, washer, and E-clip on throttle lever shaft.

(9) Remove detent ball retainer tool.

(10) Install 1-2 and 2-3 shift valve governor plugs (fig. 2C-48).

(11) Install shuttle valve, primary spring and throttle plug.

(12) Install governor plug end plate and tighten screws to 35 inch-pounds (4 N•m) torque.

(13) Install spring guides, shuttle valve secondary spring, and E-clip.

(14) Install shuttle valve cover plate (fig. 2C-55) and tighten screws to 35 inch-pounds (4 N•m) torque.

(15) Install check balls and spring in valve body (fig. 2C-46).

(16) Install rear clutch check ball in transfer plate and install pressure regulator valve screen in separator plate (fig. 2C-44).

(17) Position separator plate on transfer plate and stiffener plate on separator plate.

(18) Install stiffener and separator plate-to-transfer plate retaining screws. Tighten screws to 35 inch-pounds (4 N•m) torque.

(19) Position transfer plate assembly on valve body and install retaining screws finger-tight.

NOTE: *Before tightening retaining screws be sure the pressure regulator filter screen and 3/8-inch (10 mm) diameter check ball are properly aligned.*

(20) Starting at center and working outward, tighten transfer plate assembly retaining screws to 35 inch-pounds (4 N•m) torque.

(21) Install line pressure adjusting screw assembly on spring retainer bracket and position on valve body.

(22) Attach bracket to side of valve body and tighten retaining screws only after starting both the top and bottom bracket screws. Tighten screws to 35 inch-pounds (4 N•m) torque.

NOTE: *When installing retainer and bracket, be sure all parts are properly aligned before tightening the screws.*

(23) Install E-clip and park control rod on manual lever assembly.

(24) Install oil filter.

(25) Measure throttle and line pressure settings. Refer to In-Vehicle Service and Adjustment—Valve Body—Hydraulic Control Pressure Adjustments. Correct settings as required.

NOTE: *If pressures were satisfactory before disassembly, do not change line or throttle pressure adjusting screw settings.*

Accumulator Piston and Spring—Inspection

Inspect the piston for nicks, burrs, scores, and wear. Be sure the rings turn freely in the piston grooves. Inspect the case bore for scores or other damage.

Inspect the spring for cracks or distortion. Replace damaged or worn parts.

Adapter Housing Bearing and Seal Replacement

(1) Remove seal from extension housing using screwdriver or punch.

(2) Remove snap rings and remove bearing from housing.

(3) Install replacement bearing in housing and install snap rings.

(4) Install replacement seal in housing. Seat seal flush with edge of seal bore in housing.

Park Lock Sprag

Disassembly

(1) Remove pivot shaft from adapter housing (fig. 2C-28).

(2) Remove park sprag and spring.

(3) Remove snap ring and reaction plug and pin assembly from housing.

Inspection

Inspect the pivot shaft for scores and free movement in the housing and sprag. Inspect the control rod and sprag springs for distortion and loss of tension. Inspect the sprag and gear for cracks and broken edges on the engagement lugs. Inspect the knob at the end of the control rod for excessive wear, nicks, burrs, and free turning.

If necessary, replace the park gear as outlined under Governor and Support—Disassembly and Assembly.

Assembly

(1) Install reaction plug and pin assembly in housing and install snap ring.

(2) Install sprag and spring in housing.

NOTE: *The square lug on the sprag must face the park gear.*

(3) Position spring so it moves sprag away from gear.

(4) Install pivot pin.

Governor

Disassembly

(1) Remove large snap ring from weight end of governor body (fig. 2C-27).

(2) Remove weight assembly.

(3) Remove snap ring from governor weight assembly.

(4) Separate inner weight, spring, and outer weight.

NOTE: *If park gear or governor body are to be replaced, straighten the lock tabs and remove the four attaching bolts.*

Inspection

Thoroughly clean and dry all governor parts and check for free movement. Do not use a caustic cleaning solution.

The weights and valve should fall freely in their bores when clean and dry. Rough surfaces and burrs may be polished with crocus cloth.

Inspect the governor weight spring for distortion.

Inspect the park gear and governor support for chipped or worn gear teeth and damaged ring grooves.

Clean the filter in solvent and air dry. Replace it if damaged or defective.

Assembly

(1) If governor body was separated from park gear, assemble parts and install attaching bolts finger-tight.

NOTE: *The bolts must not be tightened to specified torque until the assembly is installed on the output shaft.*

(2) Install governor weights and spring in outer weight, and install snap ring.

(3) Install weight assembly into body.

(4) Install snap ring.

Oil Pump and Reaction Shaft Support—Model 904/999

Disassembly

(1) Remove bolts attaching pump to support and remove support.

(2) Mark pump rotors with chalk for assembly reference.

(3) Remove rotors (fig. 2C-51).

(4) Remove O-ring seal using blunt punch.

(5) Remove front clutch seal rings from support.

Inspection

Inspect the front clutch seal ring grooves for burrs, nicks, or cracked edges. Inspect the front clutch retainer-to-reaction shaft support thrust washer for wear. The washer should be 0.043 to 0.045 inch (1.09 to 1.14 mm) thick. Inspect all machined surfaces on the pump housing and support for nicks and burrs. Inspect the pump body and reaction shaft support bushings for wear and scores. Inspect the pump rotors for scores or pits.

Install the pump rotors in the pump body. Place a straightedge across the rotor faces and pump body. Using a feeler gauge, measure the clearance between the straightedge and pump rotors. Clearance limits are 0.001 to 0.003 inch (0.02 to 0.07 mm) (fig. 2C-52).

Position the inner and outer rotors so that the center of one tooth on each rotor is aligned. Measure the clearance between the tips of the teeth. Make four measurements. Rotate the inner rotor approximately 1/4 turn (90°) between measurements. Rotor tip clearance should be 0.005 to 0.010 inch (0.13 to 0.25 mm) (View A, fig. 2C-53).

Measure the clearance between the outer surface of the outer rotor and the pump bore. The clearance should be 0.004 to 0.008 inch (0.10 to 0.20 mm) (View B, fig. 2C-49).

Pump Bushing Replacement

(1) Position pump housing, with reaction shaft support mating surface facing downward, on flat, level surface.

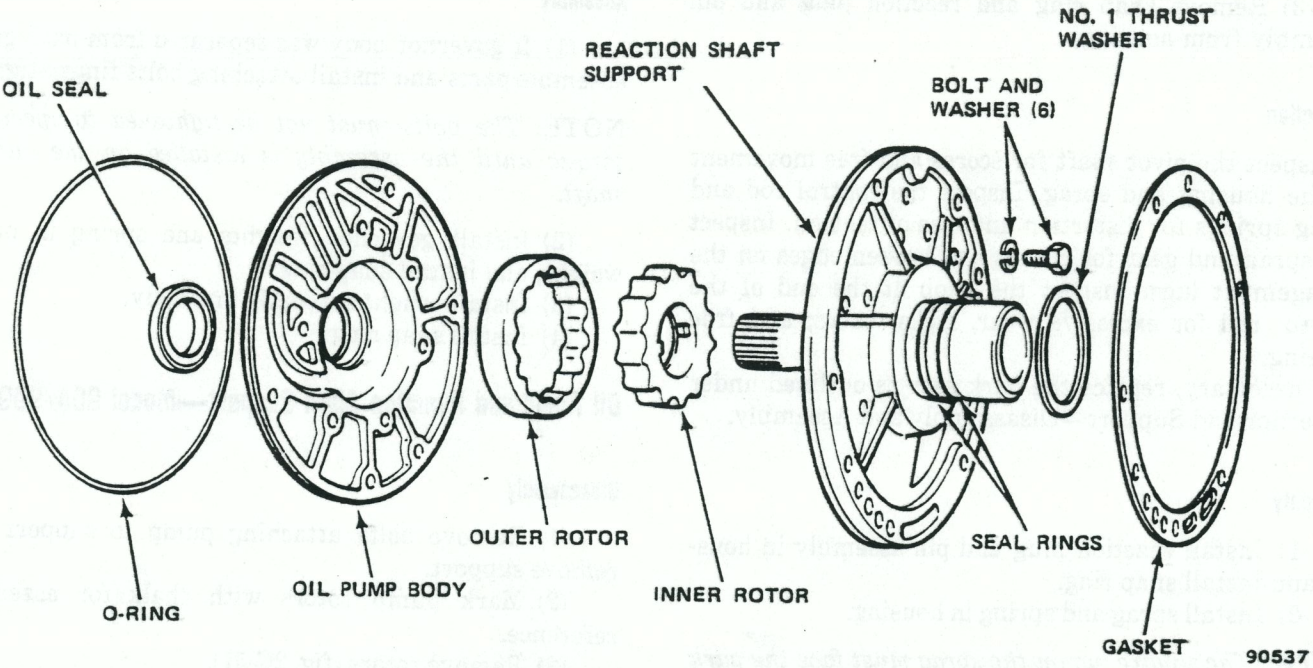

Fig. 2C-51 Oil Pump Assembly—Models 904/999

(2) Remove bushing using Remover and Installer Tool J-24049 and Driver Handle J-8092 (fig. 2C-54).

NOTE: *Be careful to keep the tool straight in the bore during removal.*

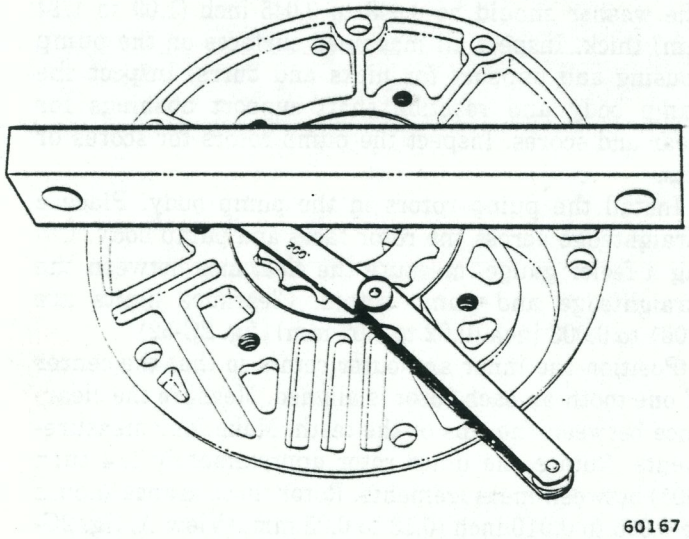

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Fig. 2C-52 Measuring Pump Rotor End Clearance—Model 904/999

(3) Position replacement bushing on Installer Tool J-24049.

(4) Turn pump housing over and install bushing straight into housing until edge of bushing is flush with bore (fig. 2C-55).

(5) Stake bushing in two places (to retain it) using blunt punch (fig. 2C-56).

(6) Use knife, with narrow blade only, to remove burrs or high points at stake points (fig. 2C-56). Do not use file or other tool that will remove more metal than is necessary.

Reaction Shaft Bushing Replacement

NOTE: *If the reaction shaft bushing requires replacement, be sure to inspect the support for wear at the input shaft and rear clutch retainer seal ring lands. If the lands are worn or grooved, replace the entire support assembly.*

CAUTION: *Do not clamp any part of the reaction shaft or support in a vise.*

(1) Thread Bushing Remover Tool J-24036 straight into bushing as far as possible by hand (fig. 2C-57).

(2) Using wrench, thread remover tool into bushing three or four additional turns to fully engage threads of tool in bushing.

(3) Install Slide Hammer Tools J-7004-3 and J-6585-1 in remover tool (fig. 2C-57).

(4) Bump outward with slide hammers to remove bushing.

(5) Clean chips from reaction shaft support assembly.

(6) Grip old bushing with pliers and remove it from Tool J-24036.

CAUTION: *Be sure to protect the remover tool threads when using the tool.*

(7) Thread Bushing Installer Tool J-24032 onto Driver Handle J-8092 (fig. 2C-58).

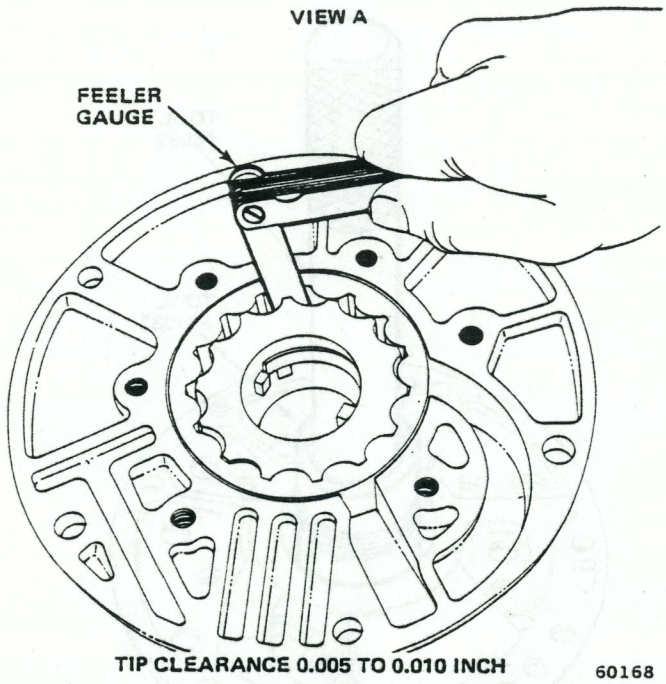

Fig. 2C-53 Measuring Rotor Clearance—Model 904/999

(8) Position replacement bushing on installer tool and install bushing straight into shaft bore until tool bottoms (fig. 2C-58).

(9) Clean reaction shaft support thoroughly after bushing installation.

Assembly

(1) Position pump housing on smooth flat surface and install pump rotors.

NOTE: *New rotors may be installed with either face up. Used rotors must be installed as removed. Refer to reference chalk marks made during disassembly.*

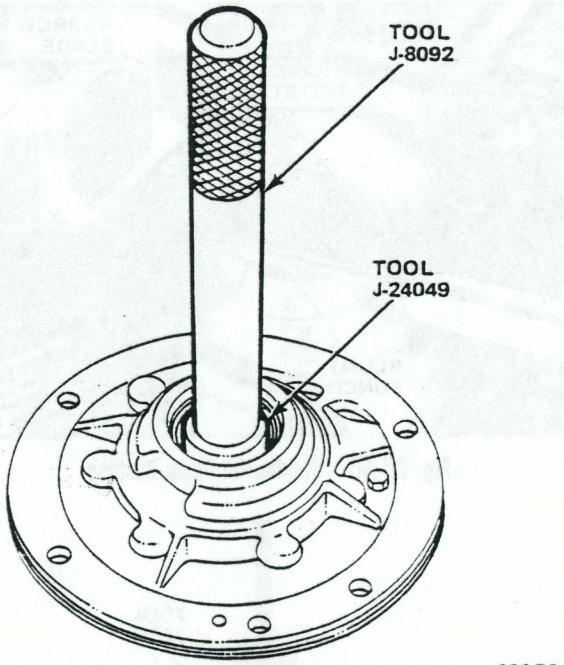

Fig. 2C-54 Pump Bushing Removal—Model 904/999

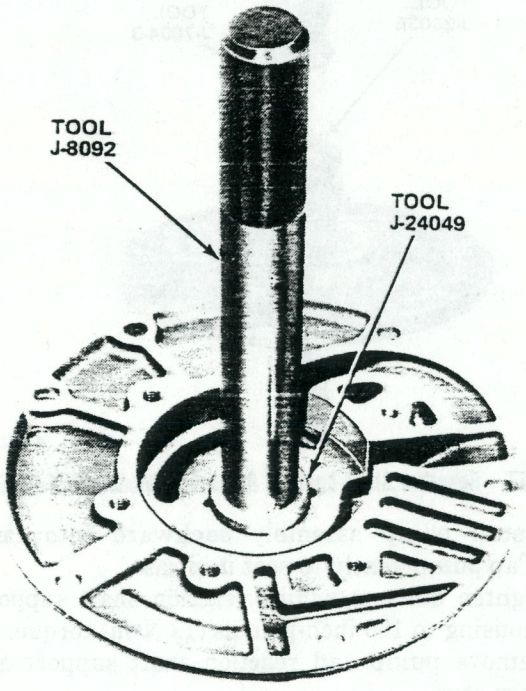

Fig. 2C-55 Pump Bushing Installation—Models 904/999

(2) Align and install reaction shaft support on pump housing and finger-tighten attaching bolt.

(3) Insert two Slide Hammers J-6585-1 and Bolts J-7004-3, from back to front, into threaded reaction shaft support holes (fig. 2C-59). Bolts should be threaded into support until ends of bolts are 1/16-inch (1.6 mm) below front machined surface of pump housing.

(4) Install one Pilot Stud Tool J-3387-2 into case pump opening (fig. 2C-60).

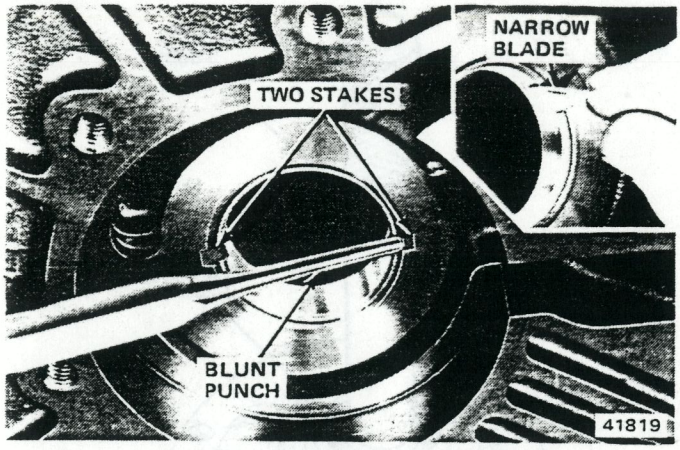

Fig. 2C-56 Staking Oil Pump Bushing

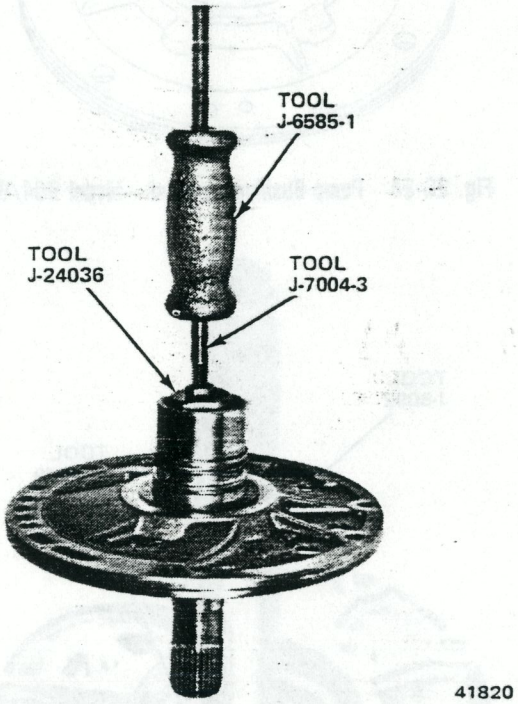

Fig. 2C-57 Reaction Shaft Bushing Removal—Models 904/999

(5) Install pump assembly **backward** into case opening. Tap pump gently to seat it in case.

(6) Tighten bolts attaching reaction shaft support to pump housing to 160 inch-pounds (19 N•m) torque.

(7) Remove pump and reaction shaft support assembly from case.

(8) Remove slide hammer tools from pump.

(9) Position oil seal in pump housing with seal lip facing inward.

(10) Install seal using Installer Tool J-9617. Install seal into housing until tool bottoms.

Disassembly

(1) Remove pump-to-support attaching bolts and remove support from pump (fig. 2C-61).

(2) Mark rotors with chalk for assembly alignment reference.

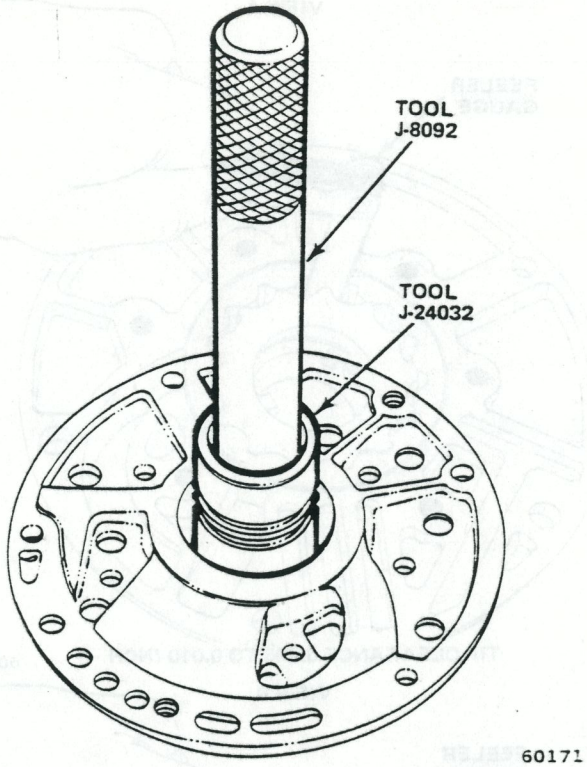

Fig. 2C-58 Reaction Shaft Bushing Installation—Model 904/999

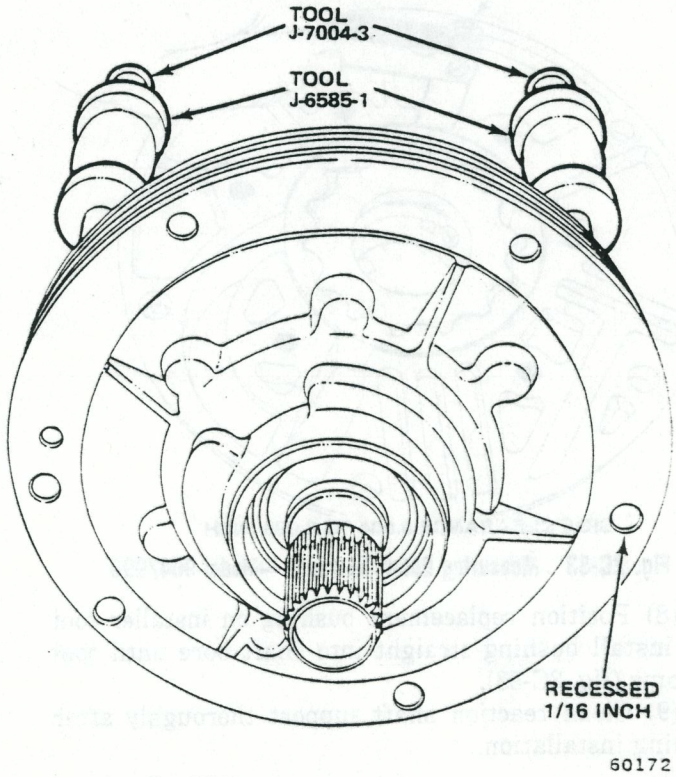

Fig. 2C-59 Installing Slide Hammer Bolts

(3) Remove rotors

(4) Remove O-ring seal.

(5) Remove O-ring seal from pump body flange.

(6) Remove front oil seal using blunt punch.

(7) Remove front clutch seal rings from support.

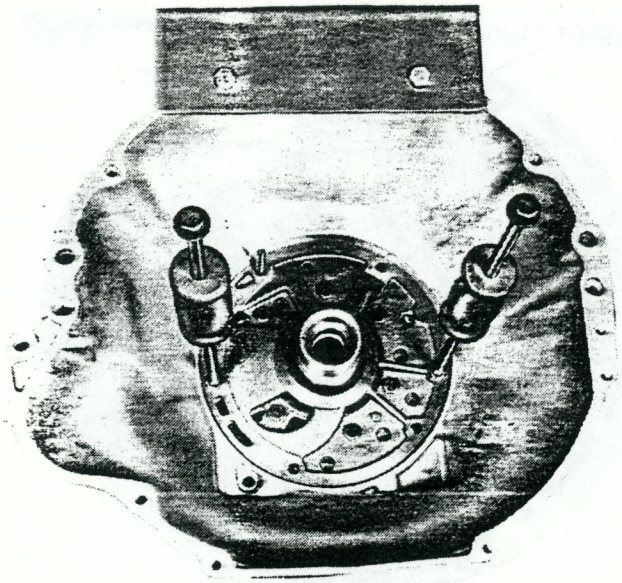

Fig. 2C-60 Pump Alignment—Model 904/999

Oil Pump and Reaction Shaft Support—Model 727

Inspection

Inspect the front clutch seal ring grooves for burrs, nicks, or cracked edges. Inspect all machined surfaces on the pump housing for nicks and burrs. Inspect the pump body and reaction shaft support bushings for wear and scores. Inspect the pump rotors for scores and pits.

Install the pump rotors in the pump body. Position a straightedge across the rotor faces and pump body and use a feeler gauge to measure the clearance between the straightedge and rotors. Clearance limits are 0.001 to 0.003 inch (0.02 to 0.07 mm) (fig. 2C-62).

Position the inner and outer rotors so that the center of one tooth on each rotor is aligned and measure the clearance between the tips of the teeth. Make four measurements. Rotate the inner rotor approximately 1/4 turn (90°) between measurements. Rotor tip clearance should be 0.005 to 0.010 inch (0.13 to 0.20 mm) (View A, fig. 2C-63).

Measure the clearance between the outer surface of the outer rotor and the pump bore. Clearance should be 0.004 to 0.008 inch (0.10 to 0.20 mm) (View B, fig. 2C-63).

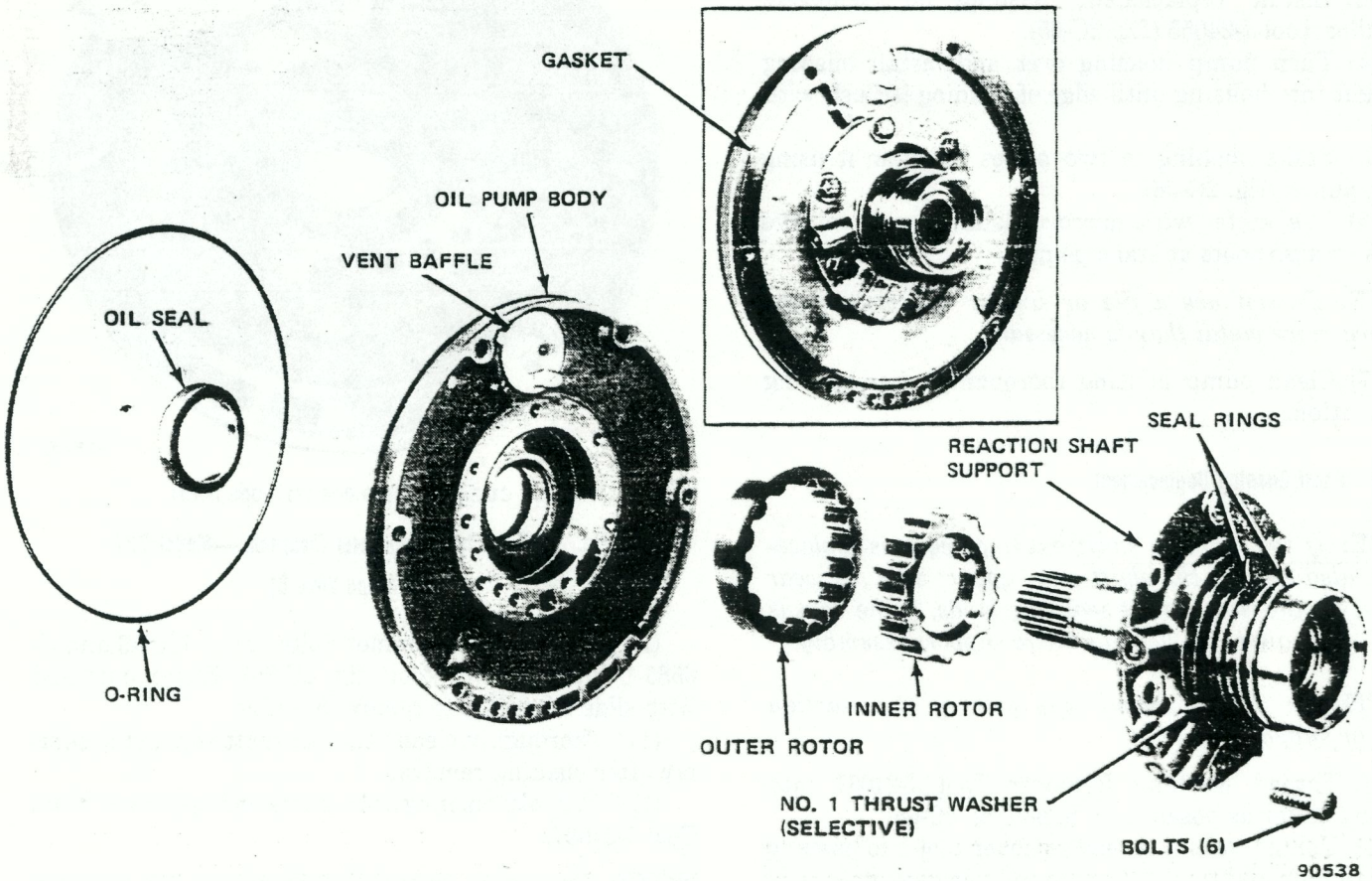

Fig. 2C-61 Oil Pump Assembly—Model 727

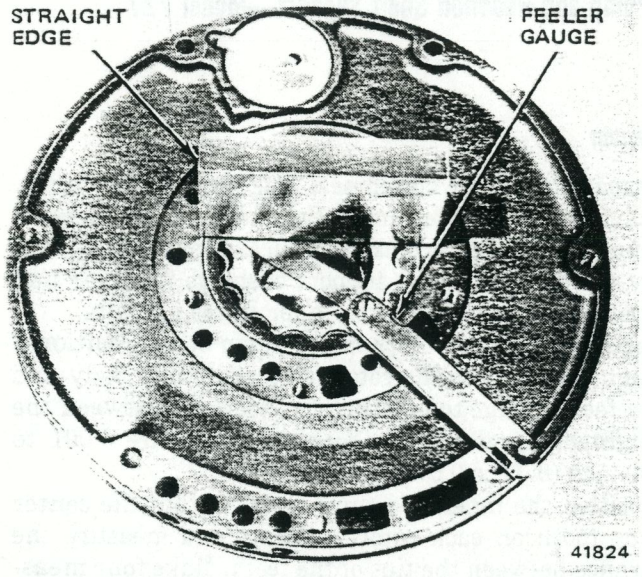

Fig. 2C-62 Measuring Rotor End Clearance—Model 727

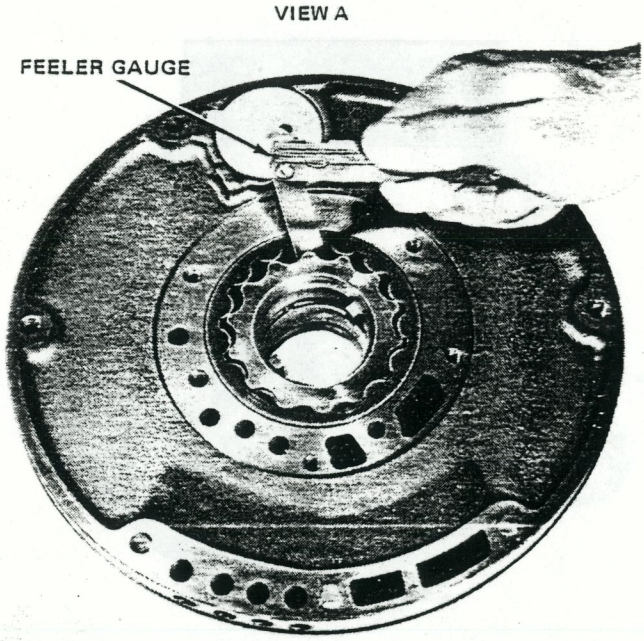

Fig. 2C-63 Measuring Rotor Clearance—Model 727 (View A and View B)

Pump Bushing Replacement

(1) Place pump housing, with reaction shaft support mating surface facing downward, on flat, level surface.

(2) Remove bushing using Remover/Installer Tool J-24055 and Driver Handle J-8092 (fig. 2C-64).

(3) Install replacement bushing on Remover/Installer Tool J-24055 (fig. 2C-65).

(4) Turn pump housing over and install bushing straight into housing until edge of bushing is flush with bore.

(5) Stake bushing in two places to retain it using blunt punch (fig. 2C-56).

(6) Use knife, with narrow blade only, to remove burrs or high spots at stake points.

NOTE: *Do not use a file or similar tool that might remove more metal than is necessary.*

(7) Clean pump housing thoroughly after bushing installation.

Reaction Shaft Bushing Replacement

NOTE: *If the reaction shaft bushing requires replacement, also inspect the shaft and support bore for wear caused by the input shaft seal ring lands. If the bore is worn or grooved, replace the entire support assembly.*

CAUTION: *Do not clamp any part of the reaction shaft or support in a vise.*

(8) Thread Bushing Remover Tool J-24037 into bushing as far as possible by hand (fig. 2C-66).

(9) Using wrench, thread remover tool into bushing three to four additional turns to fully engage threads of tool in bushing.

(10) Install Slide Hammer Bolts Tool J-7004-3 and J-6585-1 into remover tool (fig. 2C-66). Bump outward with slide hammers to remove bushing.

(11) Thoroughly clean reaction shaft support assembly after bushing removal.

(12) Grip old bushing with pliers and remove it from Tool J-24037.

NOTE: *Be sure to protect the threads on the remover tool when using the tool.*

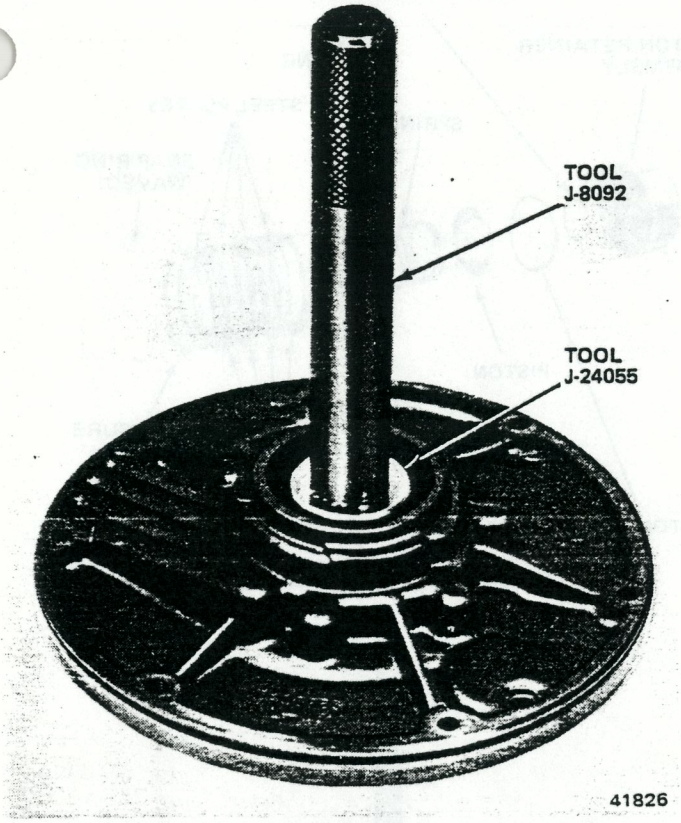

Fig. 2C-64 Pump Bushing Removal—Model 727

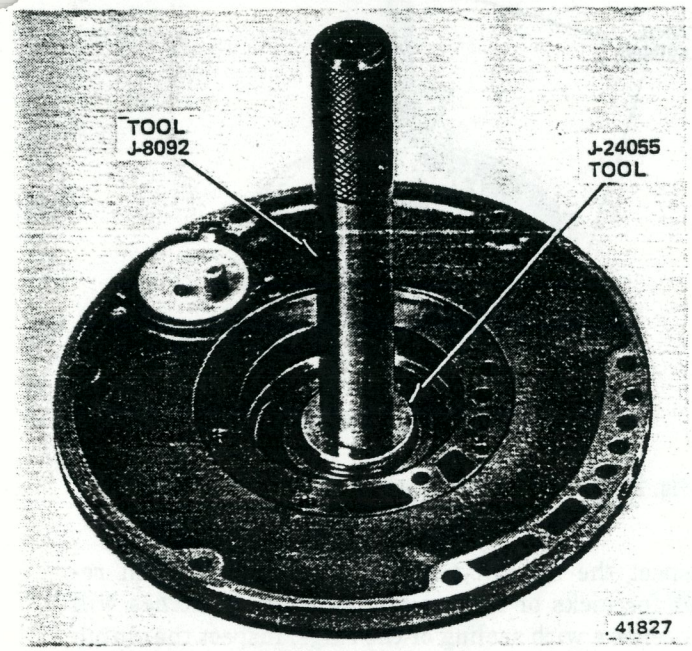

Fig. 2C-65 Pump Bushing Installation—Model 727

(13) Thread Bushing Installer Tool J-24038 onto Driver Handle J-8092 (fig. 2C-67).

(14) Position replacement bushing on installer tool and install bushing straight into shaft bore until tool bottoms.

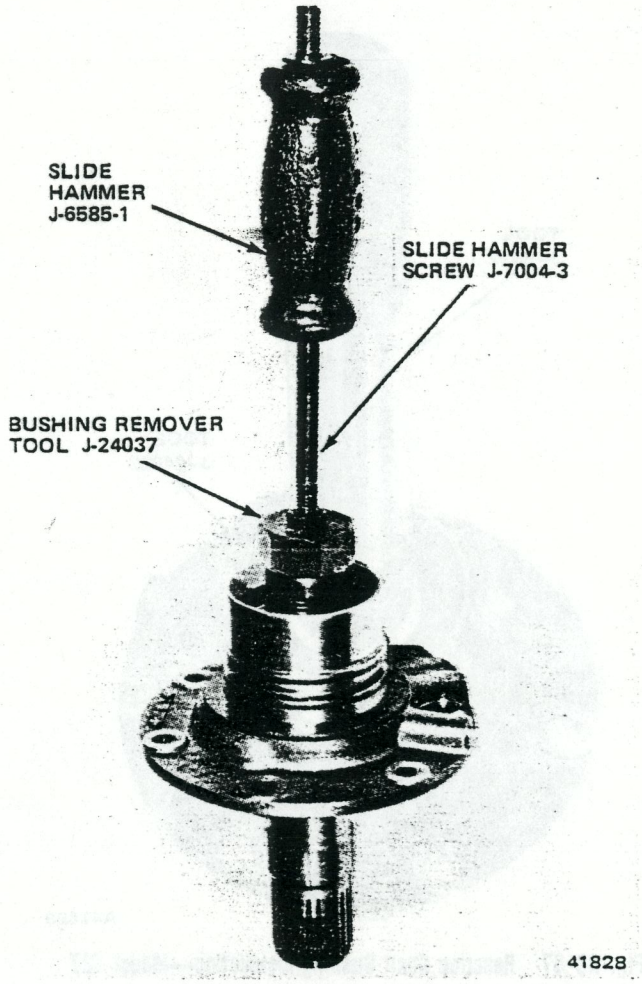

Fig. 2C-66 Reaction Shaft Bushing Removal—Model 727

Assembly

(1) Install pump rotors in housing.

(2) Install reaction shaft support and tighten attaching bolts to 160 inch-pounds (18 N•m) torque.

(3) Install O-ring seal around pump housing flange.

(4) Install oil seal pump housing with seal lip facing inward.

(5) Install oil seal on Installer Tool J-21005. Install seal straight into housing until tool bottoms.

(6) Thoroughly clean reaction shaft support assembly.

Front Clutch—Model 904/999

Disassembly

(1) Remove large waved snap ring which secures pressure plate in clutch retainer (fig. 2C-68).

(2) Install Spring Compressor Tool J-5886-01 over piston spring retainer (fig. 2C-69).

(3) Compress piston springs and remove snap ring.

(4) Release compressor tool slowly until spring retainer is free of hub.

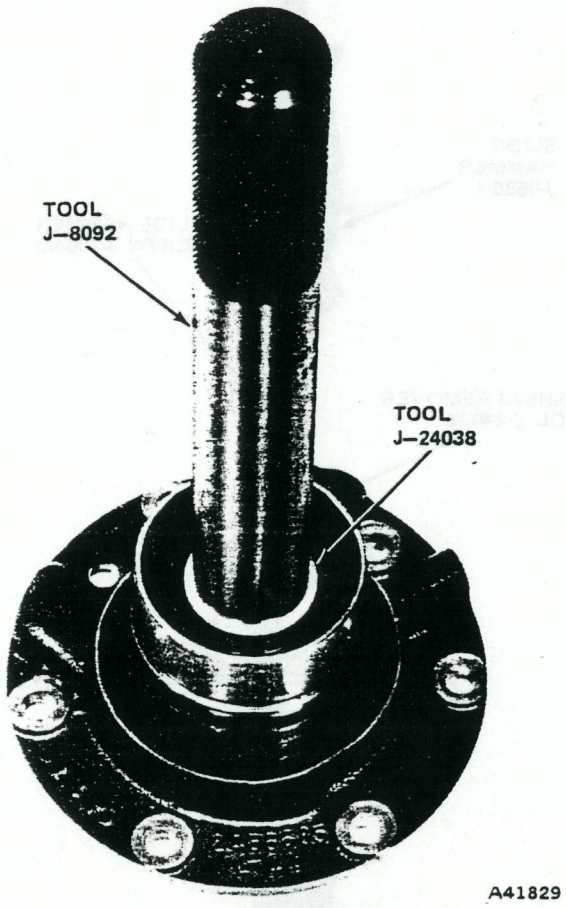

Fig. 2C-67 Reaction Shaft Bushing Installation—Model 727

NOTE: *When releasing the compressor tool, do not allow the spring retainer to stick or bind in the snap ring groove.*

(5) Remove tool, retainer and spring.

(6) Turn clutch retainer over and bump on wood block to dislodge and remove piston.

(7) Remove seal rings from piston and clutch retainer hub.

Inspection

Inspect the friction material on all driving discs. Replace discs that are charred, glazed, heavily pitted, flaking or if the friction material can be scraped off easily.

Inspect the steel plates and pressure plate surfaces for overheating, scoring, and for damaged driving lugs. Replace any worn, damaged parts.

Inspect the steel plate lug grooves in the clutch retainer for smooth surfaces. The plates must slide freely in the grooves.

Inspect the band application surface on the clutch retainer for nicks and scores. Light scratches and nicks can be removed with crocus cloth.

Inspect the ball check in the clutch retainer. The ball should move freely in its cage.

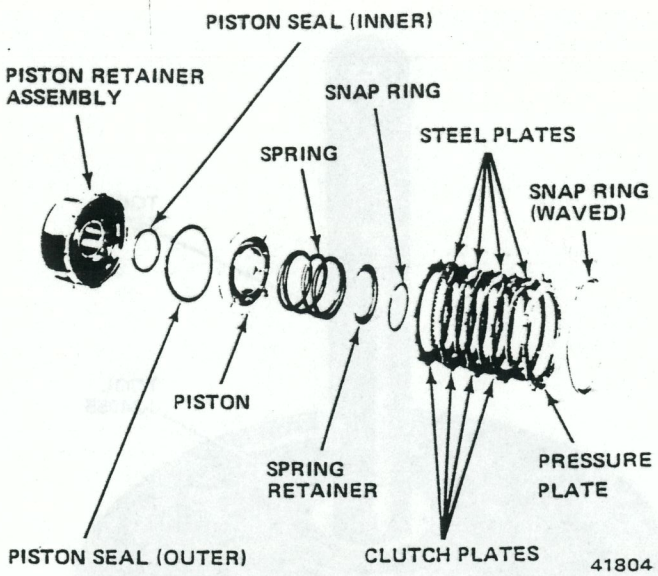

Fig. 2C-68 Front Clutch Assembly—Model 904/999

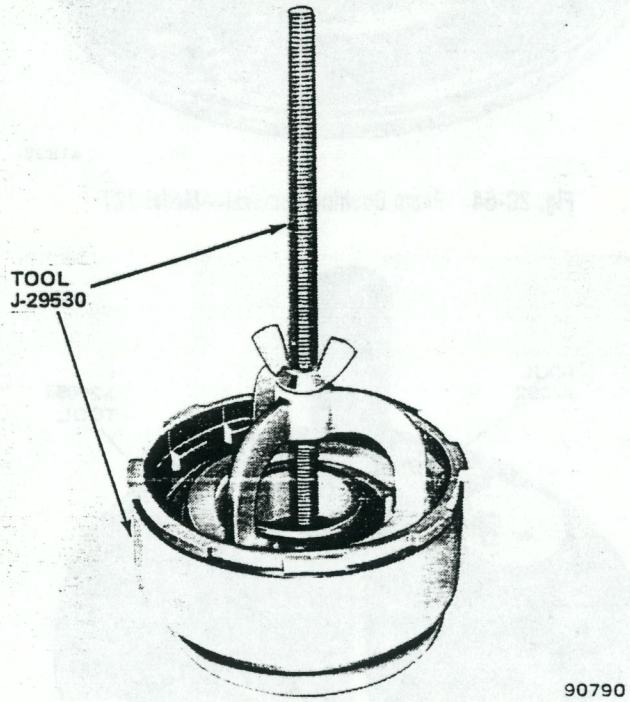

Fig. 2C-69 Front Clutch Snap Ring Removal/Installation—Model 904/999

Inspect the seal ring surfaces inside the clutch retainer for nicks or deep scratches. Light scratches will not interfere with sealing of the rings. Inspect the clutch retainer bushing for scores and wear and inspect the inner bore surface for wear and inspect the inner bore surface for wear from the reaction shaft support seal rings and lands.

Inspect the inside of the piston bore for score marks. Remove light scores with crocus cloth. Inspect the seal ring grooves for nicks and burrs. Inspect the piston spring, retainer, and snap ring for distortion.

Retainer Bushing Replacement

(1) Place clutch retainer, with open end facing down, on a clean, smooth surface.

(2) Insert Bushing Remover/Installer Tool J-24064 in bushing (fig. 2C-70).

(3) Install Driver Handle J-8092 in remover tool and drive bushing straight down and out of retainer bore.

(4) Position clutch retainer so open end faces upward.

(5) Install replacement bushing on tool and install bushing straight into retainer bore until bushing is flush with base of bore chamfer (fig. 2C-71).

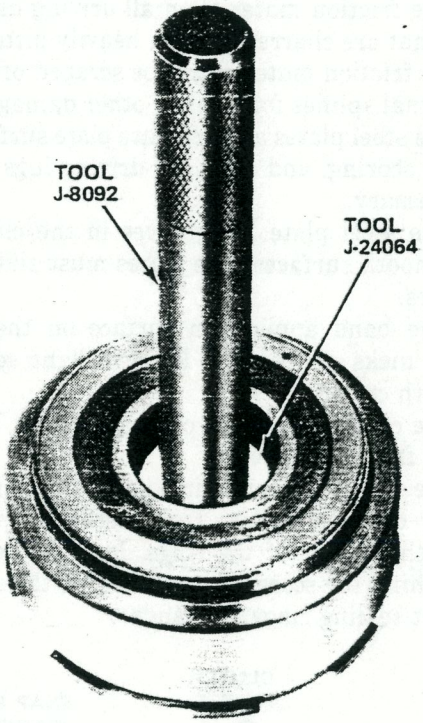

Fig. 2C-70 Clutch Retainer Bushing Removal—Model 904/999

Assembly

(1) Lubricate inner seal with petroleum jelly and install seal on hub of clutch retainer.

NOTE: *Be sure the seal lip is facing into the piston bore and that the seal is properly seated in the retainer groove.*

(2) Lubricate outer seal with petroleum jelly and install it on clutch piston so seal lip faces into piston bore.

(3) Install piston assembly in retainer using a twisting motion to seat piston at bottom of bore.

(4) Install spring on piston hub and spring retainer.

(5) Install snap ring over spring.

(6) Install Spring Compressor Tool J-5886-01 over retainer assembly.

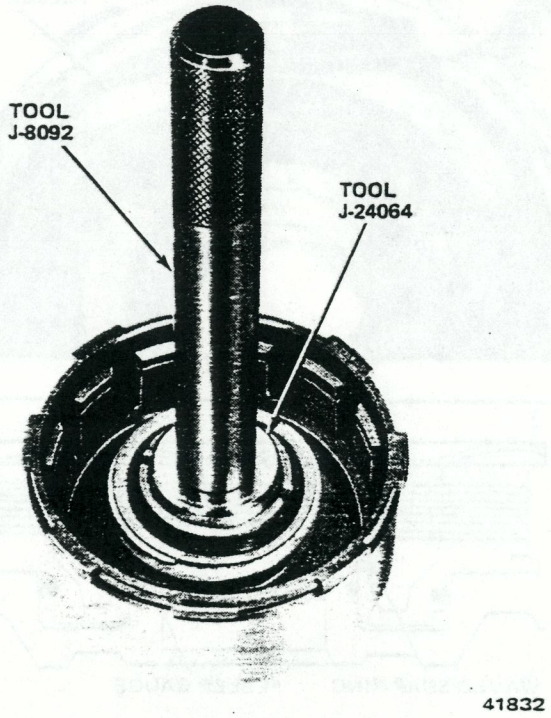

Fig. 2C-71 Clutch Retainer Bushing Installation—Model 904/999

(7) Compress spring and seat snap ring in clutch hub groove.

(8) Remove compressor tool.

(9) Lubricate clutch plates and discs with transmission fluid.

(10) Install one steel plate followed by a lined plate until proper number of plates are installed.

(11) Install pressure plate and waved snap ring.

NOTE: *Be sure snap ring is completely seated in groove.*

(12) Measure clutch pack clearance using feeler gauge.

(13) Insert gauge between pressure plate and snap ring (fig. 2C-72). Refer to Clutch Plate Clearance in Specifications for tolerances.

(14) If clutch plate clearance is not within specifications, disassemble clutch pack and measure thickness of line plate, steel plates and pressure plate. Thickness should be as follows:

Lined Plate ..... 0.083 to 0.088 inch (2.11 to 2.24 mm)
Steel Plate..... 0.066 to 0.071 inch (1.68 to 1.80 mm)
Pressure Plate ..... 0.214 to 0.218 inch (5.44 to 5.54 mm)

Any component not meeting the listed thickness specification must be replaced in order to obtain the correct clutch pack clearance.

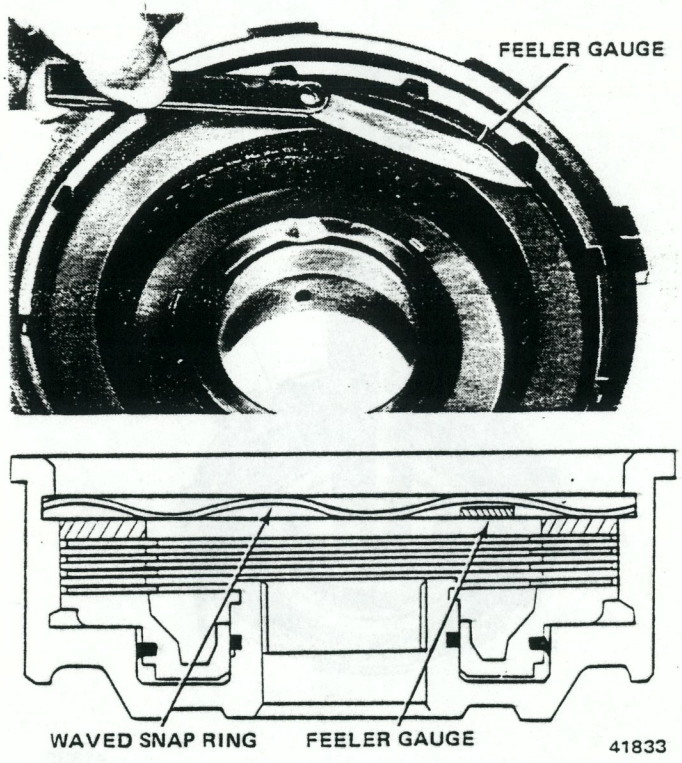

Fig. 2C-72 Measuring Front Clutch Pack Clearance

Front Clutch—Model 727

Disassembly

(1) Remove large waved snap ring that retains pressure plate in clutch piston retainer (fig. 2C-73).

(2) Remove pressure plate and clutch plates.

(3) Install Compressor Tool J-24042 over piston spring retainer (fig. 2C-74).

(4) Compress springs and remove snap ring.

(5) Slowly release compressor tool until spring retainer is free of hub.

NOTE: *Do not allow the spring retainer to stick or bind in the snap ring groove.*

(6) Remove compressor tool, retainer and springs.

(7) Turn clutch retainer over and bump on wood block to dislodge and remove piston.

(8) Remove seals from piston and retainer hub.

Inspection

Inspect the friction material on all driving discs. Replace discs that are charred, glazed, heavily pitted, flaking, or if the friction material can be scraped off easily. Inspect internal splines for wear or other damage.

Inspect the steel plates and pressure plate surfaces for overheating, scoring, and damaged driving lugs and replace as necessary.

Inspect the steel plate lug grooves in the clutch retainer for smooth surfaces. The plates must slide freely in the grooves.

Inspect the band application surface on the clutch retainer for nicks and scores. Remove light scratches and nicks with crocus cloth.

Inspect the check ball in the clutch retainer. The ball should move freely in its cage.

Inspect the seal ring surface inside the clutch retainer for nicks or deep scratches. Light scratches will not interfere with sealing of the rings. Inspect the clutch retainer bushing for scores and wear from the reaction shaft support sealing rings and lands.

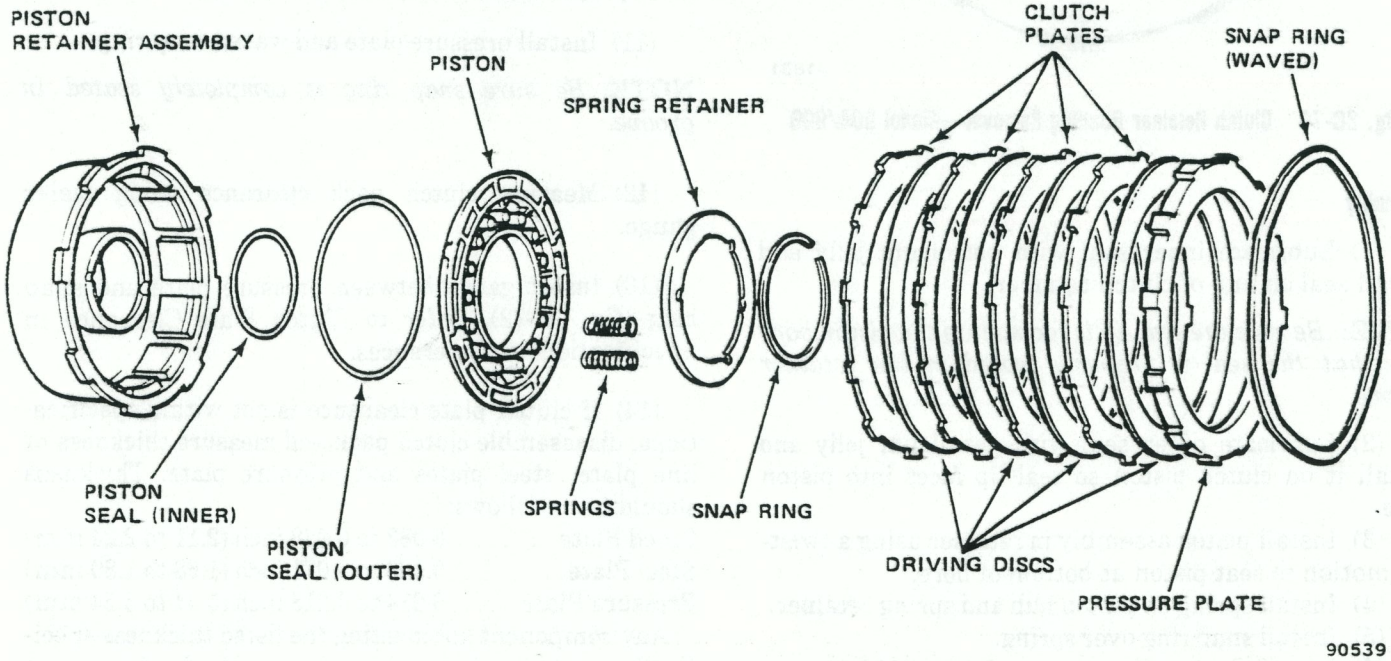

Fig. 2C-73 Front Clutch Assembly—Model 727

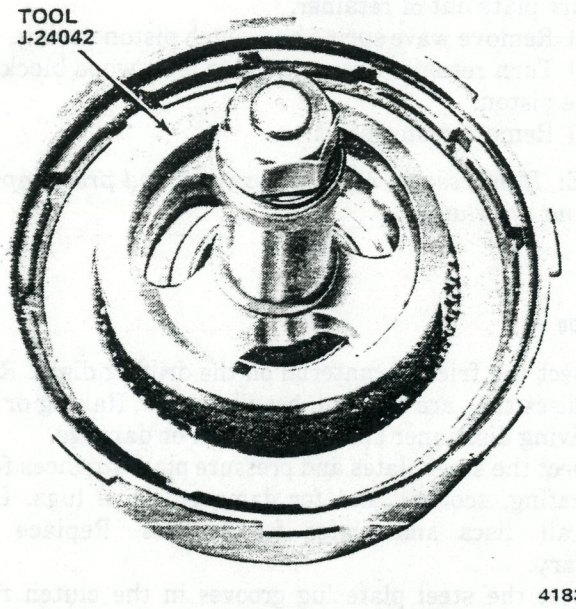

Fig. 2C-74 Front Clutch Spring Retainer Removal/Installation—Model 727

Inspect the inner bore of the piston for score marks. Remove light scores with crocus cloth. Inspect the seal ring grooves for nicks and burrs. Inspect the piston springs, retainer, and snap ring for distortion.

Retainer Bushing Replacement

(1) Place clutch retainer, with open end facing downward, on clean, smooth surface.

(2) Insert Bushing Remover/Installer Tool J-24309 in bushing (fig. 2C-75).

(3) Install Drive Handle J-8092 in tool and tap bushing straight down and out of bore.

(4) Position clutch retainer so open end faces upward.

(5) Install replacement bushing on Tool J-24039 and install bushing straight into retainer bore until bushing is flush with base of bore chamfer (fig. 2C-76).

Assembly

(1) Lubricate inner seal with petroleum jelly and install it on hub of clutch retainer.

NOTE: *Be sure the seal lip faces into the piston bore and is properly seated in the seal groove.*

(2) Lubricate outer seal with petroleum jelly and install it on clutch piston with seal lip facing into piston bore.

(3) Install piston assembly in retainer and carefully seat piston at bottom of retainer bore.

(4) Install clutch piston springs on piston (fig. 2C-77). Install nine or eleven springs in clutch (according to original number in clutch).

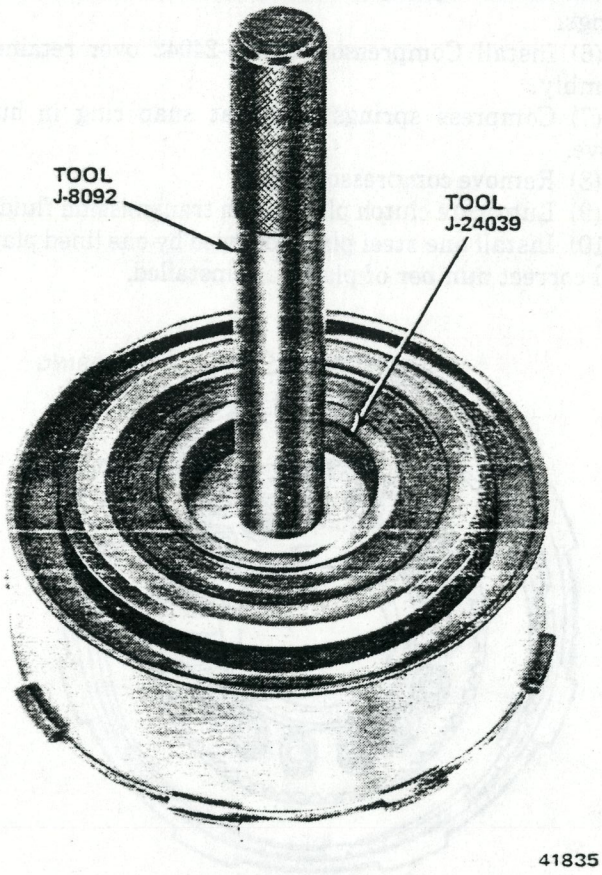

Fig. 2C-75 Front Clutch Retainer Bushing Removal—Model 727

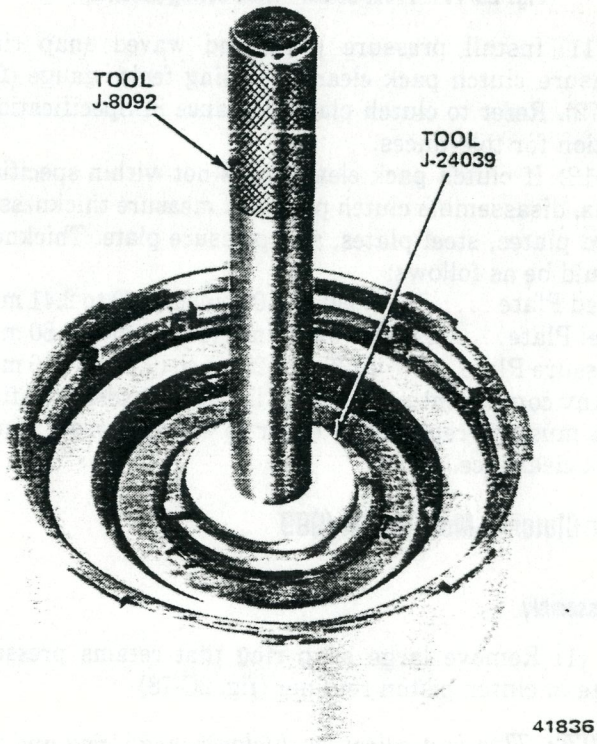

Fig. 2C-76 Front Clutch Retainer Bushing Installation—Model 727

(5) Install spring retainer and snap ring over springs.

(6) Install Compressor Tool J-24042 over retainer assembly.

(7) Compress springs and seat snap ring in hub groove.

(8) Remove compressor tool.

(9) Lubricate clutch plates with transmission fluid.

(10) Install one steel plate followed by one lined plate until correct number of plates are installed.

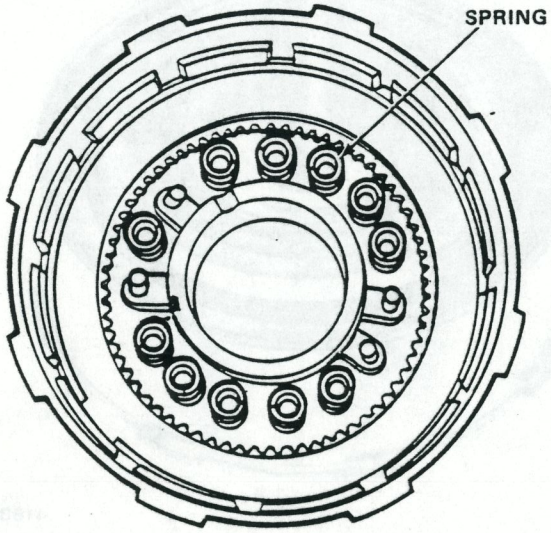

Fig. 2C-77 Front Clutch Piston Spring Location

(11) Install pressure plate and waved snap ring. Measure clutch pack clearance using feeler gauge (fig. 2C-72). Refer to clutch plate clearance in Specifications section for tolerances.

(12) If clutch pack clearance is not within specifications, disassemble clutch pack and measure thickness of lined plates, steel plates, and pressure plate. Thickness should be as follows:

Lined Plate . . . . . 0.090 to 0.095 inch (2.29 to 2.41 mm)
Steel Plate . . . . . 0.060 to 0.071 inch (1.52 mm to 1.80 mm)
Pressure Plate . . . . . 0.278 to 0.282 inch (7.06 to 7.16 mm)

Any component not meeting listed thickness specification must be replaced in order to obtain correct clutch pack clearance.

Rear Clutch—Models 904/999

Disassembly

(1) Remove large snap ring that retains pressure plate in clutch piston retainer (fig. 2C-78).

NOTE: *This is a selective thickness snap ring and determines clutch pack clearance.*

(2) Lift pressure plate, clutch plates, and inner pressure plate out of retainer.

(3) Remove wave spring and clutch piston spring.

(4) Turn retainer over and bump it on wood block to remove piston.

(5) Remove piston seals.

NOTE: *If necessary, remove snap ring and press input shaft out of retainer.*

Inspection

Inspect the friction material on the driving discs. Replace discs that are charred, heavily pitted, flaking or if the driving disc inner splines are worn or damage.

Inspect the steel plates and pressure plate surfaces for overheating, scoring, and for damaged drive lugs. Inspect all discs and plates for flatness. Replace if necessary.

Inspect the steel plate lug grooves in the clutch retainer for smooth surfaces. The plates must slide freely in these grooves. Inspect the clutch piston ball check. The ball should move freely in its cage. Inspect the seal ring surfaces in the clutch retainer for nicks or deep scratches. Light scratches will not interfere with sealing. Inspect the piston spring and wave spring for distortion or breakage.

Inspect the seal ring grooves in the input shaft and piston retainer for nicks, burrs, and wear.

Inspect the rear clutch to front clutch thrust washer. The washer should be 0.043 to 0.045 inch (1.09 to 1.14 mm) thick.

Assembly

(1) Press input shaft into piston retainer (if removed) and install snap ring.

(2) Lubricate and install inner and outer seal rings on clutch piston.

NOTE: *Be sure that the lips of the seals face into the retainer bore and that the seals are properly seated in the piston grooves.*

(3) Install piston assembly into retainer using a twisting motion to seat piston at bottom of retainer bore. Install piston spring in retainer with spring fingers touching piston and with spring centered in retainer.

(4) Install one end of wave spring into retainer groove (fig. 2C-79) and progressively push or tap spring into place until completely seated. If necessary, lightly tap piston spring to keep it centered.

(5) Install inner pressure plate. Raised side of plate should rest on piston spring and flat surface should face open end of retainer.

(6) Lubricate clutch plates with transmission fluid.

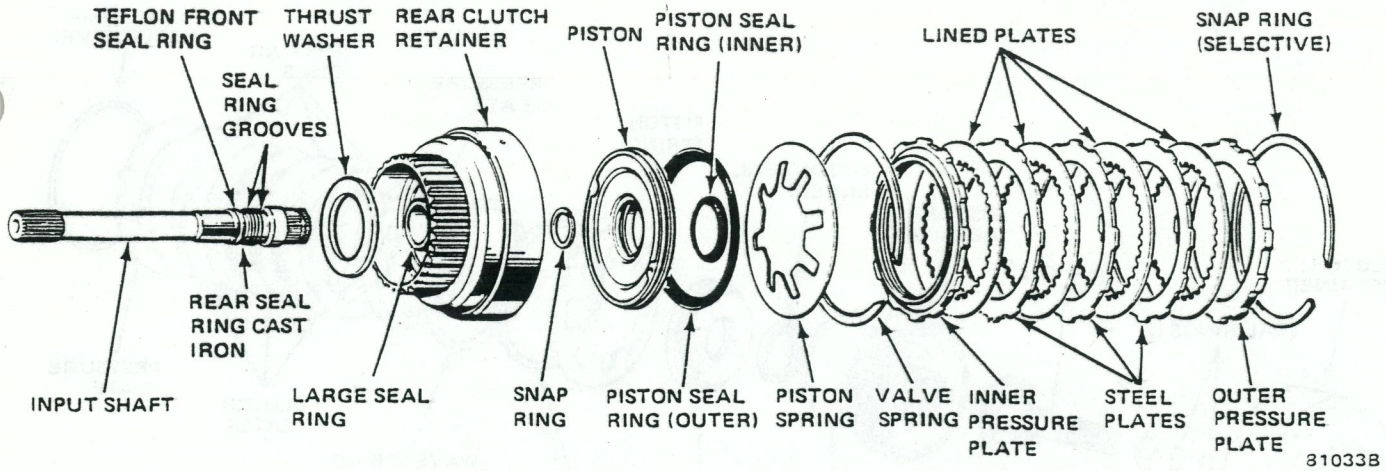

Fig. 2C-78 Rear Clutch Assembly—Models 904/999

(7) Install a lined plate first and follow with a steel plate and a lined plate until correct number of plates are installed.

(8) Install outer pressure plate and selective thickness snap ring.

(9) Measure rear clutch pack clearance. Press down firmly on outer pressure plate and insert feeler gauge between pressure plate and selective snap ring (fig. 2C-80).

(10) If necessary, adjust clearance using one of the following selective thickness outer snap rings. Snap rings are available in 0.060, 0.076 and 0.098-inch (1.52, 1.93 and 2.49 mm) thicknesses. Low limit clearance is desirable.

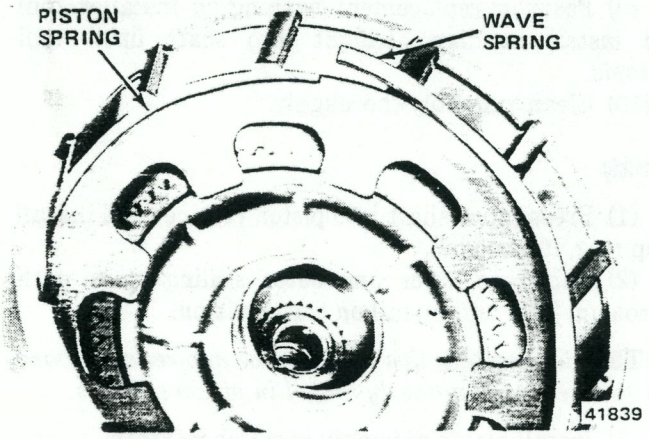

Fig. 2C-79 Piston Spring and Wave Spring Installation

NOTE: *Rear clutch pack clearance is very important in obtaining proper clutch engagement and shift quality.*

Rear Clutch—Model 727

Disassembly

(1) Remove large snap ring that retains pressure plate in clutch piston retainer (fig. 2C-81).

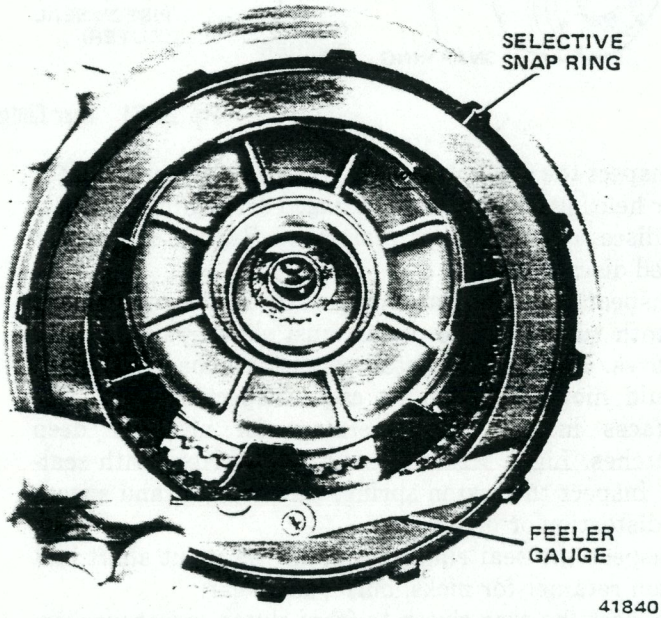

Fig. 2C-80 Measuring Rear Clutch Pack Clearance

NOTE: *This is a selective thickness snap ring and determines clutch pack clearance.*

(2) Remove pressure plate, clutch plates, and inner pressure plate.

(3) Remove wave spring, spacer ring, and clutch piston spring.

(4) Turn retainer over and bump on wood block to remove piston.

(5) Remove piston inner and outer seals.

(6) Remove input shaft snap ring and press input shaft out of retainer, if necessary.

Inspection

Inspect friction material on driving discs. Replace discs that are charred, glazed, heavily pitted, flaking or if the friction material can be scraped off easily. Inspect the driving disc inner splines for wear or other damage.

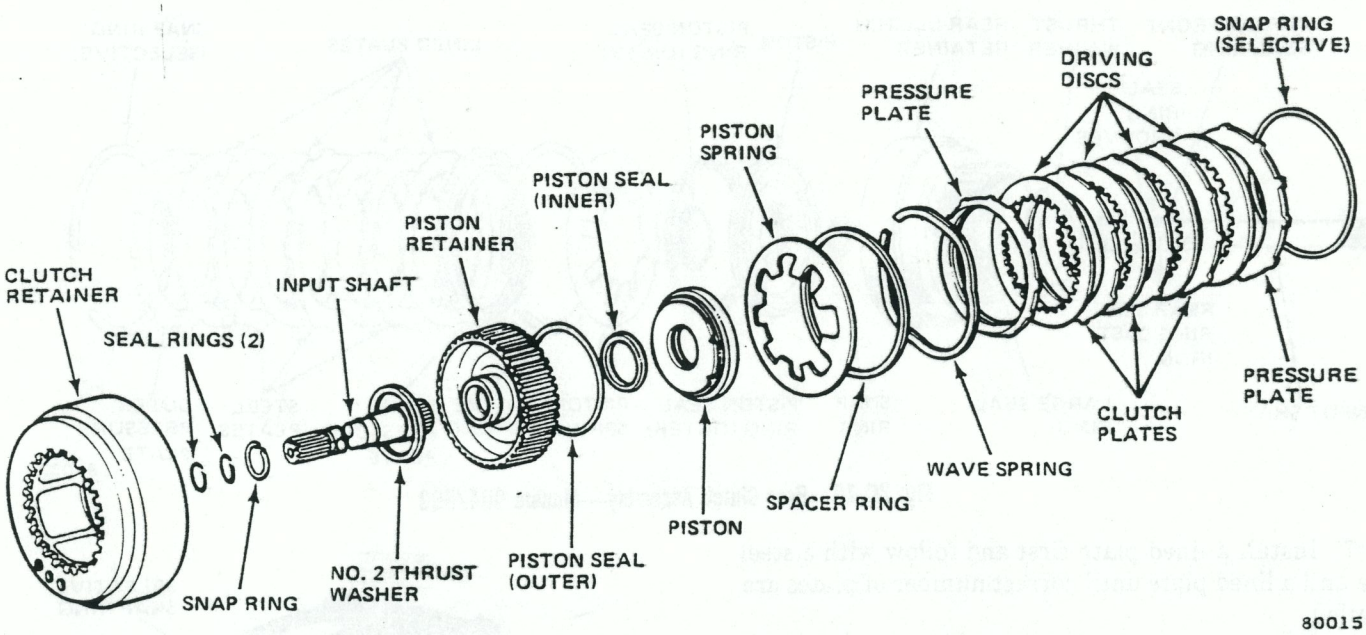

Fig. 2C-81 Rear Clutch Assembly—Model 727

Inspect the steel plates and pressure plate surfaces for over heating, scoring, and damaged driving lugs. Inspect all discs and plates for distortion. Replace warped or coned discs or plates.

Inspect the steel plate lug grooves in the retainer for smooth surfaces. The plates must slide freely in these grooves. Inspect the clutch piston ball check. The ball should move freely in its cage. Inspect the seal ring surfaces in the clutch retainer for nicks or deep scratches. Light scratches will not interfere with sealing. Inspect the piston spring, wave spring, and spacer for distortion or breakage.

Inspect the seal ring grooves in the input shaft and piston retainer for nicks, burrs, and wear.

Inspect the rear clutch to front clutch thrust washer. The washer should be 0.061 to 0.063-inches (1.55 to 1.60 mm) thick.

Input Shaft Bushing Replacement

(1) Clamp input shaft in a vise using brass protective jaws.

CAUTION: *Do not clamp the seal ring land or bearing journal.*

(2) Thread Bushing Remover Tool J-24041 straight into bushing as far as possible by hand.

(3) Using wrench, thread puller into bushing three to four additional turns to fully engage puller threads in bushing.

(4) Thread Slide Hammer Bolts Tool J-7004-3 into puller (fig. 2C-82).

(5) Bump outward with slide hammers to remove bushing.

(6) Thoroughly clean input shaft and remove chips generated by bushing removal.

(7) Grip old bushing with pliers and remove it from tool.

NOTE: *Be careful to protect the remover tool threads when using the tool.*

(8) Thread Bushing Installer Tool J-24040 onto Driver Handle J-8092 (fig. 2C-83).

(9) Position replacement bushing on installer tool and install bushing straight into shaft until tool bottoms.

(10) Clean assembly thoroughly.

Assembly

(1) Press input shaft into piston retainer and install snap ring, if removed.

(2) Lubricate inner and outer sealing rings with petroleum jelly and install on clutch piston.

NOTE: *Be sure that lips of seals face into retainer bore and that seals are properly seated in piston grooves.*

(3) Install piston assembly in clutch retainer.

(4) Seat piston at bottom of retainer bore using a twisting motion.

(5) Position clutch retainer over piston retainer splines. Support assembly to maintain position of clutch retainer.

(6) Install piston spring in clutch retainer with spring fingers touching piston.

(7) Install spacer ring. Be sure piston spring and ring are centered in retainer recess.

(8) Install one end of wave spring in retainer groove. Progressively push or tap spring into plate until completely seated.

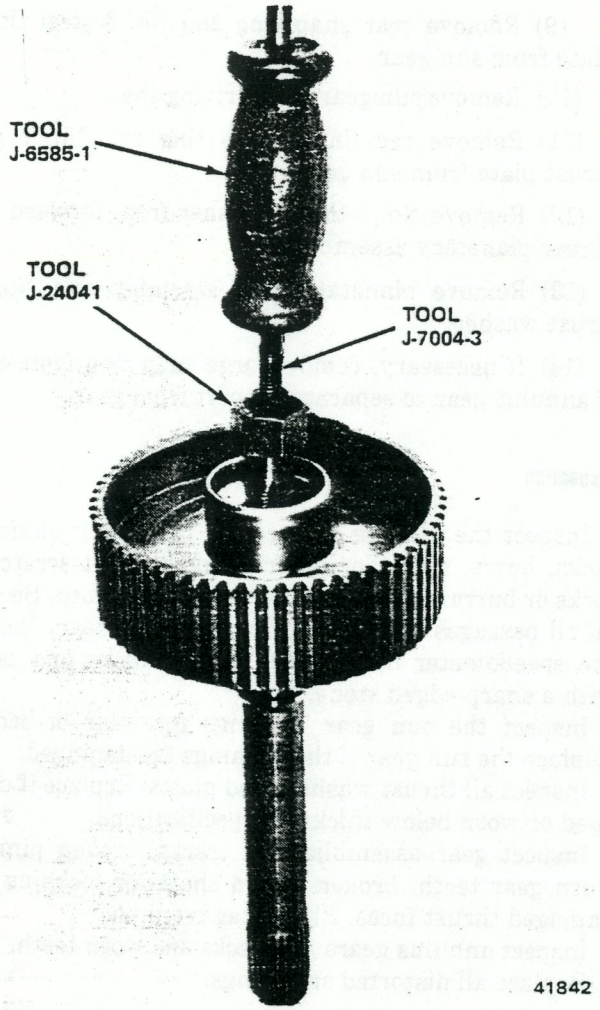

Fig. 2C-82 Input Shaft Bushing Removal—Model 727

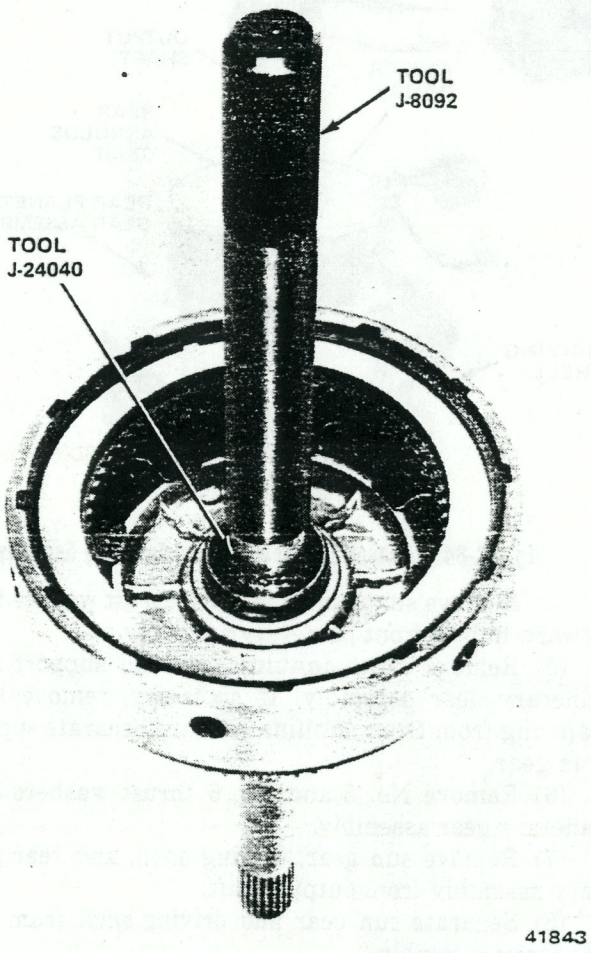

Fig. 2C-83 Input Shaft Bushing Installation—Model 727

NOTE: *If necessary, gently tap the piston spring and spacer to keep them centered.*

(9) Install inner pressure plate in retainer. Raised side of plate should rest on piston spring and flat surface should face outward.

(10) Lubricate remaining clutch plates with transmission fluid and install in retainer. Alternately install lined plate followed by steel plate until correct number of lined and steel plates have been installed.

(11) Install outer pressure plate and selective thickness snap ring.

(12) Measure clutch pack clearance. Press down firmly on outer pressure plate and insert a feeler gauge between pressure plate and selective outer snap spring.

(13) If necessary, adjust clearance using one of the following selective thickness snap rings. Snap rings are available in 0.060, 0.074, 0.088 and 0.106-inch (1.52, 188 and 2.70 mm) thicknesses.

NOTE: *Rear clutch pack clearance is very important in obtaining proper clutch engagement and shift quality.*

Planetary Gear Assembly—Models 904/999

End Play Measurement

(1) Measure end play of planetary assembly before removing component parts from output shaft.

(2) Support front end of output shaft on wood block and position assembly in an upright position.

(3) Push rear annulus gear support downward on output shaft (fig. 2C-84).

(4) Insert feeler gauge between rear annulus support and shoulder on output shaft. Clearance should be 0.001 to 0.047 inch (0.02 to 1.19 mm). If clearance is not within specifications, replace thrust washers, any worn parts, and selective thickness snap ring at assembly.

Disassembly

(1) Remove No. 3 thrust washer from forward end of output shaft (figs. 2C-85 and 2C-86).

(2) Remove selective snap ring from forward end of output shaft.

(3) Remove front planetary gear assembly.

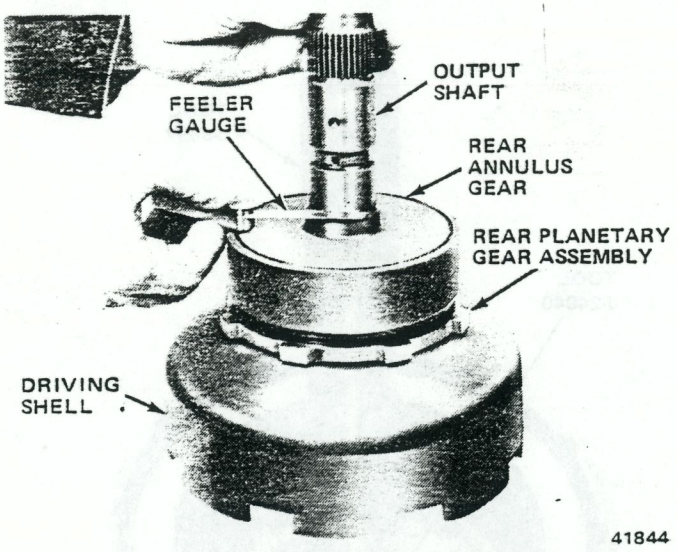

Fig. 2C-84 Measuring Planetary Gear Assembly End Play

(4) Remove snap ring and No. 4 thrust washer from forward hub of front planetary assembly.

(5) Remove front annulus gear and support from planetary gear assembly. If necessary, remove large snap ring from front annulus gear and separate support from gear.

(6) Remove No. 5 and No. 6 thrust washers from planetary gear assembly.

(7) Remove sun gear, driving shell, and rear planetary assembly from output shaft.

(8) Separate sun gear and driving shell from rear planetary assembly.

(9) Remove rear snap ring and No. 8 steel thrust plate from sun gear.

(10) Remove sun gear from driving shell.

(11) Remove remaining snap ring and No. 7 steel thrust plate from sun gear.

(12) Remove No. 9 thrust washer from forward side of rear planetary assembly.

(13) Remove planetary gear assembly and No. 10 thrust washer.

(14) If necessary, remove large snap ring from rear of annulus gear to separate support from gear.

Inspection

Inspect the bearing surfaces on the output shaft for nicks, burrs, scores or other damage. Light scratches, nicks or burrs can be removed with crocus cloth. Be sure all oil passages in the shaft are open and clean. Inspect the speedometer drive gear. Remove nicks and burrs with a sharp-edged stone.

Inspect the sun gear bushings for wear or scores. Replace the sun gear if the bushings are damaged.

Inspect all thrust washers and plates. Replace if damaged or worn below thickness specifications.

Inspect gear assemblies for cracks, broken pinions, worn gear teeth, broken pinion shafts or lockpins and damaged thrust faces. Replace as required.

Inspect annulus gears for cracks and worn teeth.

Replace all distorted snap rings.

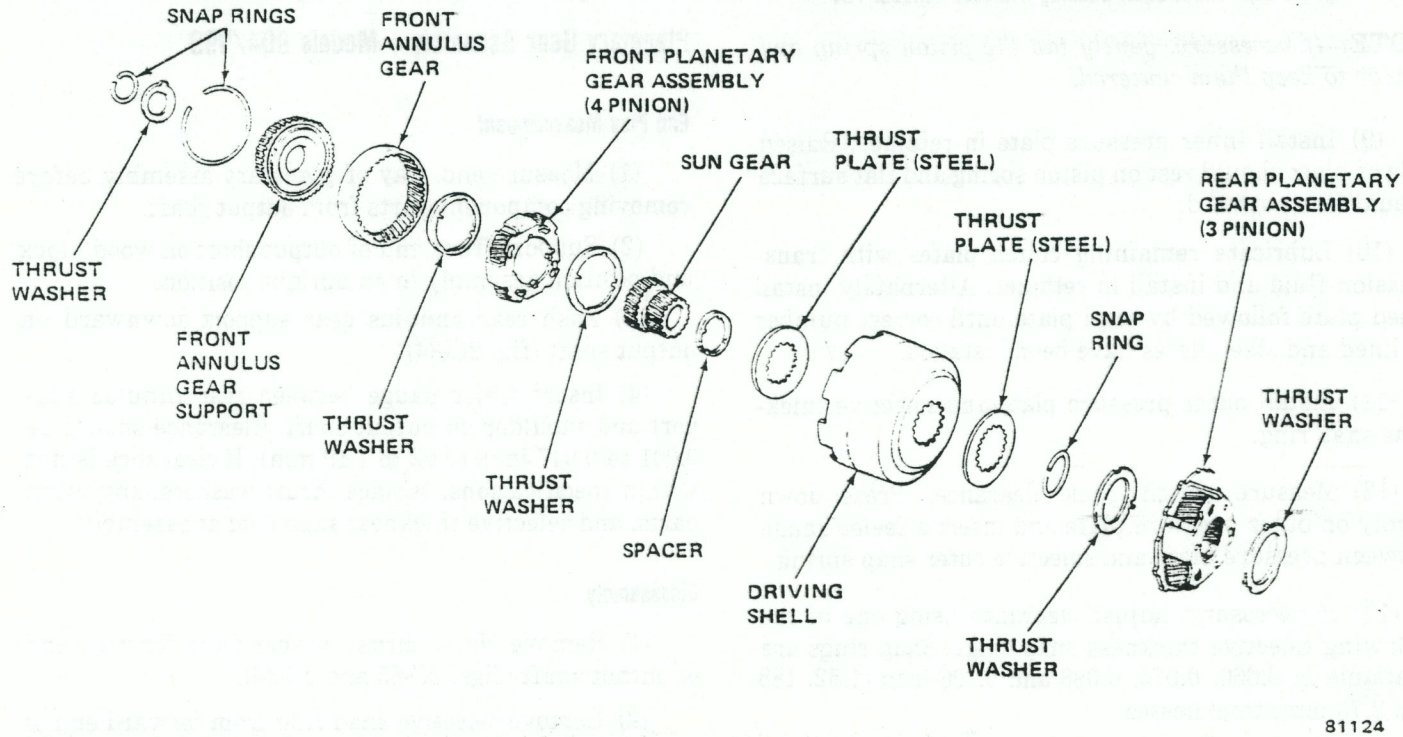

Fig. 2C-85 Planetary Gear Assembly—Model 904

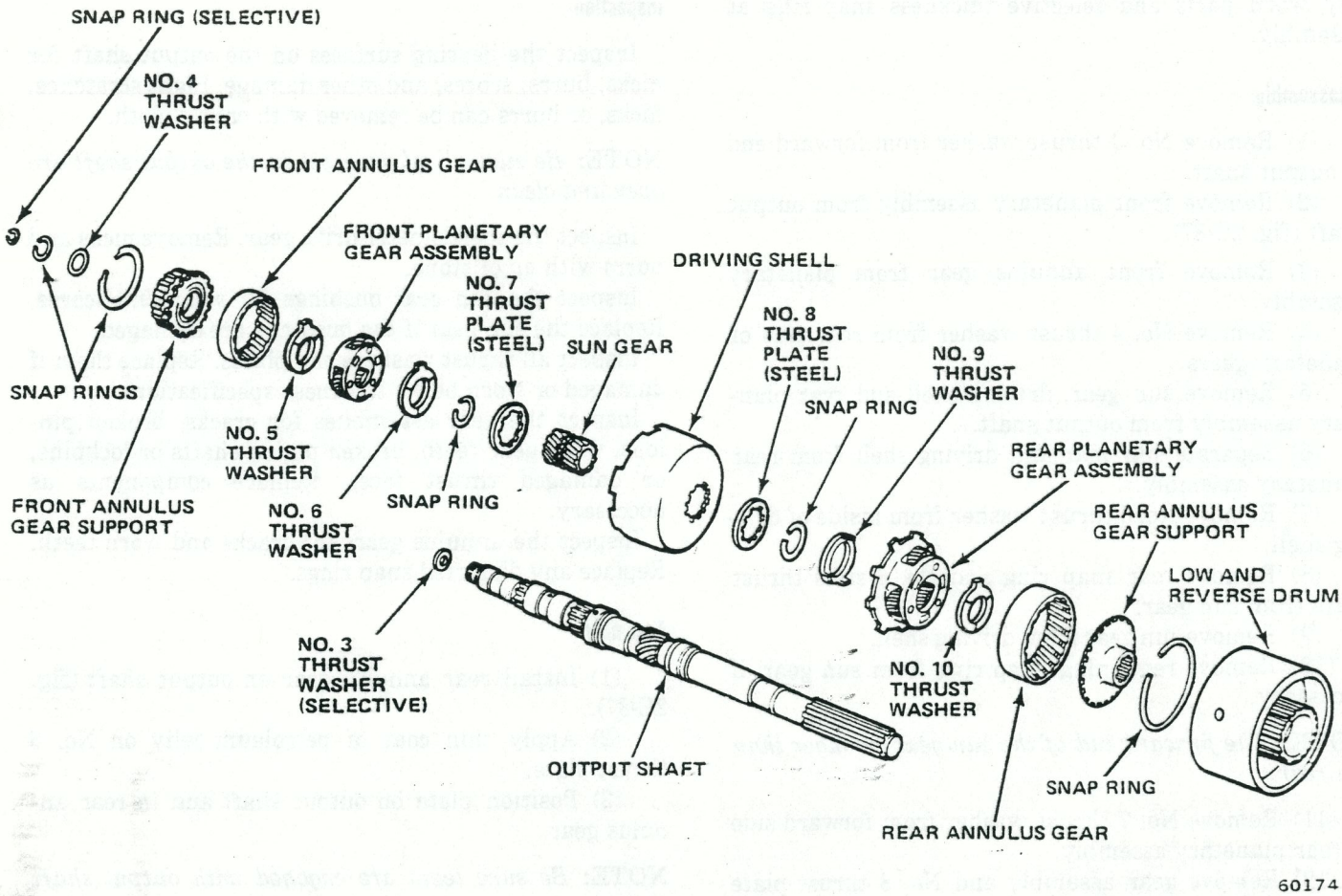

Fig. 2C-86 Planetary Gear Assembly—Model 999

Assembly

(1) Install rear annulus gear support in annulus gear and install snap ring.

(2) Install rear annulus gear assembly on output shaft.

(3) Install No. 10 thrust washer on output shaft.

(4) Position rear planetary gear assembly in rear annulus gear. Install No. 9 thrust washer on front side of gear assembly.

(5) Install No. 7 steel thrust plate and snap ring on opposite end of sun gear.

(6) Insert sun gear through front side of driving shell, and install No. 8 steel thrust plate and snap ring on one end of sun gear.

(7) Install driving shell and sun gear onto output shaft, and engage sun gear teeth with rear planetary pinions.

(8) Install front annulus gear support in annulus gear and install large snap ring.

(9) Install No. 5 thrust at forward end of front planetary gear assembly, and insert assembly into front annulus gear.

(10) Position No. 6 thrust washer on rear side of front planetary gear assembly.

(11) Carefully work front planetary and annulus gear assembly onto output shaft and mesh planetary pinions with sun gear.

(12) Install No. 3 thrust washer on output shaft.

(13) Install selective snap ring and measure assembly end play.

NOTE: *If necessary, adjust clearance by using selective thickness snap rings. Snap rings are available in 0.042, 0.064 and 0.084-inch (1.06, 1.63 and 2.13 mm) thicknesses.*

Planetary Gear Assembly—Model 727

End Play Measurement

(1) Measure planetary assembly end play before removing component parts from output shaft.

(2) Support front end of output shaft on wood block and place assembly in upright position.

(3) Push rear annulus gear support downward on output shaft.

(4) Insert feeler gauge between rear annulus support and shoulder on output shaft (fig. 2C-84). Clearance should be 0.009 to 0.0044-inch (0.22 to 1.12 mm). If clearance is not within specifications, replace thrust washers.

any worn parts and selective thickness snap ring at assembly.

Disassembly

(1) Remove No. 3 thrust washer from forward end of output shaft.

(2) Remove front planetary assembly from output shaft (fig. 2C-87).

(3) Remove front annulus gear from planetary assembly.

(4) Remove No. 4 thrust washer from rear side of planetary gears.

(5) Remove sun gear, driving shell and rear planetary assembly from output shaft.

(6) Separate sun gear and driving shell from rear planetary assembly.

(7) Remove No. 5 thrust washer from inside of driving shell.

(8) Remove rear snap ring and No. 6 steel thrust plate from sun gear.

(9) Remove sun gear from driving shell.

(10) Remove remaining snap ring from sun gear, if necessary.

NOTE: *The forward end of the sun gear is longer than the rear.*

(11) Remove No. 7 thrust washer from forward side of rear planetary assembly.

(12) Remove gear assembly and No. 8 thrust plate from rear annulus gear.

Inspection

Inspect the bearing surfaces on the output shaft for nicks, burrs, scores, and other damage. Light scratches, nicks, or burrs can be removed with crocus cloth.

NOTE: *Be sure all oil passages in the output shaft are open and clean.*

Inspect the speedometer drive gear. Remove nicks and burrs with an oilstone.

Inspect the sun gear bushings for wear and scores. Replace the sun gear if the bushings are damaged.

Inspect all thrust washers and plates. Replace them if damaged or worn below thickness specifications.

Inspect the gear assemblies for cracks, broken pinions, worn gear teeth, broken pinion shafts or lockpins, or damaged thrust faces. Replace components as necessary.

Inspect the annulus gears for cracks and worn teeth. Replace any distorted snap rings.

Assembly

(1) Install rear annulus gear on output shaft (fig. 2C-87).

(2) Apply thin coat of petroleum jelly on No. 8 thrust plate.

(3) Position plate on output shaft and in rear annulus gear.

NOTE: *Be sure teeth are engaged with output shaft splines.*

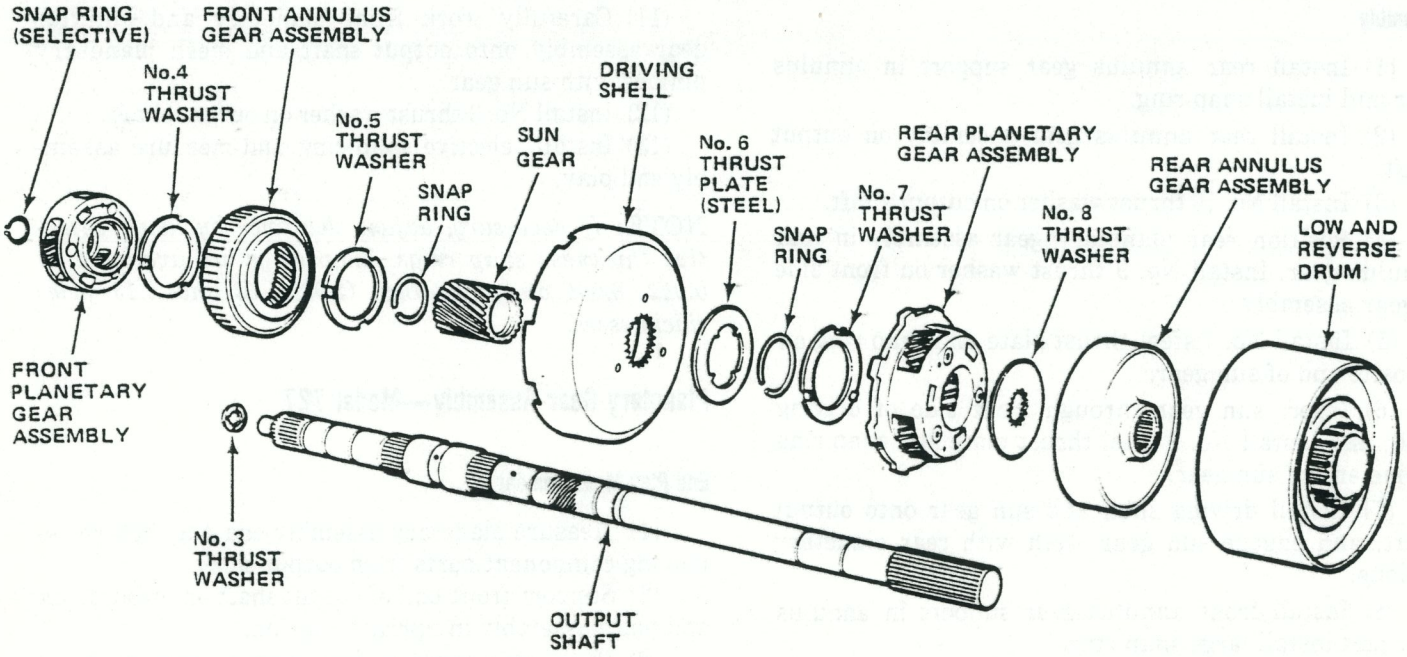

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Fig. 2C-87 Planetary Gear Assembly—Model 727

(4) Position rear planetary gear assembly in rear annulus gear and install No. 7 thrust washer on forward side of gear assembly.

(5) Install snap ring in forward groove of sun gear (long end of gear).

(6) Insert sun gear through forward side of driving shell and install steel thrust plate and snap ring on rear side of sun gear.

(7) Install snap ring in forward groove of sun gear. Install No. 5 thrust washer in driving shell over sun gear.

(8) Install driving shell and sun gear assembly on output shaft and engage sun gear teeth with rear planetary pinions.

(9) Position No. 4 thrust washer on rear hub of front planetary gear and engage planetary gear with front annulus gear.

(10) Install front planetary and annulus gear assembly onto output shaft and mesh planetary pinions with sun gear.

(11) Install selective snap ring and measure assembly end play.

NOTE: *If necessary, the clearance should be adjusted by using selective thickness snap rings. Snap rings are available in 0.048, 0.055 and 0.062-inch (1.22, 1.40 and 1.57 mm) thicknesses.*

Overrunning Clutch

Inspection

Inspect the clutch rollers for smooth, round surfaces. They must be free of flat spots and chipped teeth.

Inspect the roller contact surfaces in the cam and race for brinelling and inspect the springs for distortion, wear or other damage.

On model 727 transmission only, inspect the cam setscrew for tightness. If loose, tighten the setscrew and restake the case around the screw.

Cam Replacement—Model 999

If the overrunning clutch cam or spring retainer are damaged, they can be replaced with a service replacement cam, spring retainer and retaining screw (fig. 2C-88).

(1) Remove bolts attaching output shaft support to rear of case.

(2) Remove support from rear of case using woodblock and hammer.

(3) Centerpunch rivets **exactly** in center of each rivet head (fig. 2C-89).

(4) Drill through each rivet head using 3/8-inch (10 mm) diameter drill.

CAUTION: *Do not drill into the transmission case.*

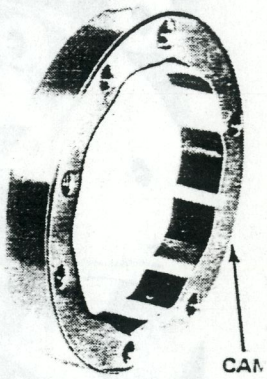

Fig. 2C-88

(5) Remove rivet he

(6) Remove rivets punch (fig. 2C-90).

NOTE: *Move punch fr wise direction after eac out of the case evenly.*

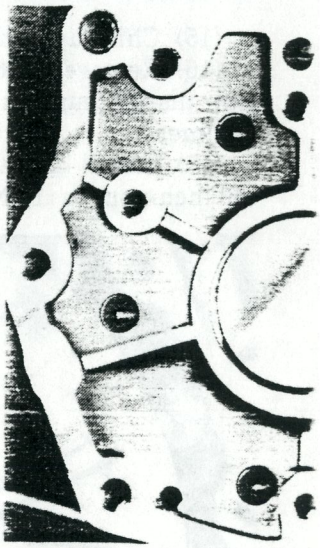

Fig. 2C-89

(7) Enlarge rivet hol eter 17/64-inch (7 mm) dr

(8) Remove chips, b from case and be sure c chips.

(9) Install replacem case with bolt holes in holes in case.

(10) Thread retaining

NOTE: *Install the wash inner diameter of the was*

(11) Install cam in case

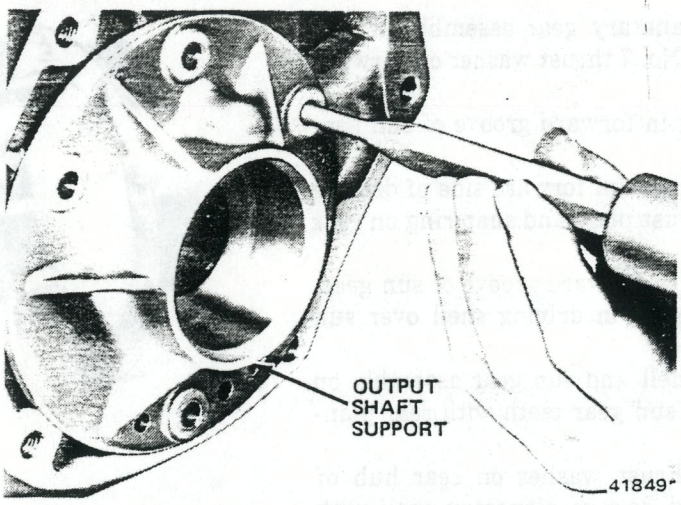

Fig. 2C-90 Overrunning Clutch Cam Removal

(12) Alternately and evenly tighten retaining screws to 100 inch-pounds (11 N•m) torque.

(13) Thread two Pilot Studs Tool J-3387-2 into case (fig. 2C-91).

(14) Position illuminated light bulb next to case to heat case.

CAUTION: *Do not use an open flame to heat the case.*

(15) Chill support with ice (preferably dry ice).

(16) Remove light, position support over pilot studs and install support in case using wood block and hammer.

(17) Install and tighten support attaching bolts to 150 inch-pounds (17 N•m) torque.

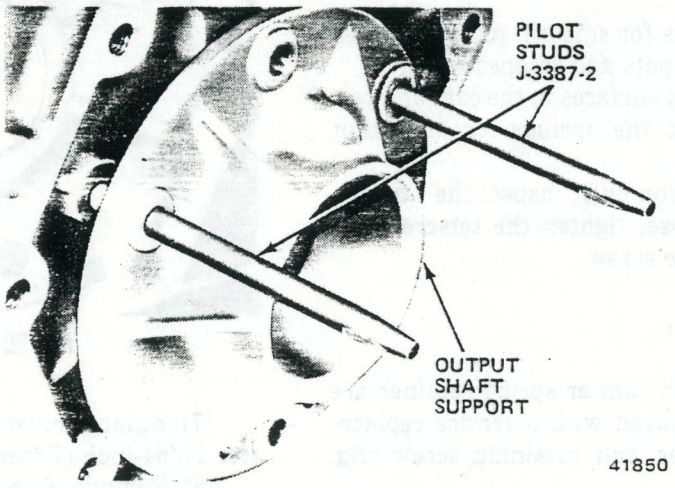

Fig. 2C-91 Output Shaft Support Alignment

Cam Replacement—Model 727

The overrunning clutch cam and spring retainer should be removed only if replacement is necessary.

(1) Remove setscrew from case.

(2) Remove bolts attaching output shaft support to rear of case.

(3) Insert punch through bolt holes and drive cam out of case (fig. 2C-90).

NOTE: *Move punch from one bolt hole to another in clockwise direction after each punch stroke to drive the cam out of the case evenly.*

CAUTION: *The output shaft support must be installed in the case before the overrunning clutch cam can be installed. If the support must be replaced drive it out the rear of the case using a wood block and hammer.*

(4) Thread two Pilot Stud Tools J-3387-2 into case (fig. 2C-91).

(5) Install support in case using wood block and hammer.

(6) Clean all burrs, chips, and foreign material from cam area in case.

(7) Position spring retainer on cam. Be sure retainer lugs snap firmly into cam notch.

(8) Align cam serrations with those in case.

(9) Install cam evenly into case as far as possible using brass hammer.

(10) Install Tool J-24042 (fig. 2C-92).

(11) Tighten tool nut to seat cam in case. Be sure cam is completely seated.

(12) Install cam retaining setscrew and stake case around setscrew.

(13) Remove Tool J-24042.

(14) Install and tighten support retaining bolts to 150 inch-pounds (17 N•m) torque.

(15) Stake case around cam in twelve places using blunt chisel.

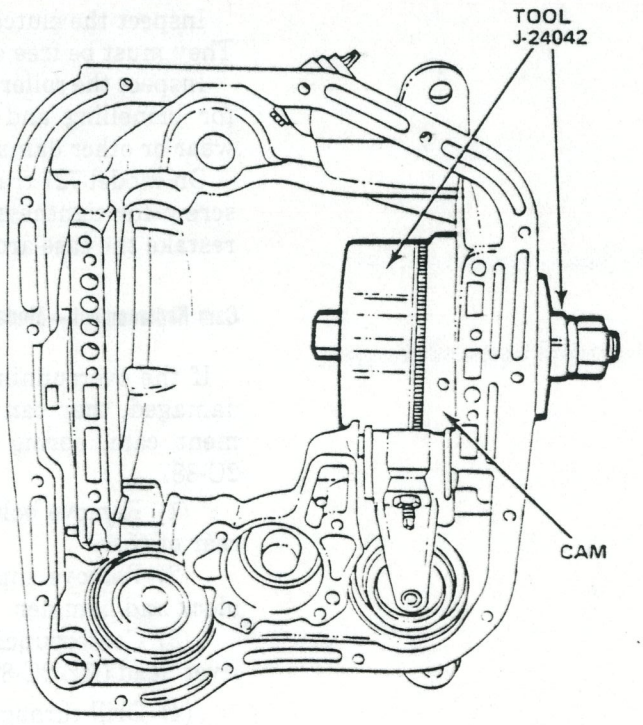

Fig. 2C-92 Overrunning Clutch Cam Installation—Model 727

Front Servo and Band

Two front servo designs are used. Refer to figures 2C-93 and 2C-94 for assembly details.

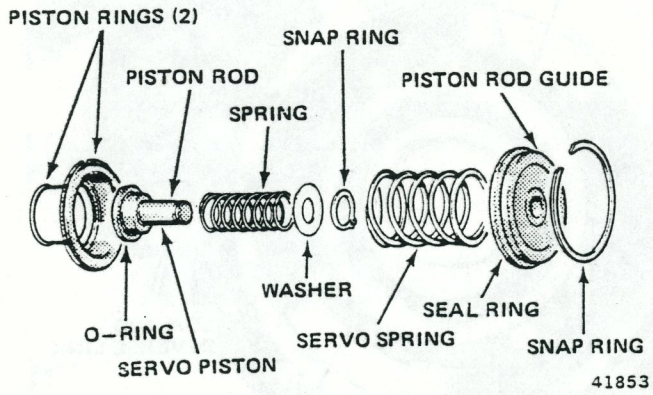

Fig. 2C-93 Kickdown Servo Front Servo Assembly

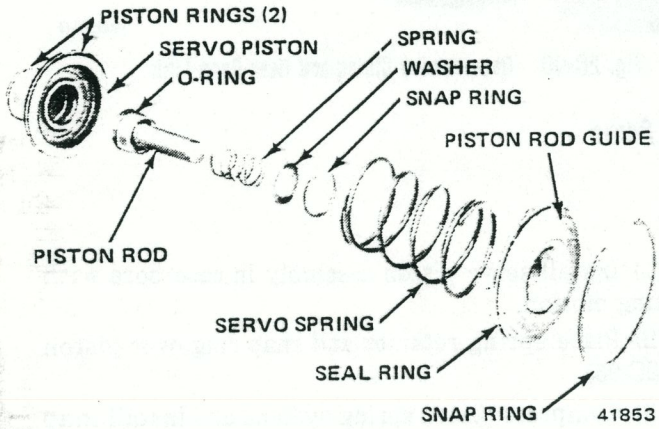

Fig. 2C-94 Front Servo Assembly—Model 727

Disassembly

NOTE: *The front servo in model 727 transmissions requires further disassembly after removal from the servo bore (fig. 2C-93).*

(1) Remove piston rod retaining snap ring from servo piston.

(2) Remove washer, piston rod spring, and piston-rod from servo piston.

Inspection

Inspect the piston for nicks, burrs, scores, and wear. Be sure the ring grooves are not damaged. Inspect the fit of the guide on the piston rod. Inspect the piston bore in the case for scores or other damage. Inspect the piston spring(s) for distortion. On model 727 transmissions, inspect the bore in the piston and the piston rod O-ring (fig. 2C-94).

Inspect the band lining for a poor bond to the band, burn marks, glazing, uneven wear pattern and flaking.

If the lining is so badly worn that the grooves are not visible at any portion of the band, replace the band. Inspect the band for distortion or cracked ends. Replace as necessary.

Assembly

CAUTION: *Do not use force to assemble any of the servo components. If they do not assemble easily, investigate and correct the cause before proceeding with assembly.*

(1) Apply petroleum jelly to piston rod O-ring and install piston rod in servo piston bore.

(2) Install piston rod spring on piston rod.

(3) Install washer.

(4) Compress spring and install piston rod retaining snap ring.

Rear Servo and Rear Band

Disassembly

(1) Compress piston plug spring and remove snap ring.

(2) Remove snap ring, piston plug, and plug spring (fig. 2C-95).

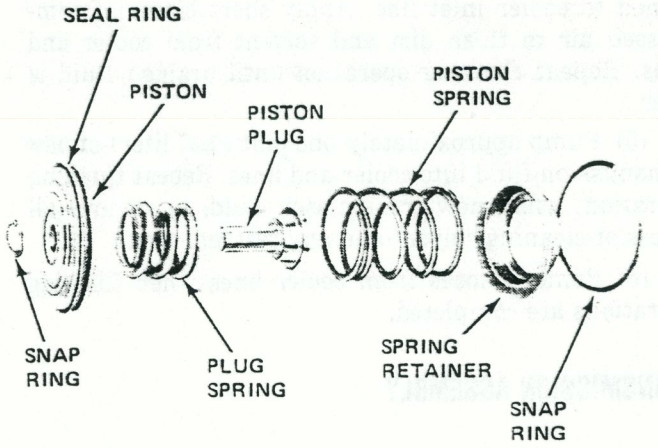

Fig. 2C-95 Rear Servo Assembly

Inspection

Inspect the piston and piston plug for nicks, burrs, scores, and wear. The plug must move freely in the piston. Inspect the piston bore in the case for scores or other damage. Inspect the springs for distortion.

Inspect the band lining for poor bonding to the band and for excessive wear. If the lining is so excessively worn that the grooves are not visible at any portion of the band, replace the band. Inspect the band for distortion or cracks and replace as necessary.

Assembly

(1) Lubricate piston plug and piston with petroleum jelly and insert piston plug through plug spring and into piston.

(2) Compress piston spring and install snap ring.

Torque Converter Service

If the transmission is being overhauled to correct a malfunction that generated sludge or heavy accumulations of metal particles or friction material, the oil cooler and cooler lines must be flushed thoroughly and the torque converter replaced. Do not attempt to clean or flush the converter.

The oil cooler and cooler lines can be flushed using solvent and compressed air.

Flushing Oil Cooler and Cooler Lines

(1) Place length of hose over cooler outlet line and secure end of hose in waste container.

(2) Place length of hose over cooler inlet line.

(3) Pump approximately one pint (0.47 liter) cleaning solvent into oil cooler through hose attached to inlet line.

(4) Insert compressed air gun nozzle into hose attached to cooler inlet line. Apply short blasts of compressed air to flush dirt and solvent from cooler and lines. Repeat flushing operation until drained fluid is clear.

(5) Pump approximately one pint (0.47 liter) of new transmission fluid into cooler and lines. Repeat flushing operation, using new transmisson fluid, to remove all traces of cleaning solvent and any residual dirt.

(6) Remove hoses from cooler lines when flushing operations are completed.

TRANSMISSION ASSEMBLY

NOTE: *Use automatic transmission fluid or petroleum jelly only to lubricate transmission components during assembly.*

Overrunning Clutch

(1) Place transmission case in upright position and install clutch cam and spring retainer.

(2) Install clutch springs and rollers so springs rest against retainer post and rollers rest against springs, and with both springs and rollers installed on counterclockwise side of spring retainer posts (fig. 2C-96).

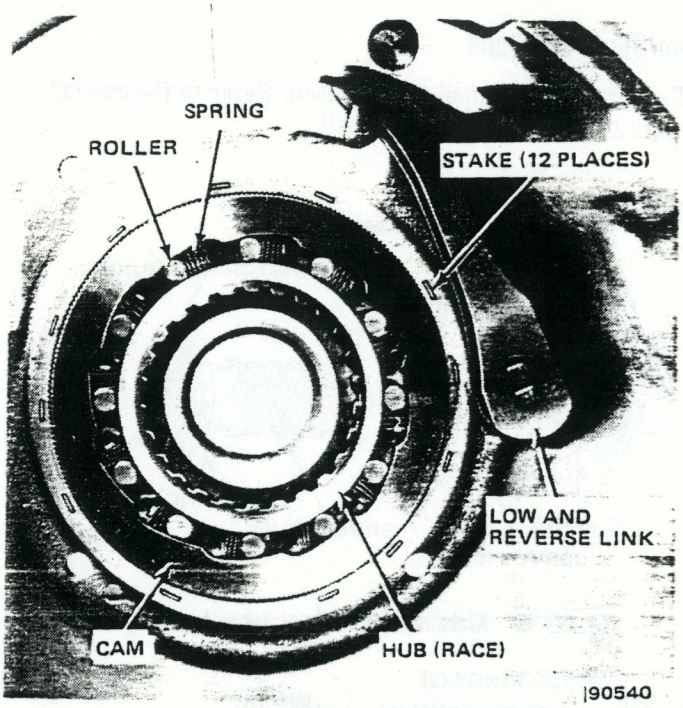

Fig. 2C-96 Overrunning Clutch and Rear Band Link

Rear Servo

Servo

(1) Install servo piston assembly in case bore with twisting motion.

(2) Place spring retainer and snap ring over piston (fig. 2C-95).

(3) Compress piston spring by hand and install snap ring.

Rear Band—Model 727

(1) Install rear band in case.

(2) Install short strut, and connect long link and anchor in band (fig. 2C-97).

(3) Thread band adjusting screw inward just enough to hold band strut in place.

(4) Be sure long link and anchor assembly is installed as shown in figure 2C-90 to provide clearance for rear band and drum.

(5) Install low-reverse drum in overrunning clutch hub and rear band.

Rear Band—Model 904/999

NOTE: *Model 904 has a single wrap band. Model 999 transmission has a double wrap band supported at two points by a reaction pin mounted in the case. It is actuated at one point by the rear servo adjusting screw (fig. 2C-98).*

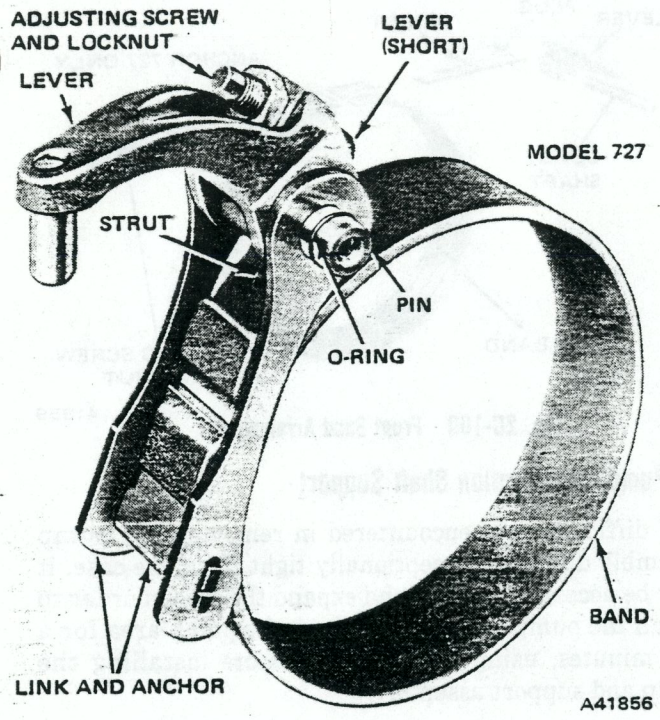

Fig. 2C-97 Rear Band—Model 727

(1) Install replacement O-ring on reaction pin and insert pin into case until pin is flush with gasket surface.

(2) Position band in case so both band lugs rest against reaction pin.

(3) Install low-reverse drum in overrunning clutch hub and into rear band.

(4) Install band operating lever and pivot pin.

NOTE: *When installed, the lever adjusting screw should touch the center lug of the band and the pivot pin should be flush with the case (fig. 2C-99).*

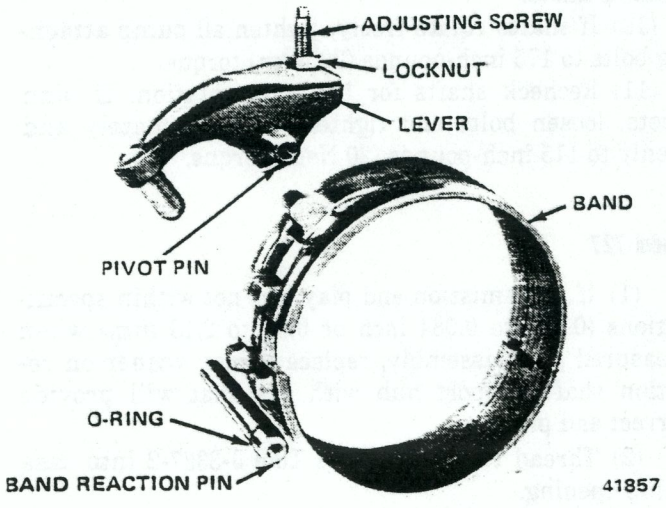

Fig. 2C-98 Rear Band—Model 999

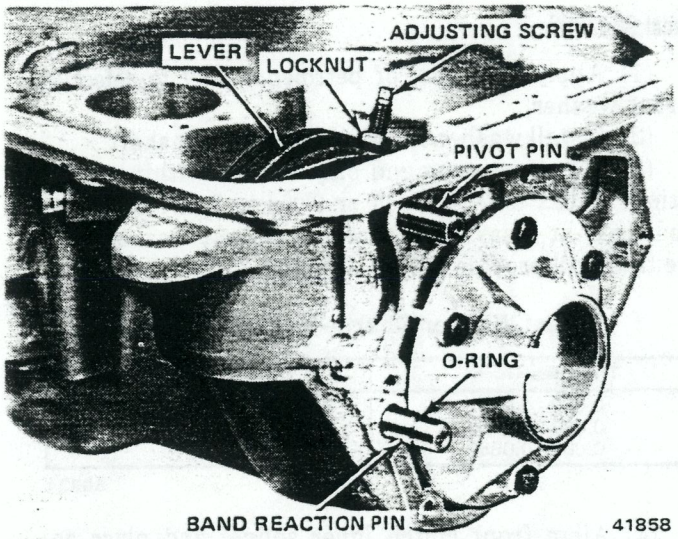

Fig. 2C-99 Rear Band Installation—Model 999

Front Servo

NOTE: *On model 727 transmission(s), the servo piston must be subassembled before installation.*

(1) Lubricate O-ring with petroleum jelly and install on piston rod.
(2) Install rod in piston.
(3) Install spring, flat washer and snap ring.
(4) Insert servo piston assembly into case bore.
(5) Install piston rod, spring(s) and guide.
(6) Compress piston spring(s) with large C-clamp and install snap ring.
(7) Remove C-clamp.

Planetary Gear Assembly and Output Shaft

CAUTION: *Protect all machined surfaces of the output shaft during installation.*

(1) Position and support gear and output shaft assembly in case and insert output shaft through rear support.
(2) Carefully work gear and shaft assembly rearward and engage rear planetary carrier lugs in low reverse drum slots.

Front and Rear Clutch Assemblies

The front and rear clutches, front band, oil pump and reaction shaft support are installed with the transmission in an upright position.

Cut a 3-1/2 inch (9 cm) diameter hole in a workbench, in the end of a small oil drum or a large wooden box strong enough to support the transmission. Cut or file notches at the edge of the hole to accommodate the output shaft.

Carefully insert the output shaft into the hole and support the transmission in an upright position on the output shaft support flange.

Model 904/999

(1) Apply thin coat of petroleum jelly to selective thrust washer.

(2) Install washer on front end of output shaft.

(3) If transmission end play was not within specifications (0.022 to 0.091 inch or 0.056 to 2.31 mm) when measured at disassembly, replace thrust washer with one that will provide proper end play.

Thrust Washer Chart—Model 904/999

Thickness (Inch)	Color
0.052 - 0.054	Natural (Brown)
0.068 - 0.070	Red
0.083 - 0.085	Black

60234

(4) Align front clutch inner splines and place assembly in position on rear clutch.

NOTE: *Be sure the front clutch plate splines are fully engaged on the rear clutch front hub.*

(5) Align rear clutch inner splines.

(6) Install clutch assemblies. Grasp input shaft and lower assemblies into case to install them.

(7) Install clutch assemblies using twisting motion and engage rear clutch splines over splines of front annulus gear.

NOTE: *Be sure the front clutch drive lugs are fully engaged in the driving shell slots.*

Model 727

(1) Apply thin coat of petroleum jelly to output shaft thrust washer.

(2) Install washer on front of output shaft.

(3) Align front clutch inner splines and place assembly in position on rear clutch.

NOTE: *Be sure the front clutch splines are fully engaged on the rear clutch front hub.*

(4) Align rear clutch inner splines.

(5) Install clutch assemblies. Grasp input shaft and lower clutch assemblies into case to install them.

(6) Install clutch assemblies using a twisting motion to engage rear clutch splines over splines of front annulus gear.

NOTE: *Be sure the front clutch drive lugs are fully engaged in the driving shell slots.*

Front Band

(1) Slide band over front clutch assembly.

(2) Install band strut. Also install band anchor on model 727 (fig. 2C-100).

(3) Tighten band adjusting screw enough to hold band and linkage in place.

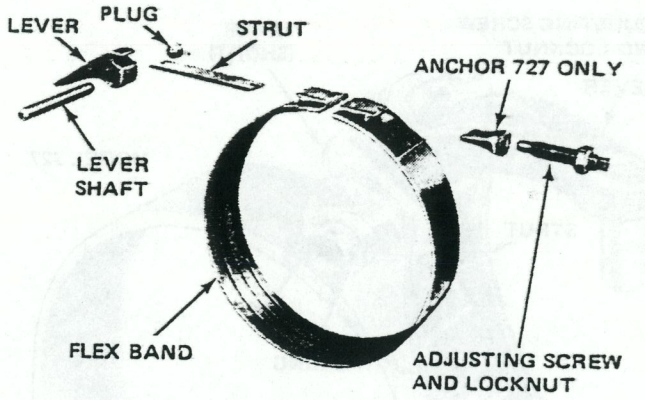

Fig. 2C-100 Front Band Arrangement

Oil Pump and Reaction Shaft Support

If difficulty was encountered in removing the pump assembly due to an exceptionally tight fit in the case, it may be necessary to heat and expand the case in order to install the pump. If necessary, heat the pump area for a few minutes, using a heat lamp, before installing the pump and support assembly.

Model 904/999

(1) Install thrust washer on reaction shaft support hub.

(2) Thread two Pilot Studs J-3387-2 into case pump opening.

(3) Install gasket over studs.

(4) Install rubber seal ring in groove in outer flange of pump housing. Be sure seal is not twisted.

(5) Coat seal ring with petroleum jelly.

(6) Install pump assembly in case. If necessary, tap pump assembly lightly with rawhide mallet to install.

(7) Install four pump attaching bolts finger-tight.

(8) Remove pilot studs and install remaining pump attaching bolts finger-tight.

(9) Rotate input and output shafts to see if any binding exists.

(10) If shafts rotate freely, tighten all pump attaching bolts to 175 inch-pounds (20 N•m) torque.

(11) Recheck shafts for bind-free rotation. If bind exists, loosen bolts and tighten bolts alternately and evenly to 175 inch-pounds (20 N•m) torque.

Model 727

(1) If transmission end play was not within specifications (0.036 to 0.084 inch or 0.91 to 2.13 mm) when measured at disassembly, replace thrust washer on reaction shaft support hub with one that will provide correct end play.

(2) Thread two Pilot Studs Tool J-3387-2 into case pump opening.

(3) Install gasket over studs.

Thrust Washer Chart—Model 727

Thickness (Inch)	Color
0.061 - 0.063	Natural (Brown)
0.084 - 0.086	Red
0.102 - 0.104	Yellow

60235

(4) Install rubber seal ring in groove in outer flange of pump housing. Be sure seal is not twisted.

(5) Coat seal ring with petroleum jelly.

(6) Install pump assembly in case. If necessary, tap pump assembly lightly with rawhide mallet to install.

(7) Position deflector, if equipped, over vent opening and install four pump attaching bolts finger-tight.

(8) Remove pilot studs and install remaining pump attaching bolts finger-tight.

(9) Rotate input and output shafts to see if any binding exists.

(10) If shafts rotate freely, tighten all pump attaching bolts to 175 inch-pounds (20 N•m) torque.

(11) Recheck shafts for free rotation. If bind exists, loosen bolts and tighten bolts alternately and evenly to 175 inch-pounds (20 N•m) torque.

Governor and Park Gear

(1) Install gear and governor body assembly on output shaft.

(2) Align assembly so governor valve shaft hole in governor body is aligned with hole in output shaft.

(3) Slide assembly into place and install snap ring behind governor body.

(4) Tighten governor body-to-gear attaching bolts to 100 inch-pounds (11 N•m) torque.

(5) Bend end of lock tabs against shoulders of bolt heads.

(6) Install governor valve on valve shaft.

(7) Insert assembly into body and through governor weights.

(8) Install valve shaft retaining E-clip.

Output Shaft Bearing and Adapter Housing

(1) Install bearing in adapter housing if not installed previously.

(2) Install seal in housing.

(3) Install bearing snap rings.

Valve Body and Accumulator Piston

(1) Before installing valve body, check operation of clutches and bands using air pressure test procedure to confirm proper operation.

(2) Clean all mating surfaces and remove any burrs from transmission case or valve body steel plate mating surfaces.

(3) Install accumulator piston assembly in case bore and install piston spring on piston (fig. 2C-101).

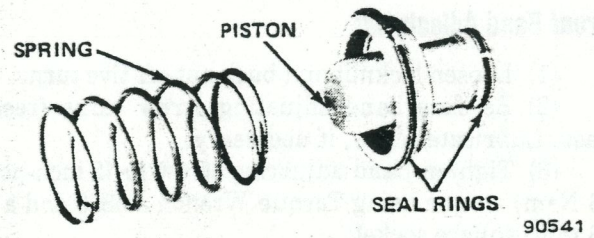

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Fig. 2C-101 Accumulator Assembly

(4) Insert park lock rod through opening in rear of case.

(5) Position knob of lock rod against reaction plug and sprag.

(6) Move front end of rod toward centerline of transmission while exerting rearward pressure on rod to force it past sprag. Rotate output shaft, if necessary.

NOTE: *Before installing the valve body, be sure the neutral start switch has not yet been installed.*

(7) Place valve body manual lever in Drive position.

(8) Place valve body assembly in its approximate position in case.

(9) Align valve body in case and install attaching screws finger-tight.

(10) Install neutral start switch.

(11) Shift valve body manual lever to Neutral position.

(12) Relocate valve body if necessary to align manual lever neutral finger over neutral start switch plunger ball.

(13) Tighten valve body attaching screws to 100 inch-pounds (11 N•m) torque.

(14) Install gearshift control lever on manual lever shaft and tighten clamp bolt.

(15) Check lever shaft for binding in case by moving lever through all detent positions.

NOTE: *If binding exists, loosen the valve body attaching screws and align the valve body.*

(16) Install flat washer and throttle lever and tighten throttle lever clamp bolt.

Rear Band Adjustment

(1) Loosen locknut and back nut off five turns.

(2) Tighten band adjusting screw to 72 inch-pounds (8 N•m) torque.

CAUTION: *If Adapter Tool J-24063 is used to adjust the band, tighten the adjusting screw to 36 inch-pounds (4 N•m) torque only.*

(3) Back off adjusting screw seven turns on 904, four turns on 999, and two turns on 727.

(4) Hold adjusting screw in position and tighten locknut to 35 foot-pounds (47 N•m) torque.

(5) Install oil pan and gasket.

Front Band Adjustment

(1) Loosen locknut and back nut off five turns.

(2) Be sure band adjusting screw turns freely in case. Lubricate screw, if necessary.

(3) Tighten band adjusting screw to 72 inch-pounds (8 N•m) torque using Torque Wrench J-5853 and a 5/16 (8 mm) square socket.

CAUTION: *If Adapter Tool J-24063 is used to adjust the band, tighten the adjusting screw to 36 inch-pounds (4 N•m) torque only.*

(4) Back off adjusting screw two turns on 999 and two and one-half turns on 727 and 904.

(5) Hold adjusting screw in position and tighten locknut to 35 foot-pounds (47 N•m) torque.

SPECIFICATIONS

Transmission Specifications

	MODEL 904	MODEL 999	MODEL 727
Clutch Plate Clearance			
Front Clutch	3 Disc 0.0074 to 0.125 inch	3 Disc 0.074 to 0.125 inch 4 Disc 0.067 to 0.134 inch 5 Disc 0.075 to 0.152 inch	3 Disc 0.070 to 0.129 inch 4 Disc 0.082 to 0.051 inch
Rear Clutch	3 and 4 Disc 0.032 to 0.55 inch	3 and 4 Disc 0.032 to 0.55 inch	4 Disc 0.025 to 0.045 inch
Clutch Component Thickness Tolerance			
Front Clutch			
Lined Plate	0.083 to 0.088 inch	0.083 to 0.088 inch	0.090 to 0.095 inch
Steel Plate	0.066 to 0.071 inch	0.066 to 0.071 inch	0.066 to 0.071 inch
Pressure Plate	0.244 to 0.218 inch	0.244 to 0.218 inch	0.278 to 0.282 inch
Rear Clutch			
Lined Plate	0.060 to 0.065 inch	0.060 to 0.065 inch	0.060 to 0.065 inch
Steel Plate	0.066 to 0.071 inch	0.066 to 0.071 inch	0.066 to 0.071 inch
Flat Pressure Plate	0.214 to 0.218 inch	0.214 to 0.218 inch	0.278 to 0.282 inch
Formed Pressure Plate	0.409 to 0.413 inch	0.409 to 0.413 inch	0.441 to 0.445 inch
Clutches			
Number of Front Clutch Plates	3	5	4
Number of Front Clutch Discs	3	5	4
Number of Rear Clutch Plates	3	3	3
Number of Rear Clutch Discs	4	4	4

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Transmission Specifications (Continued)

	MODEL 904		MODEL 999		MODEL 727	
	U.S. Measure	Metric Measure	U.S. Measure	Metric Measure	U.S. Measure	Metric Measure
Torque Converter Diameter	9.50 inches		10.75 inches			
Oil Capacity - Transmission and Torque Converter	14.2 pts.	6.6 liters	17. pts.	7.9 liters	17 pts.	7.9 liters
Cooling Method - All Models	Water-Heat Exchanger (In Radiator Lower Tank)					
Lubrication - All Models	Rotor Type Pump					
Gear Ratios - All Models	First 2.74 to 1	Second 1.55 to 1	First 2.45 to 1	Second 1.45 to 1	Third 1.00 to 1	Reverse 2.20 to 1
	Third 1.00 to 1	Reverse 2.20 to 1				
Pump Clearances						
Outer Rotor to Case Bore			.004 to .008 inch			
Outer to Inner Tip			.005 to .010 inch			
End Clearance-Rotors	.001 to .003 inch		.001 to .003 inch		.001 to .002 inch	
Gear Train End Play	.001 to .047 inch		.001 to .047 inch		.009 to .044 inch	
Input Shaft End Play	.022 to .091 inch		.016 to .059 inch		.036 to .084 inch	
Snap Rings						
Front and Rear Clutches Rear Snap Ring (Selective)	.060 to .062 inch		.060 to .062 inch		.060 to .062 inch	
	.068 to .070 inch		.068 to .070 inch		.074 to .076 inch	
	.076 to .078 inch		.076 to .078 inch		.088 to .090 inch	
Output Shaft (Forward End)	.040 to .044 inch		.040 to .044 inch		.106 to .108 inch	
	.048 to .052 inch		.048 to .052 inch		.055 to .059 inch	
	.059 to .065 inch		.059 to .065 inch		.062 to .066 inch	

70122B

Thrust Washer Chart

Thrust Washers	Thrust Washer No. and Transmission Model			
	904 / 999		727	
Reaction Shaft Support to Front Clutch Retainer	No. 1	.061 to .063	No. 1	Selective .061 to .063 — Natural .084 to .086 — Red .102 to .104 — Yellow
Rear Clutch to Front Clutch Retainer	No. 2	.061 to .063	No. 2	.061 to .063 — Natural
Output Shaft to Input Shaft	No. 3	Selective .052 to .054 — Tin .068 to .070 — Red .083 to .085 — Green	No. 3	.062 to .064
Front Annulus Support to Rear Clutch Retainer	No. 4	.121 to .125		—
Front Annulus Support to Front Planetary Gear	No. 5	.048 to .050	No. 4	.059 to .062
Driving Shell to Front Annulus Gear		—	No. 5	.060 to .062
Front Planetary Gear to Driving Shell	No. 6	.048 to .050		—
Sun Gear and Driving Shell Front Thrust Plate	No. 7	.050 to .052	No. 6	.034 to .036
Sun Gear and Driving Shell Rear Thrust Plate	No. 8	.050 to .052		—
Rear Planetary Gear to Driving Shell	No. 9	.048 to .050	No. 7	.059 to .062
Rear Planetary Gear to Rear Annulus Gear		—	No. 8	.034 to .036
Rear Planetary Gear to Rear Annulus Support	No. 10	.048 to .050		—

60517

Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (in-lbs)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Cooler Line Fitting	160 in-lb	120-200 in-lb	18	14-23
Cooler Line Nut	150 in-lb	130-180 in-lb	17	15-20
Converter Drive Plate to Crankshaft Bolts - 4 Cylinder	58	50-56	79	68-89
Converter Drive Plate to Crankshaft Bolts - 6 Cylinder	105	95-120	142	129-163
Converter Drive Plate to Torque Converter Bolts - 4 Cylinder	40	35-40	54	47-54
Converter Drive Plate to Torque Converter Bolts - 6 Cylinder	26	22-30	35	30-44
Adapter Housing-to-Transmission Case Bolt	24	—	33	—
Governor Body Bolt	100 in-lb	—	11	—
Front Band Adjusting Screw Locknut	35	—	47	—
Kickdown Lever Shaft Plug	150 in-lb	—	17	—
Rear Band Adjusting Screw Locknut	35	—	47	—
Neutral Starter Switch	24	—	33	—
Oil Filler Tube Bracket Bolt	150 in-lb	—	17	—
Oil Pan Bolt	150 in-lb	9-13	17	12-18
Oil Pump Housing-to-Transmission Case Bolt	175 in-lb	—	20	—
Output Shaft Support Bolt	150 in-lb	—	17	—
Overrunning Clutch Cam Setscrew	40 in-lb	—	4	—
Pressure Test Port Plug	110 in-lb	—	12	—
Reaction Shaft Support to Oil Pump Bolt	160 in-lb	—	18	—
Transmission-to-Engine Bolt	28	22-30	38	30-41
Valve Body Screw	35 in-lb	—	4	—
Valve Body-to-Transmission Case Screw	100 in-lb	—	11	—

All Torque values given in inch-pounds and Newton-meters with dry fits unless otherwise specified.

70121

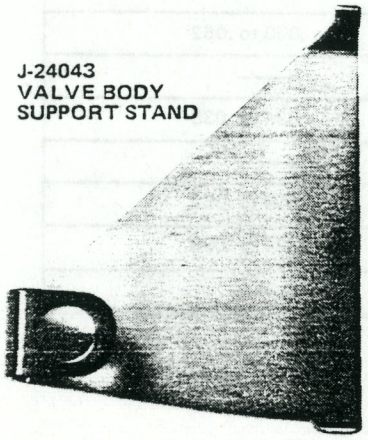
Band Adjustments

	904	999	727
Front Band Turns	2-1/2	2	2-1/2
Rear Band Turns	7	4	2

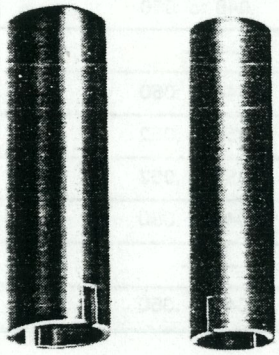
NOTE: * 904 backed off from 41 inch-lbs (5 N.m); 999/727 backed off from 72 inch-lb (8 N.m).

70130

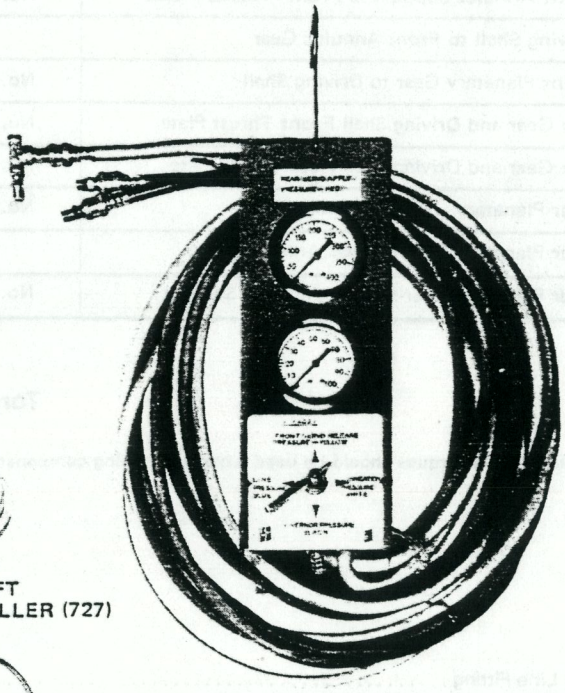
Tools



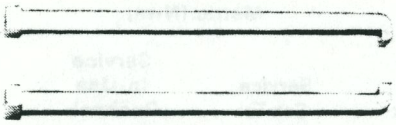
J-24043
VALVE BODY
SUPPORT STAND



J-24045 (727) J-24033 (999)
PUMP ROTOR ALIGNMENT TOOLS



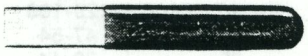
J-24027 PRESSURE TEST SET



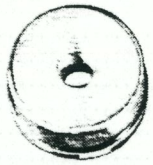
J-22205
FRONT PUMP OIL
SEAL REMOVER (LEGS)

J-24039
FRONT CLUTCH
RETAINER BUSHING
REMOVER AND
INSTALLER (727)

J-24038
REACTION SHAFT
BUSHING INSTALLER (727)

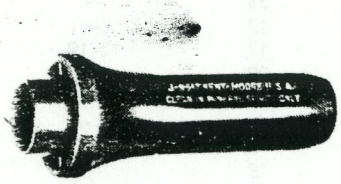


J-24031
KICKDOWN
VALVE GAUGE

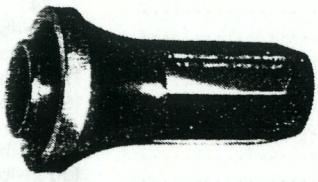


J-24055
OIL PUMP BUSHING
REMOVER AND INSTALLER (727)

J-24044
DETENT BALL
RETAINER



J-9617
FRONT PUMP OIL
SEAL INSTALLER (999)



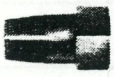
J-21005
FRONT PUMP OIL
SEAL INSTALLER (727)

J-24040
INPUT SHAFT
BUSHING INSTALLER (727)

J-24064
FRONT CLUTCH BUSHING
REMOVER AND INSTALLER (999)

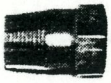
J-24049
OIL PUMP BUSHING
REMOVER AND INSTALLER (999)

J-5886-01
FRONT CLUTCH
SPRING COMPRESSOR (999)



J-24036
REACTION SHAFT
BUSHING REMOVER (999)

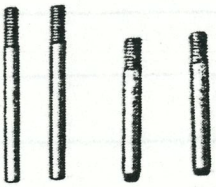
J-24041
INPUT SHAFT
BUSHING REMOVER (727)



J-24037
REACTION SHAFT
BUSHING REMOVER (727)

J-21232-01
FRONT PUMP OIL
SEAL REMOVER
(STEERING WHEEL
PULLER)

J-24036
REACTION SHAFT
BUSHING REMOVER (999)

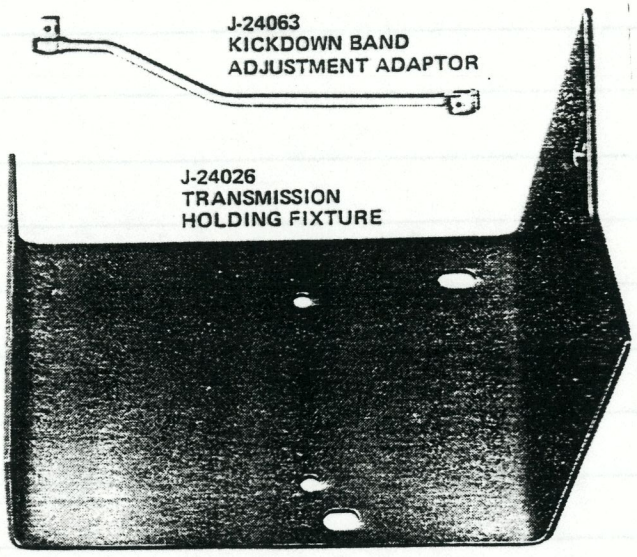


J-24108 J-3387-2

PILOT STUDS

J-24042
FRONT CLUTCH SPRING
COMPRESSOR AND
OVERRUNNING CLUTCH
CAM INSTALLER (727)

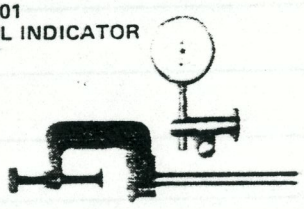
J-24063
KICKDOWN BAND
ADJUSTMENT ADAPTOR



J-24026
TRANSMISSION
HOLDING FIXTURE

J-24048
EXTENSION HOUSING
BUSHING REMOVER
AND INSTALLER (727)

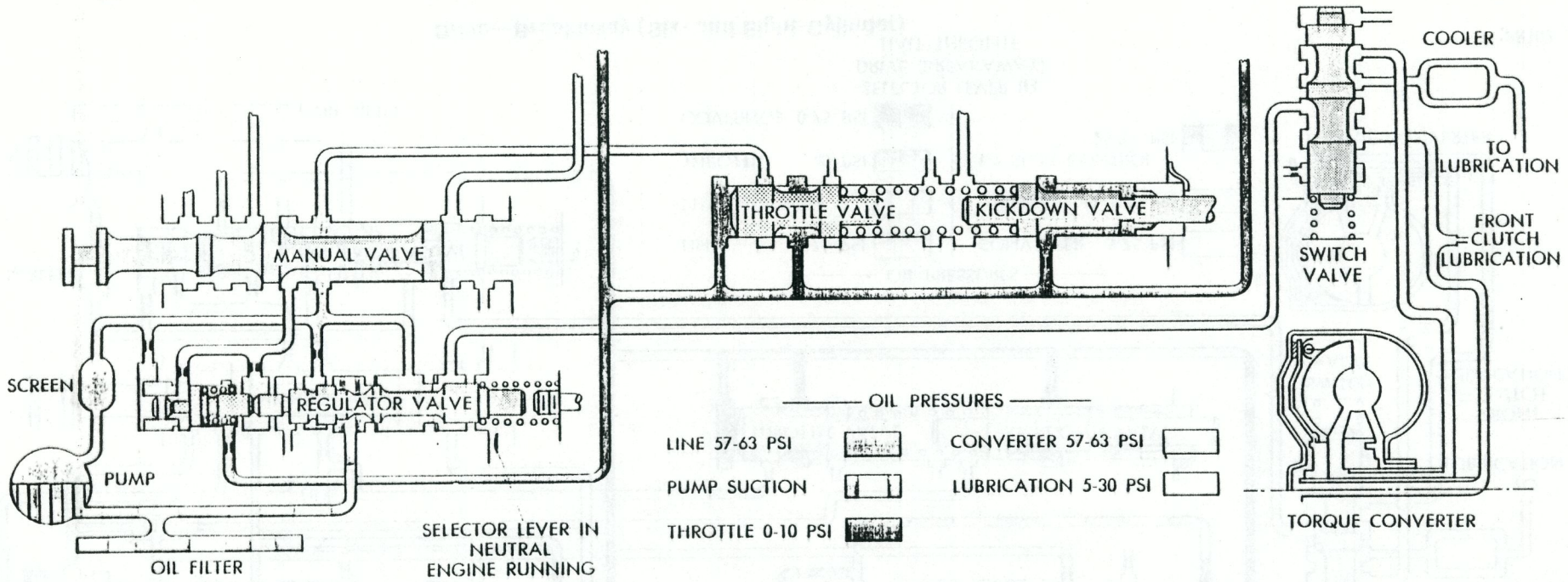
J-8001
DIAL INDICATOR
SET

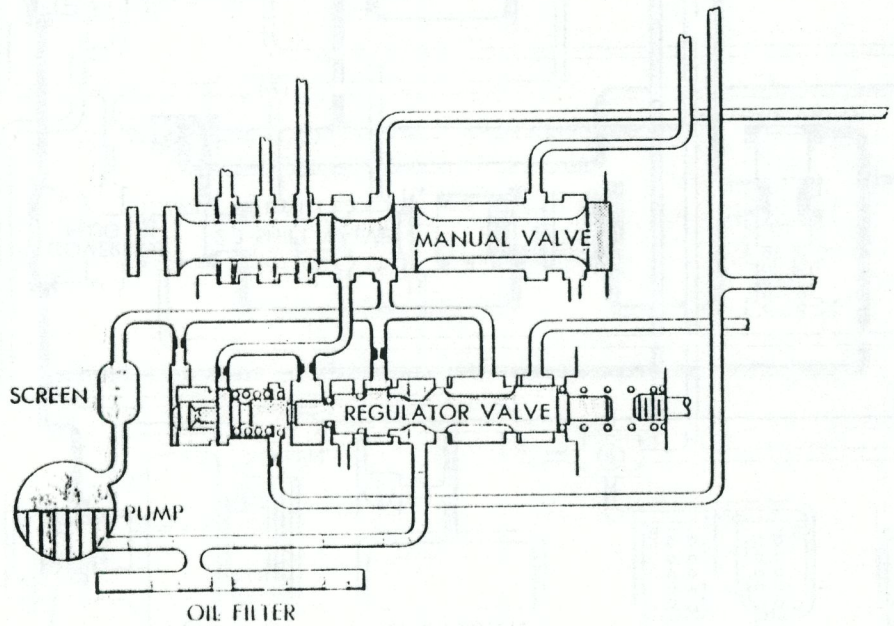


41816

NOTES

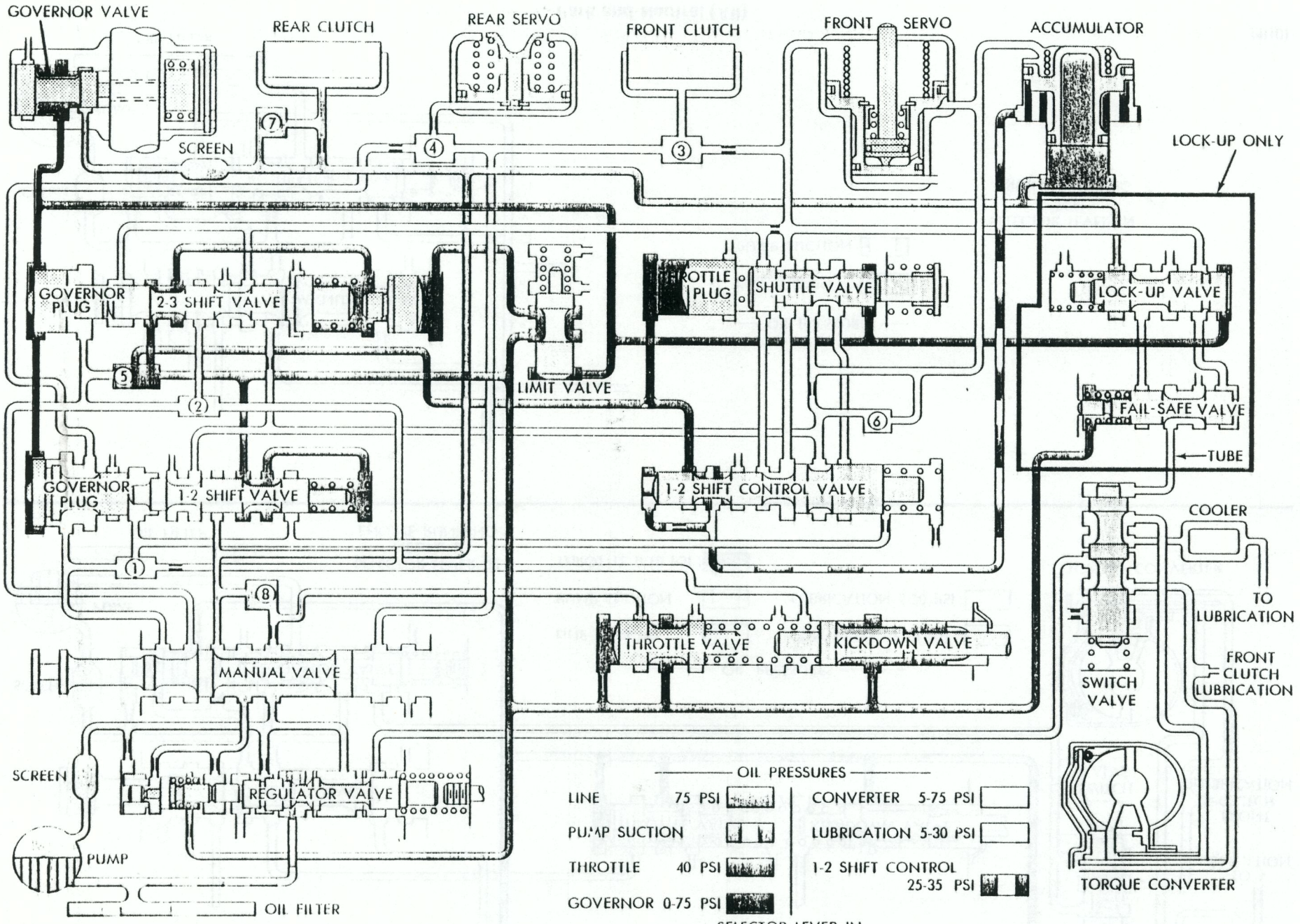
HYDRAULIC FLOW CHARTS



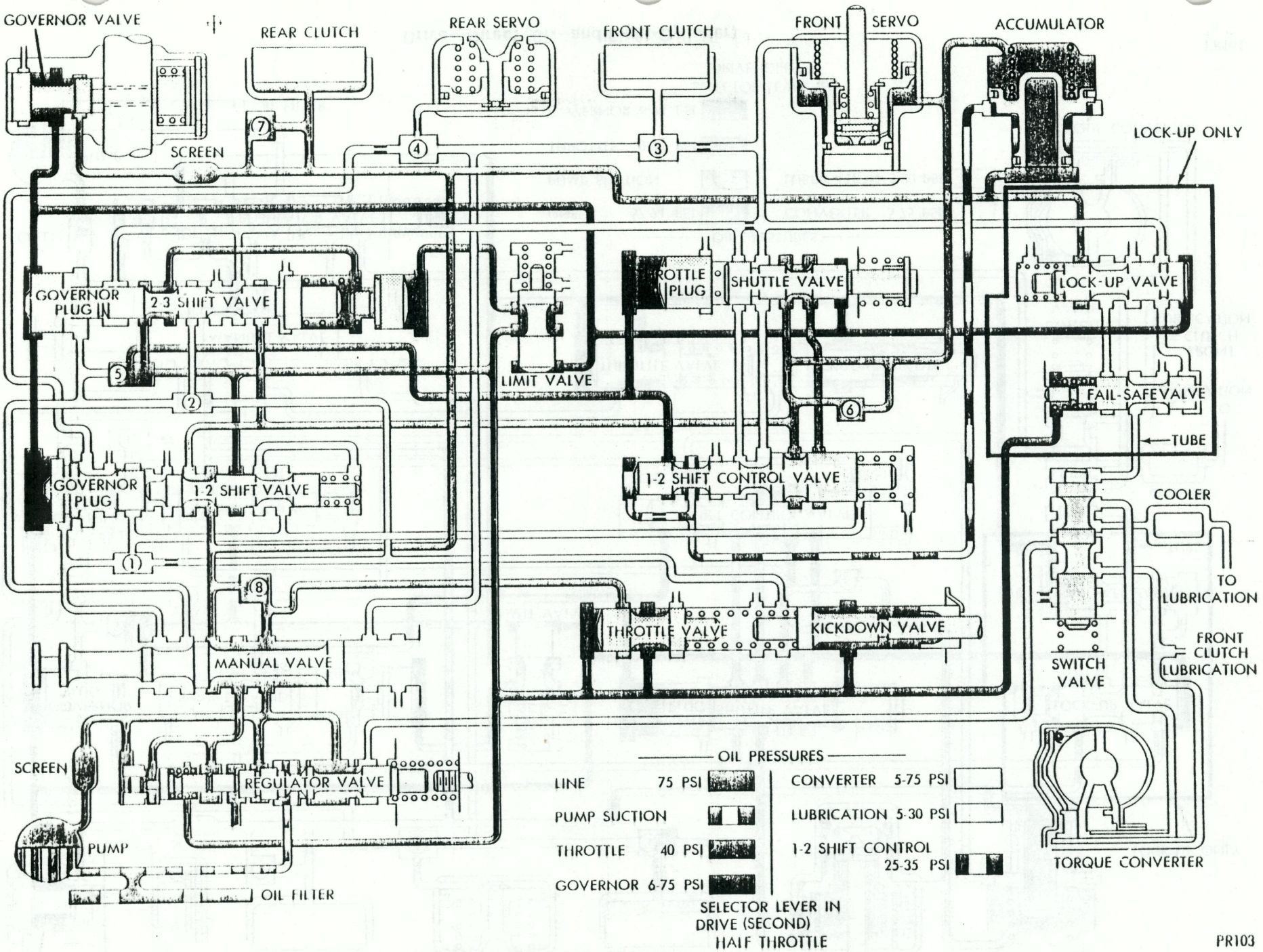


PR101

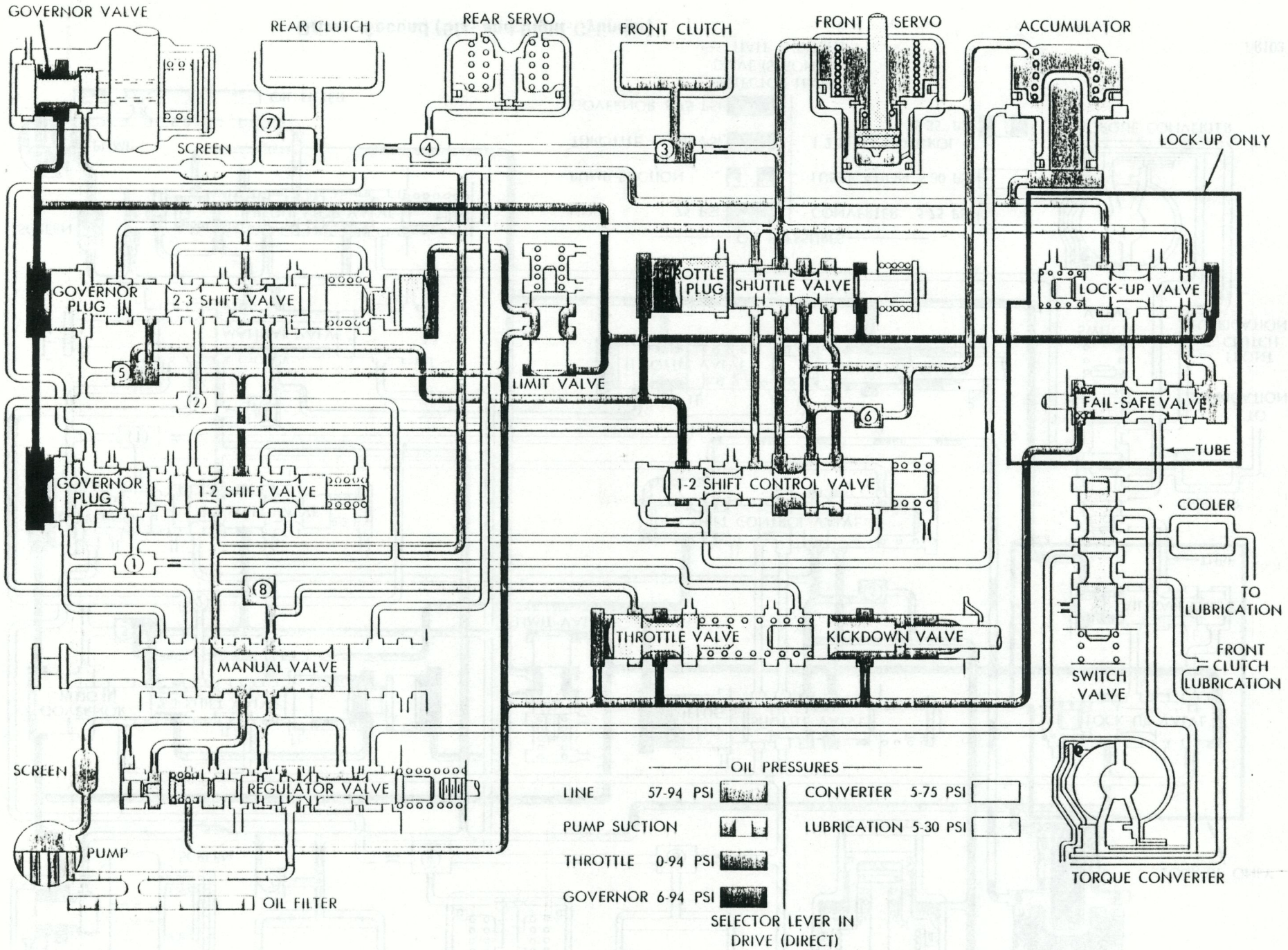
Park and Neutral (All)



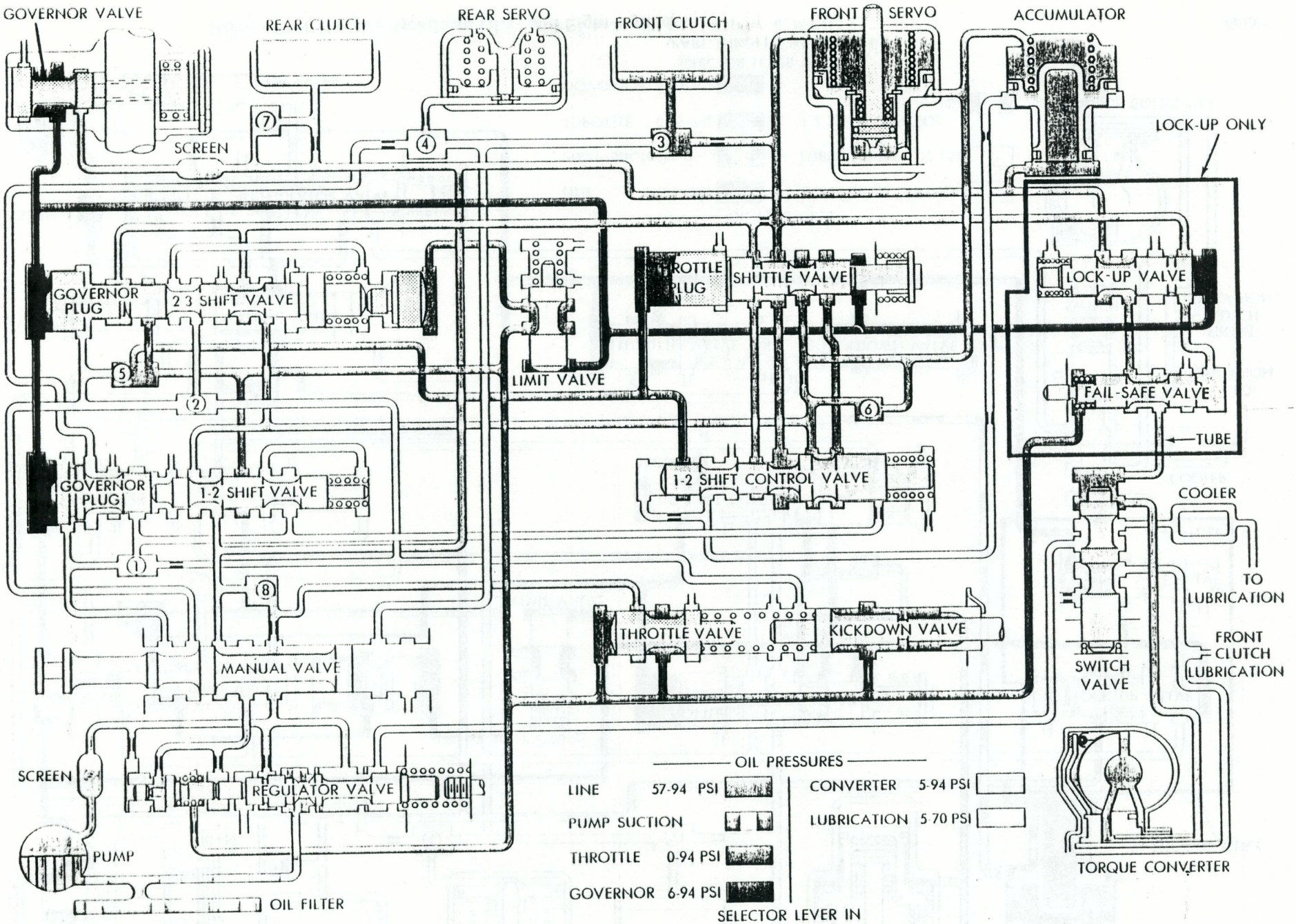
Drive—Breakaway (Six- and Eight-Cylinder)



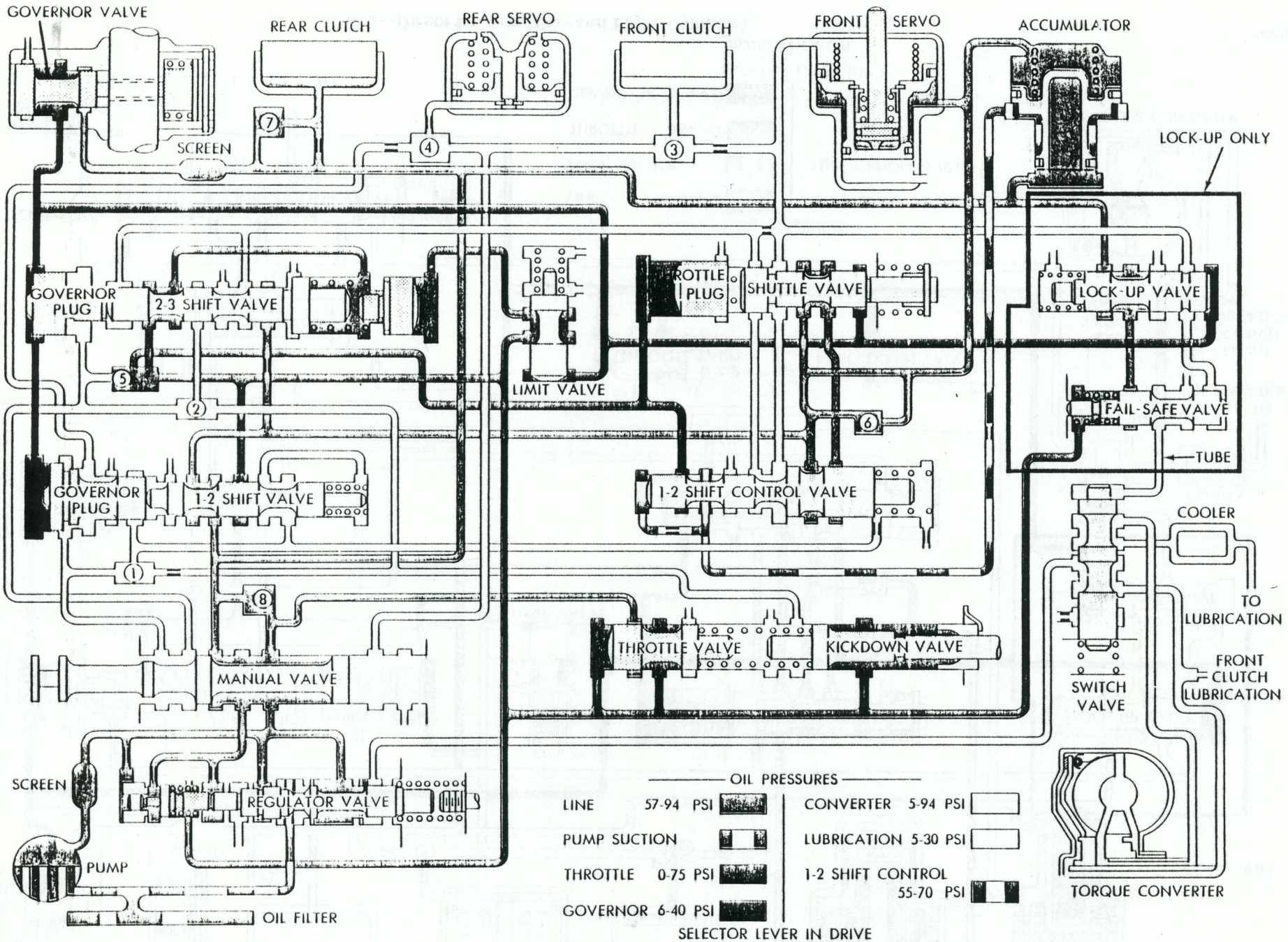
Drive—Second (Six- and Eight-Cylinder)



Drive—Direct (Six- and Eight-Cylinder)



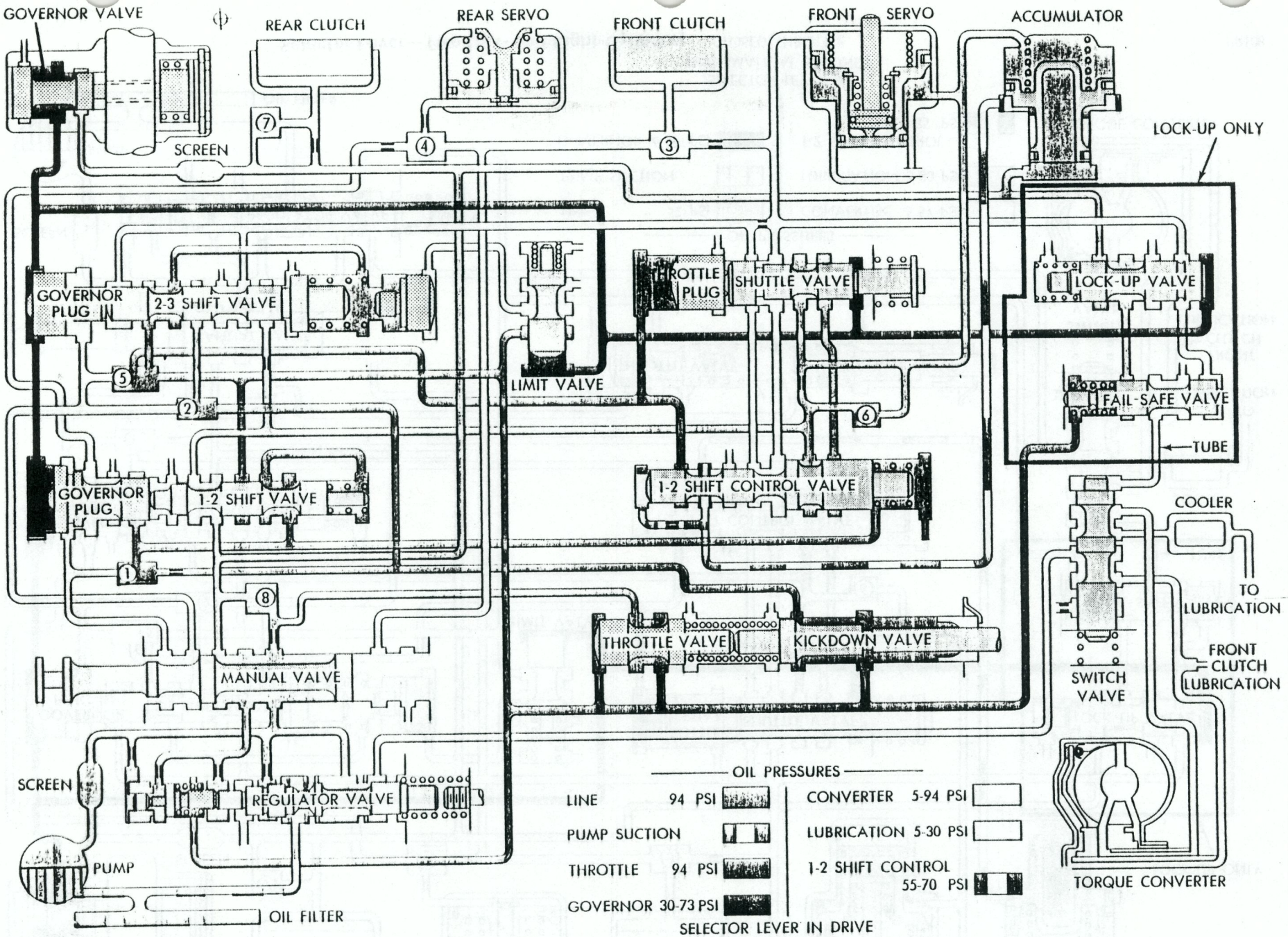
Drive—Direct Lockup (Six- and Eight-Cylinder)



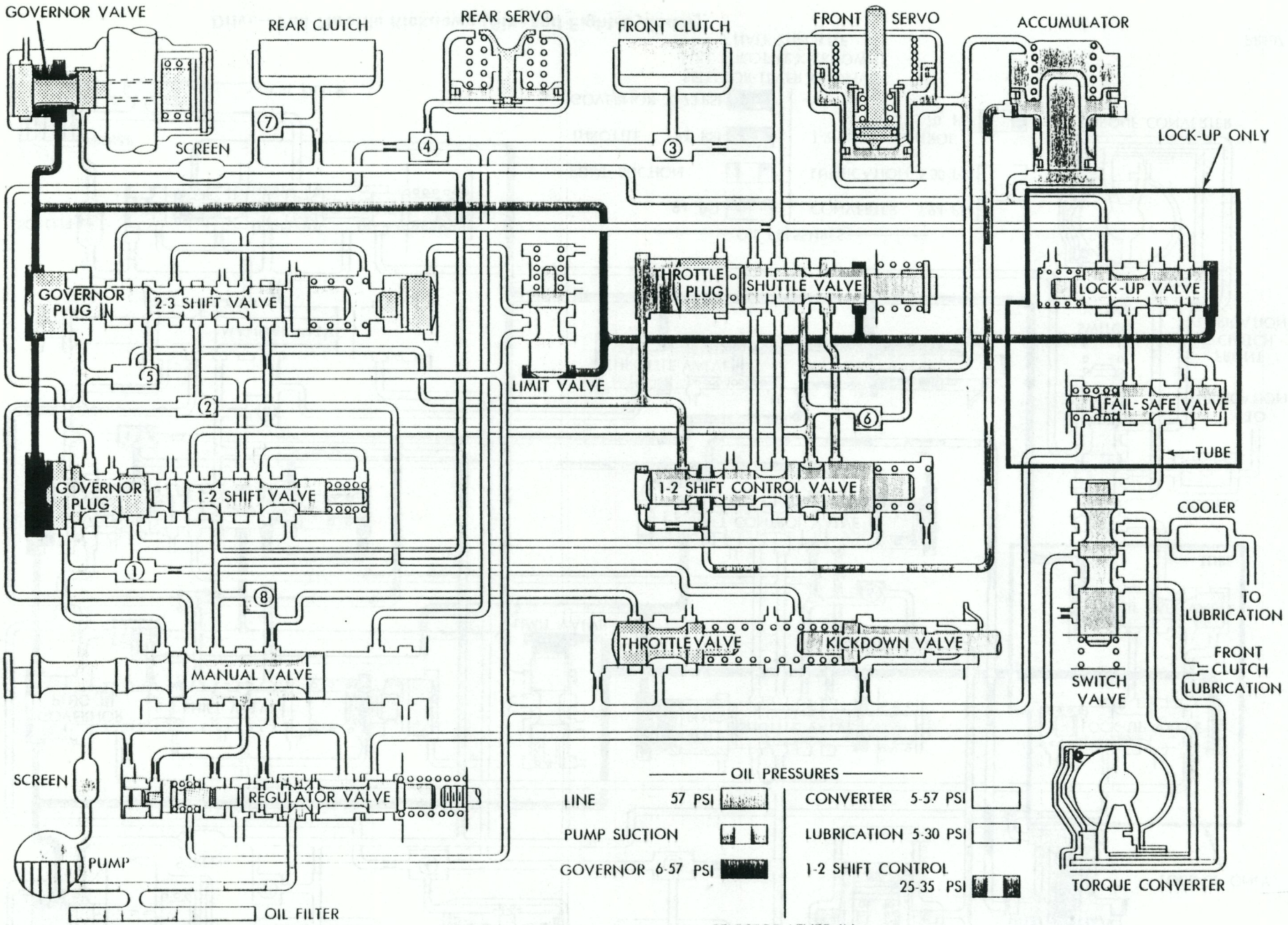
SELECTOR LEVER IN DRIVE
(PART THROTTLE KICKDOWN)
BELOW 40 M.P.H.

Drive—Part Throttle Kickdown (Six- and Eight-Cylinder)

PR106

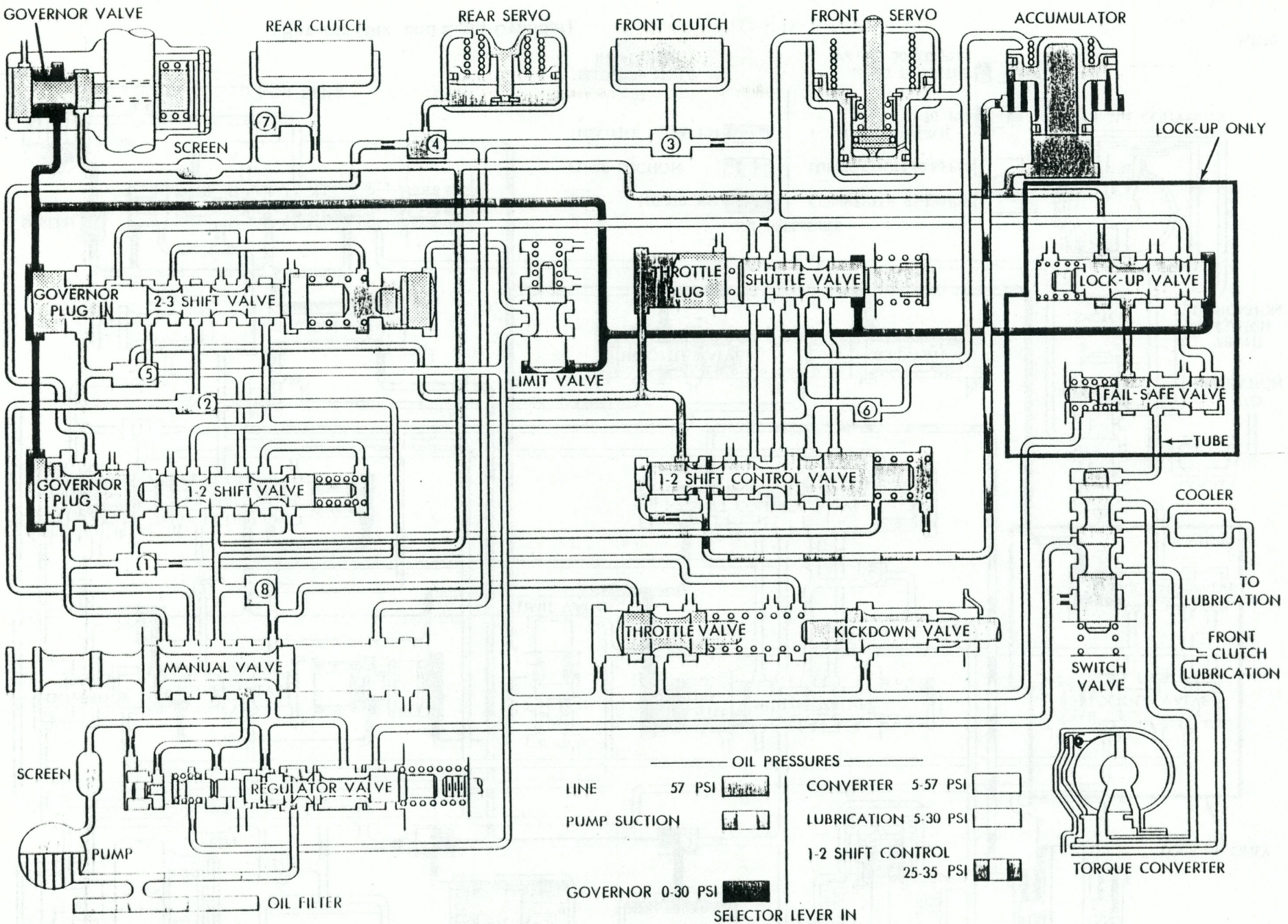


Drive—Full Throttle Kickdown (Six- and Eight-Cylinder)

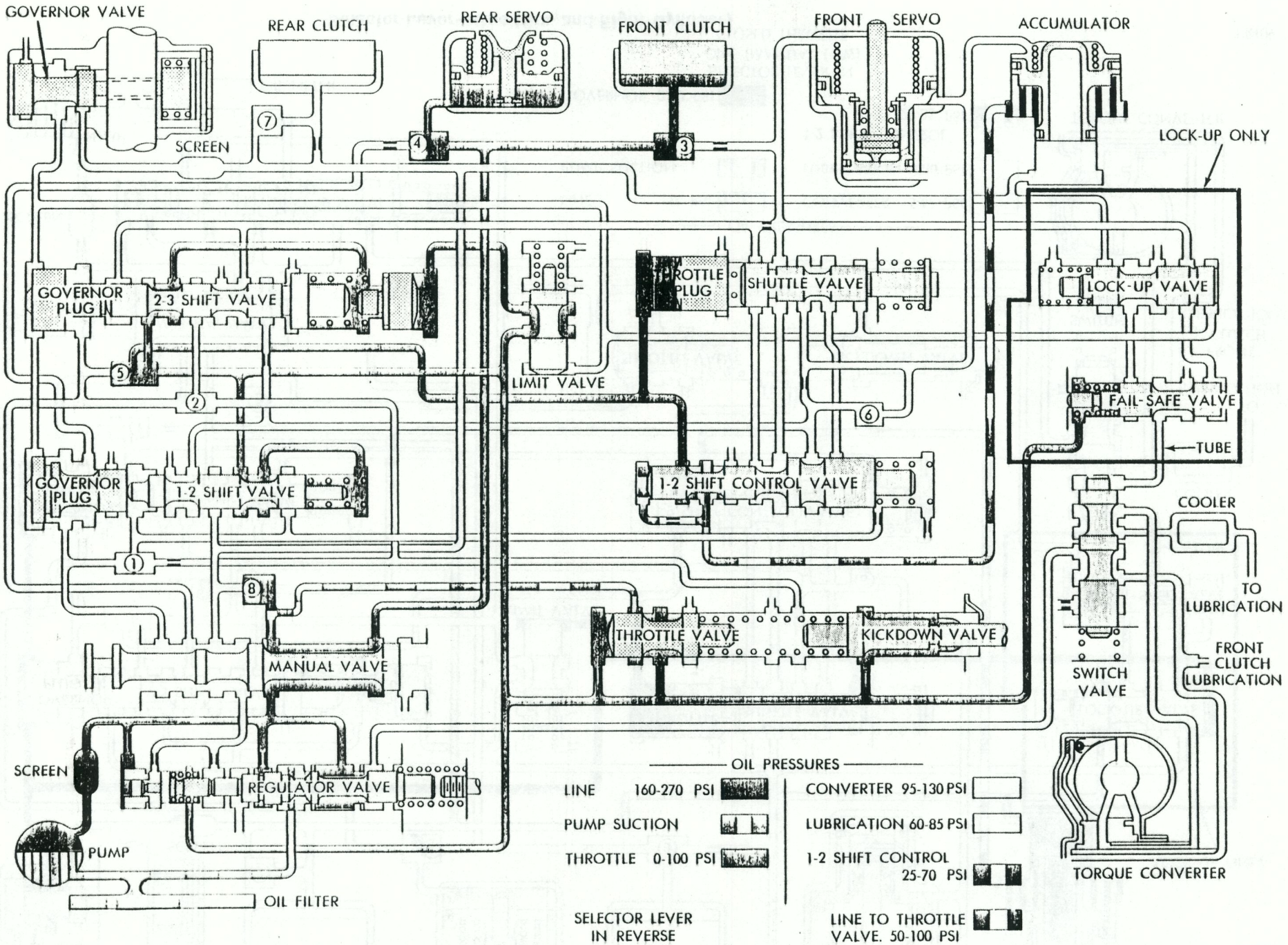


Selector Lever—Two (Six- and Eight-Cylinder)

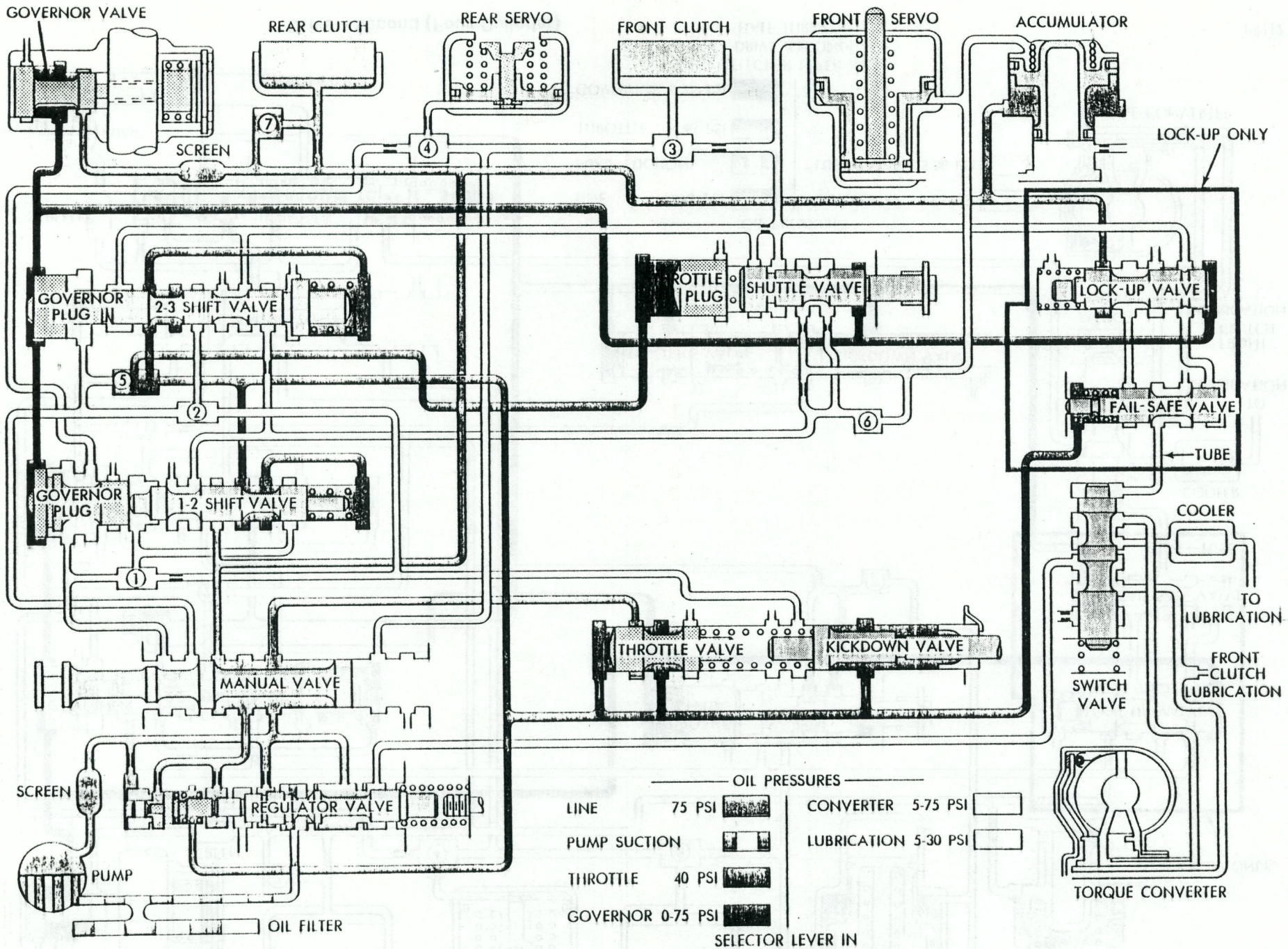
PR108



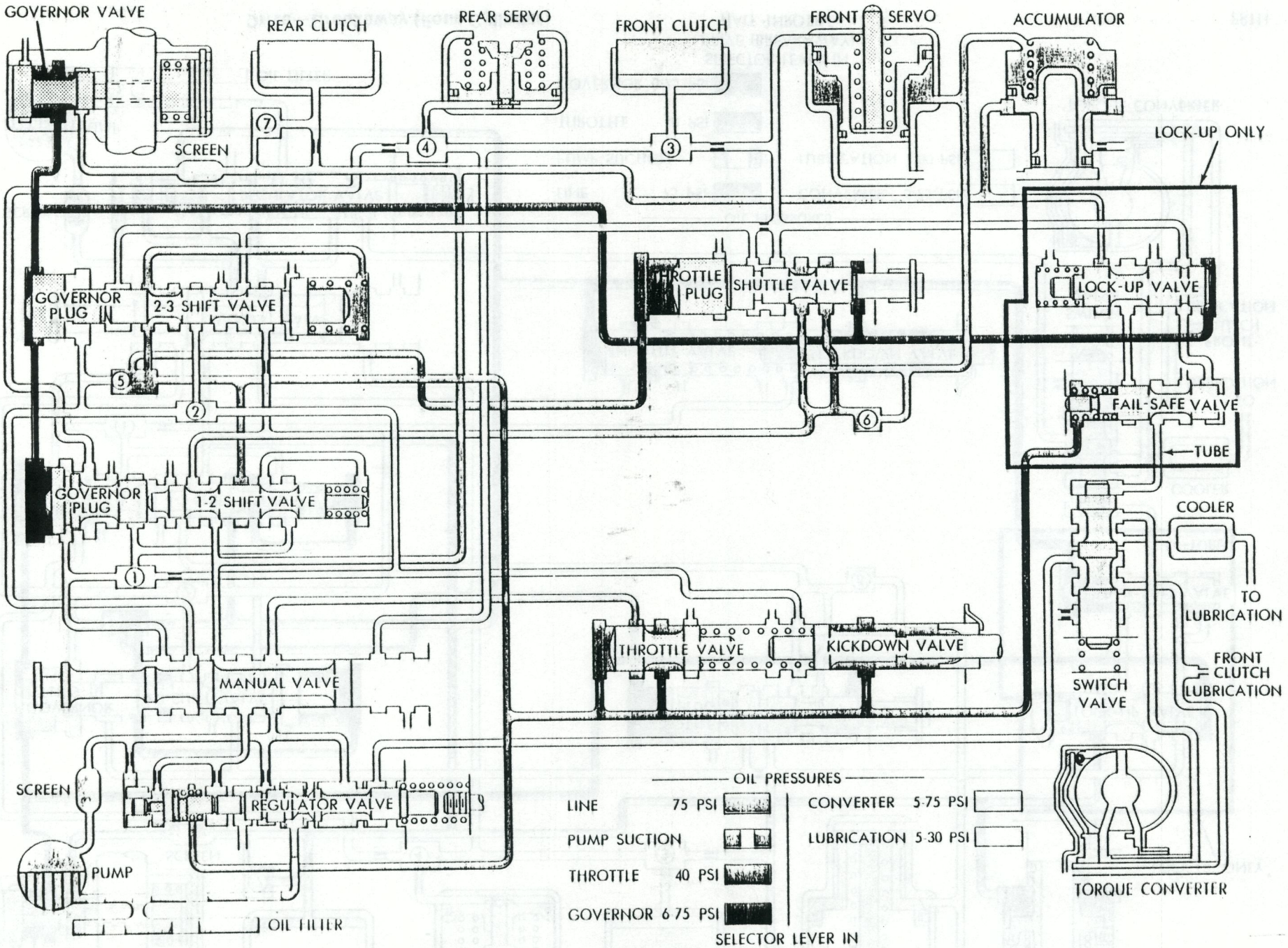
Selector Lever—One (Six- and Eight-Cylinder)



Reverse (Six- and Eight-Cylinder)

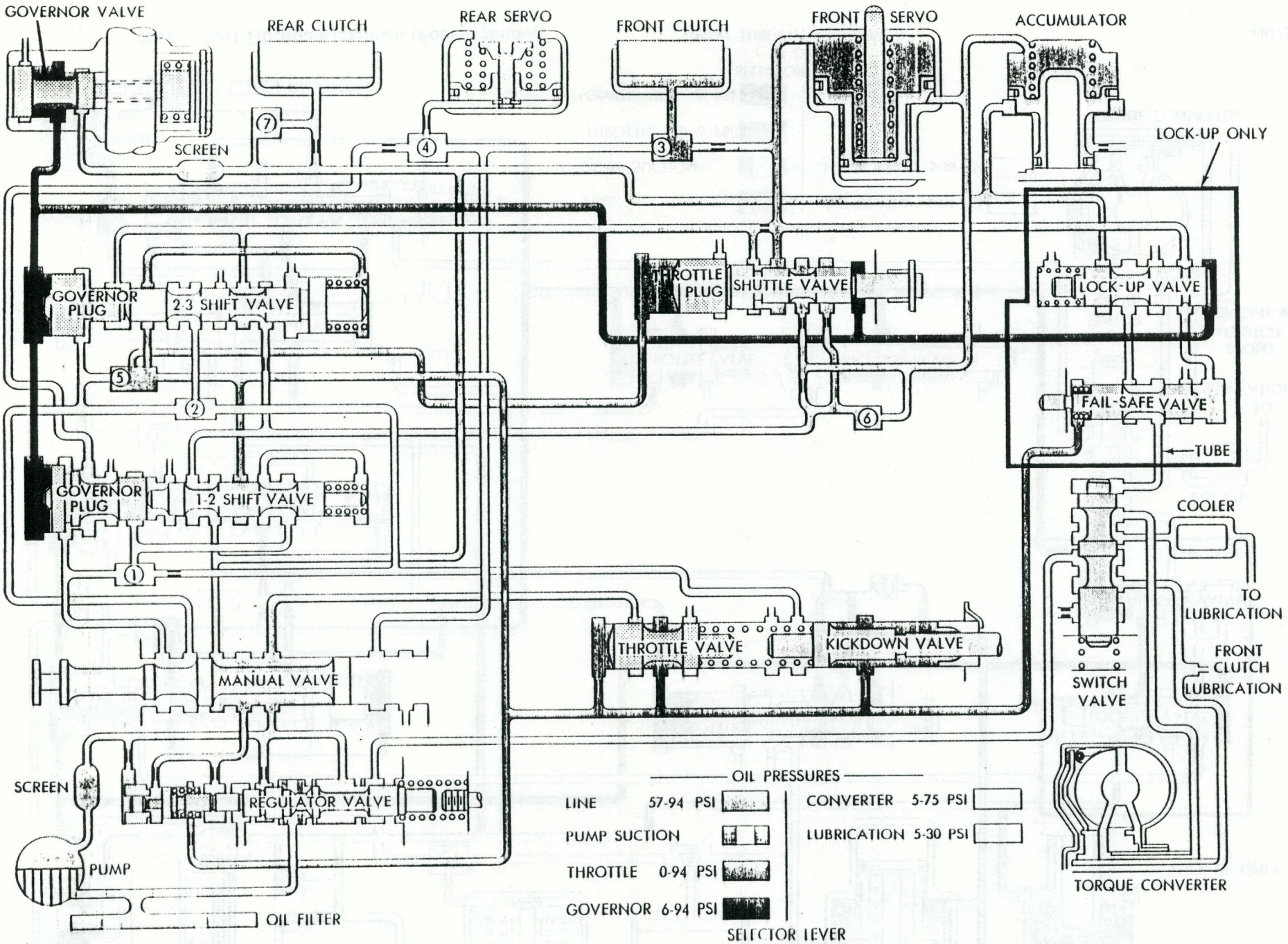


Drive—Breakaway (Four-Cylinder)

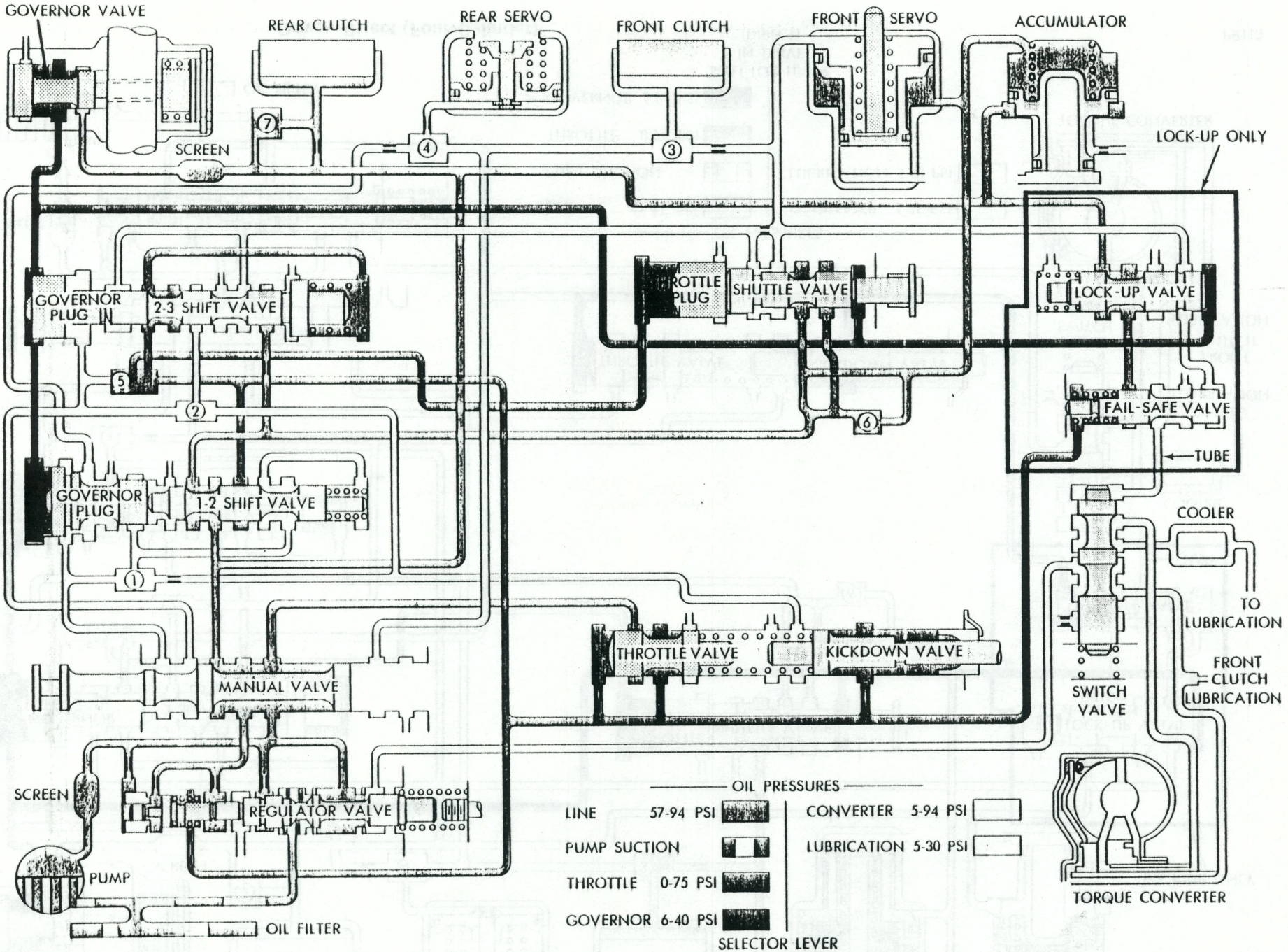


Drive—Second (Four-Cylinder)

PR112

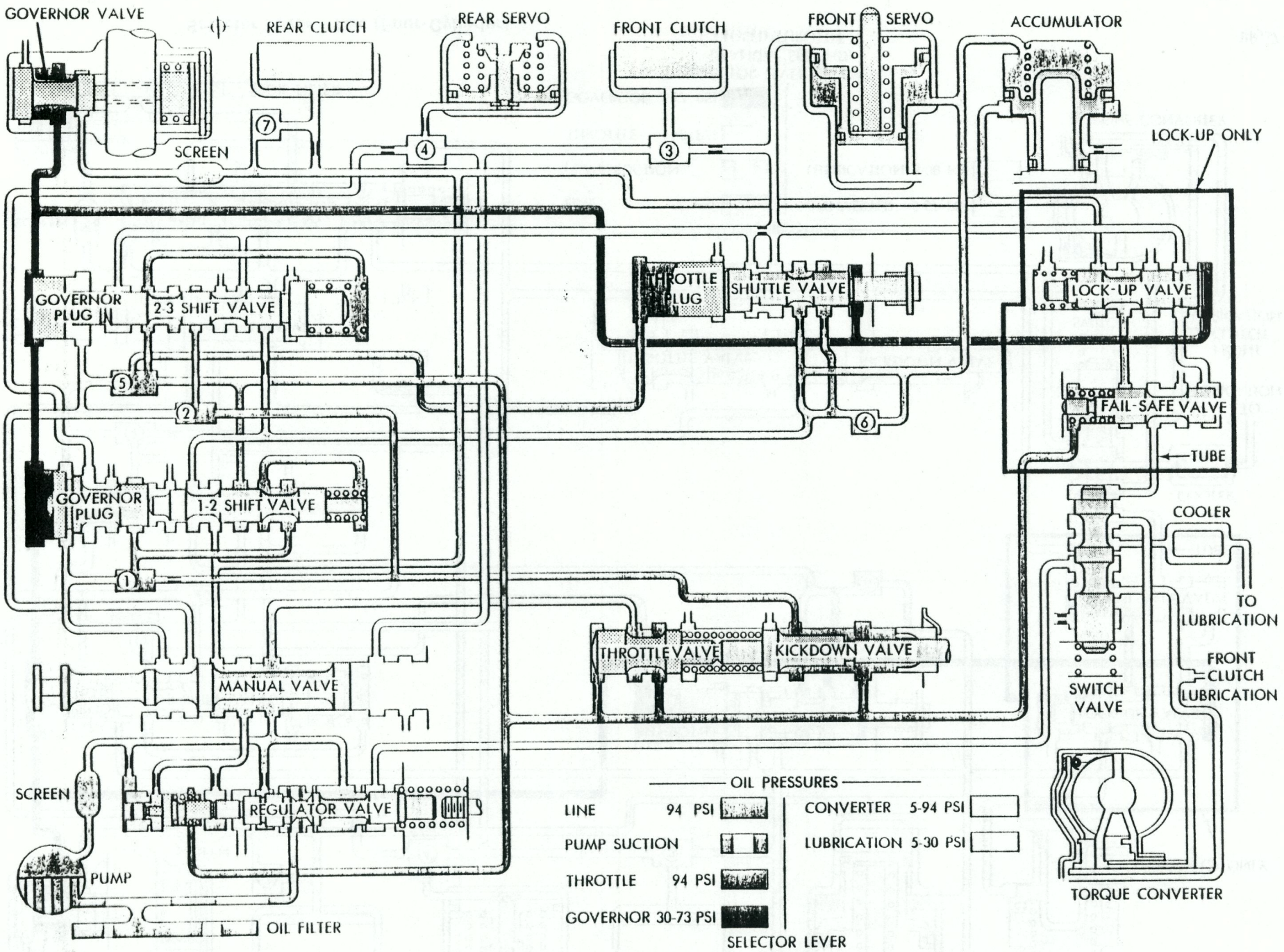


Drive—Direct (Four-Cylinder)

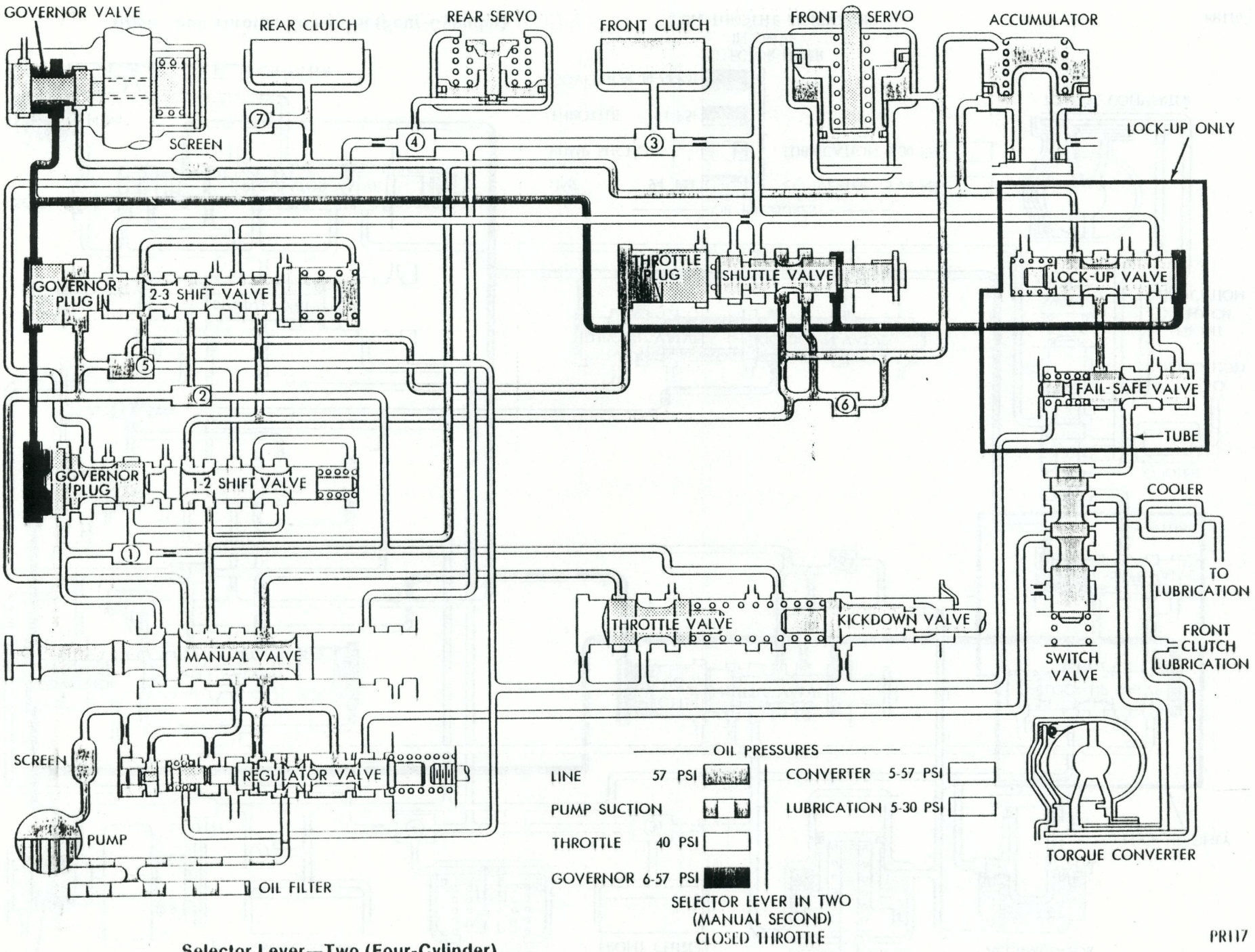


Drive—Part Throttle Kickdown (Four-Cylinder)

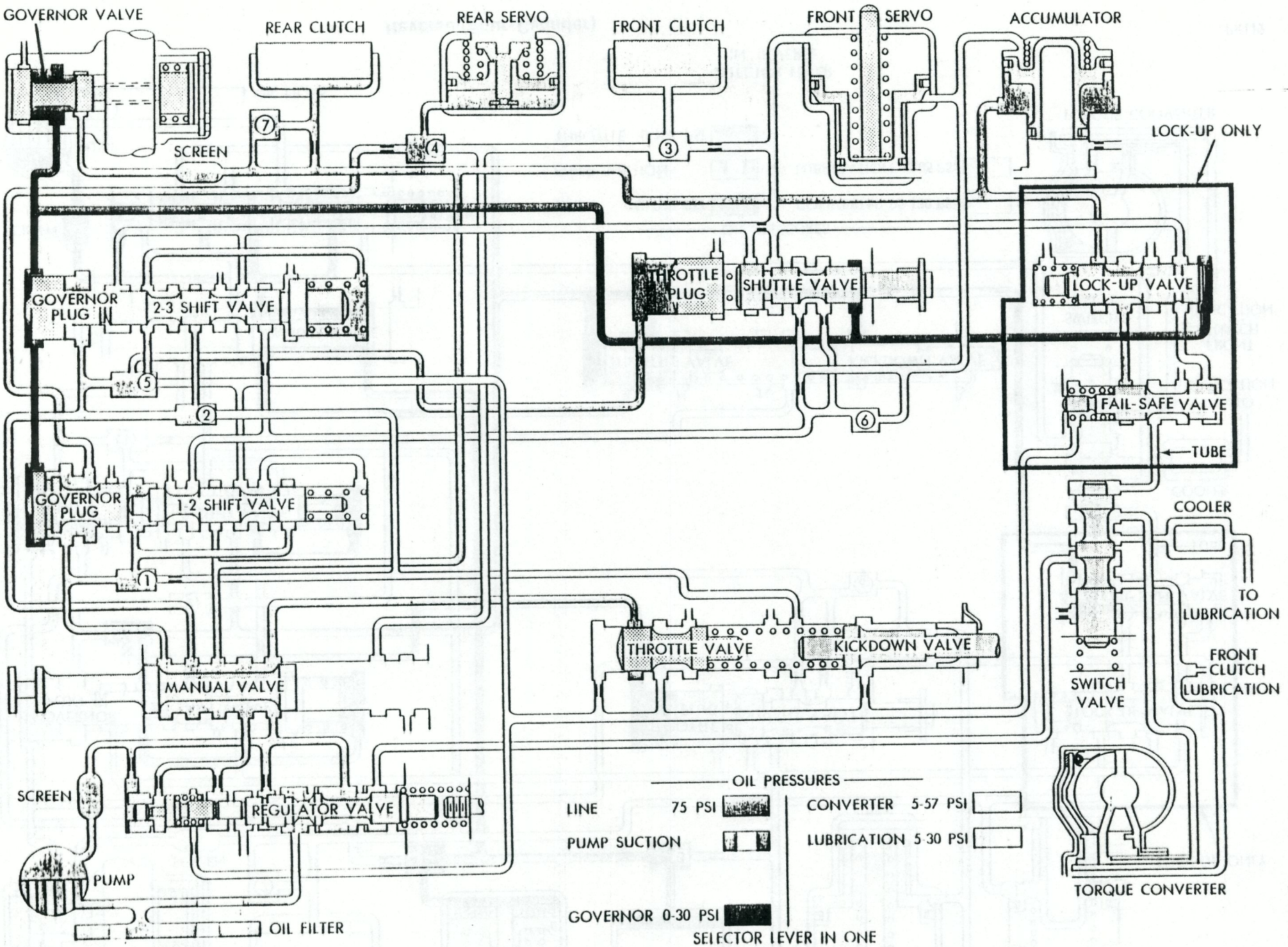
PR115



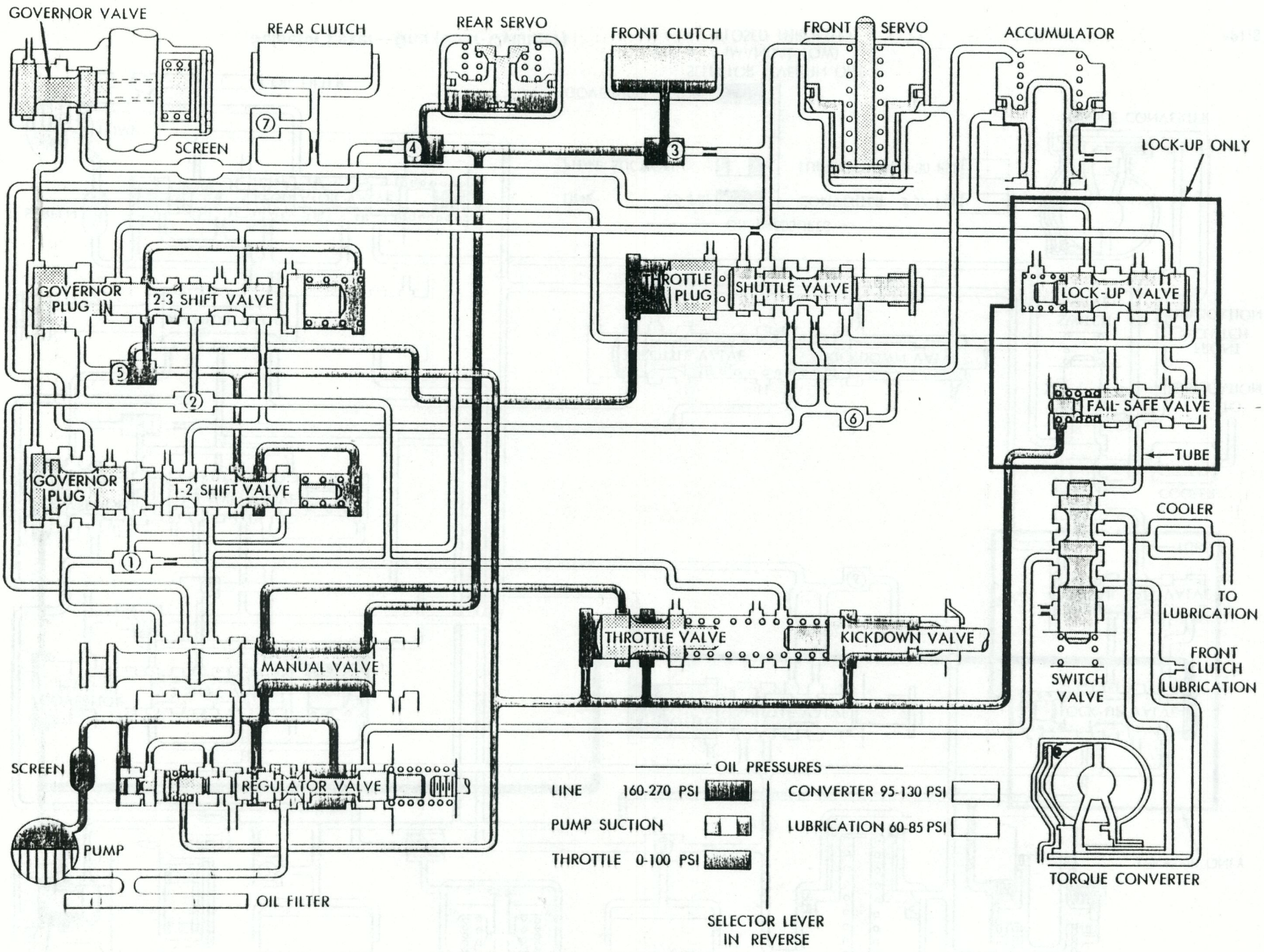
Drive—Full Throttle Kickdown (Four-Cylinder)



Selector Lever—Two (Four-Cylinder)



Selector Lever—One (Four-Cylinder)



Reverse (Four-Cylinder)

PR119

TRANSFER CASE 2D

SECTION INDEX

	Page		Page
General Information	2D-1	Model 300 Transfer Case	2D-37
Model 208 Transfer Case	2D-6	Tools	2D-48
Model 219 Quadra-Trac Transfer Case	2D-21		

GENERAL INFORMATION

	Page		Page
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Towing	2D-1	Transfer Case Service	2D-3
Transfer Case Installation	2D-5		

GENERAL

Three transfer case models are used in Jeep vehicles. They are models 208, 219 and 300. Models 208 and 219 are aluminum case chain drive units and are used in Cherokee, Wagoneer and Truck models exclusively. Model 300 is a cast iron case gearbox type unit and is used in CJ models only. All three models have an integral four-wheel low range.

Model 208 is a four position unit providing four-wheel drive high and low ranges, a two-wheel high range and a neutral position. Model 208 is a part-time four-wheel drive unit. Torque input in four-wheel high and low ranges is undifferentiated. The range positions on the model 208 are selected by a floor mounted gearshift lever. Refer to the model 208 section for shift patterns. Model 208 is the standard equipment transfer case for Cherokee, Wagoneer and Truck models. Front drive hubs are also standard equipment on Jeep models equipped with this transfer case.

The model 219 Quadra-Trac, full time four-wheel drive transfer case is available as an option on Cherokee, Wagoneer and Truck models with automatic transmission only. This transfer case is also a four position unit providing four-wheel high and low ranges, a neutral position for towing and a four-high lock position for use only when the vehicle is immobile due to excessive wheel spin.

The model 219 provides fully differentiated operation in four-wheel high range. This is accomplished through a torque biasing viscous coupling.

The 219 is a chain drive unit employing two drive sprockets and an interconnecting drive chain. The 219 range positions are selected by a floor mounted gearshift lever. Refer to the model 219 section for shift patterns.

NOTE: *Front drive hubs are not available nor recommended for vehicles equipped with the model 219 Quadra-Trac transfer case.*

Model 300 is a cast iron case, four position gearbox type transfer case. It is used in CJ models only and provides four-wheel high and low ranges, a neutral position and a two-wheel drive high range. Model 300 is a part-time unit. Torque input in four-wheel high and low ranges is undifferentiated.

TOWING

Emergency Towing

If the vehicle is disabled and is to be towed with the front or rear wheels off the ground, towing speed should be limited to 30 mph (48 km/h) for a distance no greater than 15 miles (24 km).

Towing Vehicles with Manual Transmission and Model 208 or 300 Transfer Case

Ignition Key Available: Shift transmission and transfer case into Neutral. Vehicle can now be towed with all four wheels on the ground or with front or rear wheels raised. Turn front drive hubs to 4 x 4 or Lock position. Turn ignition key to Off position to unlock steering column.

Ignition Key Not Available and Vehicle is Unlocked: Shift transmission and transfer case into Neutral and tow vehicle with front wheels raised.

Ignition Key Not Available and Vehicle is Locked: Place dolly under rear wheels and tow vehicle with front end raised. Or, disconnect rear propeller shaft at rear axle yoke (be sure to mark the shaft and yoke for proper alignment at reassembly), secure shaft to underside of vehicle, and tow with front end raised.

NOTE: *On CJ models, when towing vehicle over 200 miles (300 km), stop towing every 200 miles (300 km). With the transfer case still in N (Neutral) and transmission in gear, start engine and rev engine for about one minute to circulate oil in the transfer case.*

Towing Vehicle with Automatic Transmission and Model 208 or 300 Transfer Case

Ignition Key Available: Turn ignition key to Off position to unlock steering column and gearshift selector linkage. Move gearshift lever to Park and transfer case shift lever to Neutral.

Ignition Key Not Available: Place dolly under rear wheels and tow vehicle with front end raised. Or, disconnect rear propeller shaft at rear axle yoke (index mark yoke for correct assembly), secure shaft to underside of vehicle, and tow with front wheels raised.

NOTE: *On CJ models, when towing vehicle over 200 miles (300 km), stop towing every 200 miles (300 km) and with the transfer case still in N (Neutral), start engine, place automatic transmission in D (Drive), and rev engine for about one minute to circulate oil in the transfer case.*

Towing Vehicle with Automatic Transmission and Model 219 Quadra-Trac Transfer Case

Ignition Key Available: Vehicle can be towed with all four wheels on the ground without disconnecting propeller shafts. Turn ignition key to Off position to unlock steering wheel. Move gearshift lever to Park and shift transfer case shift lever to Neutral position.

Ignition Key Not Available: Place dolly under rear wheels and tow vehicle with front wheels raised. Or, disconnect rear propeller shaft at rear axle (mark yoke for correct assembly), secure shaft to underside of vehicle, and tow with front wheels raised.

Recreational Towing

Jeep vehicles can be towed behind a recreational vehicle such as a motor home, but the following instructions must be followed to avoid damaging drive line components. Also be sure to check and comply with federal, state and local laws or ordinances regarding this type of towing.

With Manual Transmission and Model 208 or Model 300 Transfer Case

(1) Turn ignition switch to Off position to unlock steering wheel.

(2) Shift transmission into gear and the transfer case into Neutral.

(3) Turn selective drive hubs to 4 x 4 or Lock position, for axle lubrication.

With Automatic Transmission and Model 208 or Model 300 Transfer Case

(1) Turn ignition switch to Off position to unlock steering wheel.

(2) Shift automatic transmission into Park.

(3) Shift transfer case into Neutral position.

(4) Turn selective drive hubs to 4 x 4 or Lock position for axle lubrication.

With Automatic Transmission and Model 219 Quadra-Trac Transfer Case

(1) Turn ignition switch to Off position to unlock steering wheel.

(2) Shift automatic transmission into Park.

(3) Shift transfer case into Neutral position.

Trailer Towing and Campers

The Jeep Corporation new vehicle warranty includes conditions and limitations for vehicles used in towing trailers or campers or installation of slide-in campers on Jeep Trucks. The requirements and recommendations in this manual and other factory literature must be followed in order to maintain this coverage.

In addition to the vehicle maintenance and servicing requirements set forth in this manual, the GVW and GAW ratings are of special significance. When a Jeep vehicle is to be used for trailer or camper towing, or slide-in camper installations in Jeep Trucks, it is extremely important that the GVW or GAW ratings not be exceeded by the addition of:

- The tongue weight of a trailer.
- The weight transferred to a Truck model by the mounting of a fifth-wheel trailer.
- The weight of a slide-in camper or any other type of truck camper.
- The weight of any other type of vehicle put in or on the towing vehicle.

Remember that additional items placed in or on the trailer or mounted camper will add to the load.

CAUTION: *Jeep Corporation will not be responsible for brake performance if the Jeep vehicle and trailer hydraulic brake systems are interconnected in any way. A separate brake system is recommended, and actually required in some states, for all trailers weighing 1,000 pounds (454 kg) or more.*

TRANSFER CASE SERVICE

All three transfer case models are fully serviceable units and can be disassembled for cleaning, inspection, overhaul and adjustment procedures. In-vehicle and out-of-vehicle servicing procedures are outlined in this chapter. Refer to the necessary subsection for service diagnosis, principles of operation and all servicing, lubrication, and adjustment procedures.

TRANSFER CASE SHIFT LINKAGE

Cherokee-Wagoneer-Truck with Manual Transmission

Removal

(1) Raise vehicle.

(2) Disconnect shift lever link from operating lever and transfer case shift lever (fig. 2D-1). Do not lose washers, grommets, and bushings that retain link in levers.

(3) Lower vehicle.

(4) Remove screws attaching shift lever boot to floorpan and slide boot upward on shift lever.

(5) Remove screws attaching shift lever support bracket to floorpan (fig. 2D-1).

(6) Remove knob from transfer case shift lever.

(7) Slide shift lever out of boot and remove lever and support bracket as assembly.

(8) Remove shoulder bolt from support bracket and remove shift lever from bracket. Do not lose shift lever bushing or spring washer.

(9) Inspect lever, link, support bracket, shoulder bolt and bushings. Replace any component that is bent, cracked, broken, scored or excessively worn.

Installation

(1) Install shift lever bushing in shift lever (fig. 2D-1).

(2) Install shift lever in support bracket.

(3) Align lever bushing with holes in support bracket and install spring washer and shoulder bolt. Tighten bolt securely.

(4) Slide shift lever into boot and into floorpan hole.

(5) Position lever support bracket on floorpan and install bracket attaching screws.

(6) Install knob on shift lever.

(7) Raise vehicle.

(8) Install grommet in operating lever, if removed.

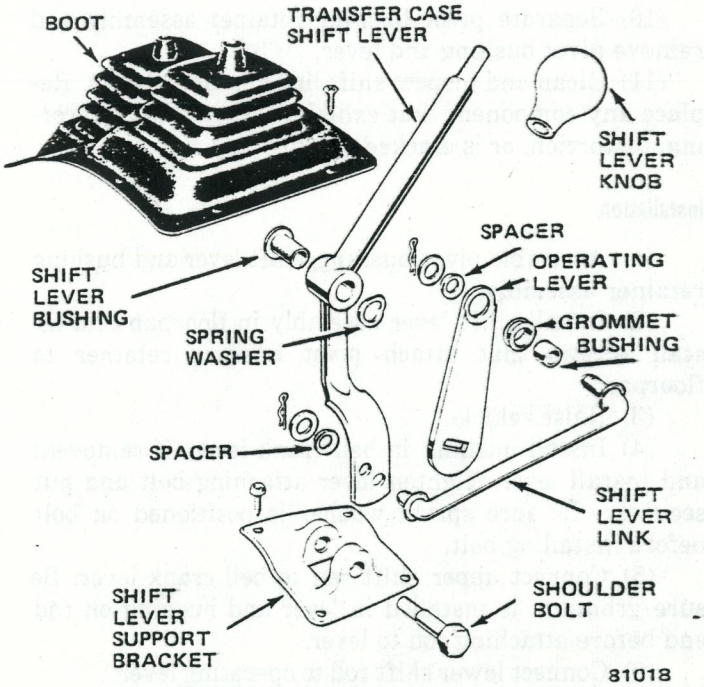

Fig. 2D-1 Transfer Case Shift Linkage—Cherokee-Wagoneer-Truck with Manual Transmission

(9) Install bushing on end of shift lever link that attaches to operating lever.

(10) Connect shift lever link to operating lever and shift lever using spacers and washers removed previously, and new cotter pins.

(11) Lower vehicle.

(12) Install screws that attach shift lever boot to floorpan.

Cherokee-Wagoneer-Truck with Automatic Transmission

Removal

(1) Remove screws attaching pivot bushing retainer assembly to floorpan (fig. 2D-2).

(2) Raise vehicle.

(3) Disconnect lower shift rod at operating lever (fig. 2D-2). Retain flat washer, wave washer and push-on retainer that attach rod end to lever.

(4) Disconnect upper shift rod at shift lever. Retain cotter pin, spacer, and washer that attach rod end to shift lever.

(5) Disconnect lower shift rod at bell crank lever. Retain cotter pin, spacer and washer that attach lower shift rod trunnion to bell crank (fig. 2D-2).

(6) Disconnect upper shift rod at bell crank lever. Retain bushing, cotter pin, spacer, and washer that attach rod end to bell crank.

(7) Remove bolt, nut and spring washer that attach bell crank lever (fig. 2D-2). Remove lever and bushing.

(8) Lower vehicle.

(9) Remove shift lever, pivot bushing and bushing retainer as assembly.

(10) Separate pivot bushing retainer assembly and remove pivot bushing and lever.

(11) Clean and inspect shift linkage components. Replace any component that exhibits excessive wear, scoring, distortion, or is cracked, bent or broken.

Installation

(1) Assemble pivot bushing, shift lever and bushing retainer assembly.

(2) Install shift lever assembly in floorpan and install screws that attach pivot bushing retainer to floorpan.

(3) Raise vehicle.

(4) Install bushing in bell crank lever (if removed) and install lever. Tighten lever attaching bolt and nut securely. Be sure spring washer is positioned on bolt before installing bolt.

(5) Connect upper shift rod to bell crank lever. Be sure grommet is installed in lever and bushing on rod end before attaching rod to lever.

(6) Connect lower shift rod to operating lever.

(7) Connect lower shift rod trunnion to bell crank lever.

(8) Connect upper shift rod to transfer case shift lever.

(9) Lower vehicle.

(10) Check linkage operation. If adjustment is necessary, adjust linkage at lower shift rod trunnion. Loosen trunnion jamnuts and position trunnion on rod as required to obtain desired adjustment.

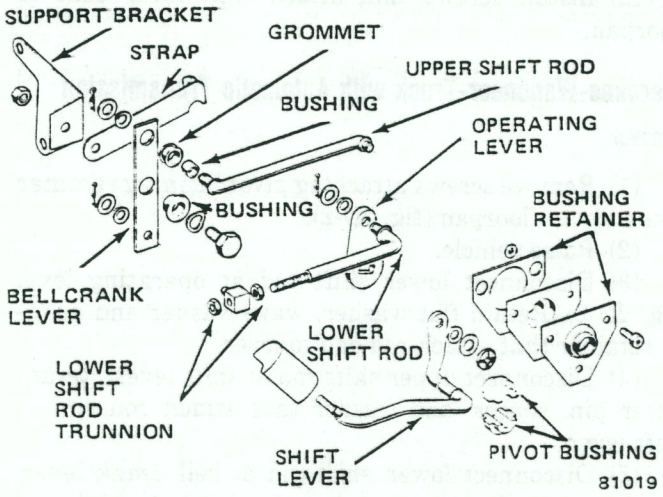

Fig. 2D-2 Transfer Case Shift Linkage—Cherokee-Wagoneer-Truck with Automatic Transmission

CJ Models—With Manual or Automatic Transmission

Removal

(1) Remove screws that attach shift lever boot to floorpan.

(2) Remove shift lever knob and slide boot up and off lever.

(3) Raise vehicle.

(4) Remove shifter shaft retaining nut (fig. 2D-3).

(5) Remove cotter pins that retain link pins in shift rods and remove link pins. Discard old cotter pins.

(6) Remove shifter shaft from shift lever.

NOTE: *On some models, the shifter shaft is treaded into the shift lever and must be unthreaded to remove it. On other models, the shaft is removed simply by sliding it out of the lever and front cover bosses.*

(7) Remove shift lever.

(8) Remove shift and shift control links from shift rods.

(9) Clean and inspect linkage components. Replace any component that is broken, bent, cracked, or excessively worn or scored.

Installation

(1) Install shift and shift control links.

(2) Install shift lever.

(3) Install shifter shaft in front cover bosses and shift lever.

(4) Install and tighten shifter shaft retaining nut.

(5) Install link pins in shift rods. Secure pins with new cotter pins.

(6) Lower vehicle.

(7) Install boot on shift lever.

(8) Install knob on shift lever.

(9) Position boot on floorpan and install boot attaching screws.

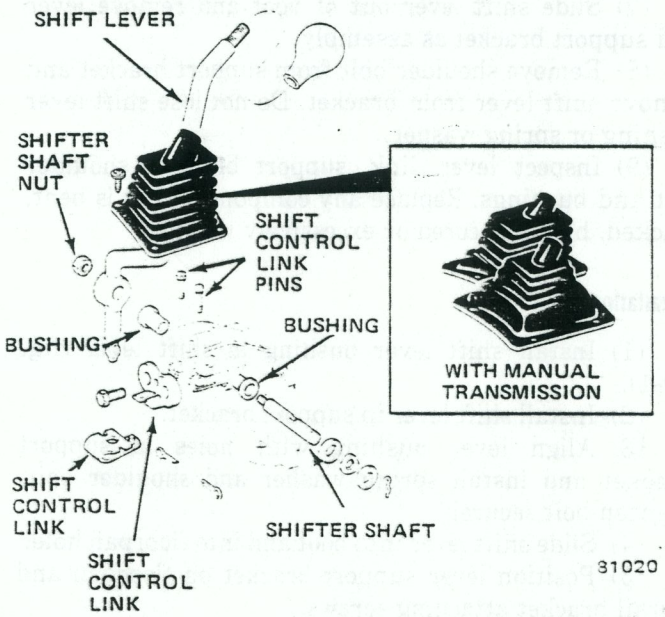

Fig. 2D-3 Transfer Case Shift Linkage—CJ Models with Manual or Automatic Transmission

TRANSFER CASE REMOVAL

Removal—Cherokee-Wagoneer-Truck Models

(1) Raise vehicle.

(2) Drain lubricant from transfer case.

(3) Disconnect speedometer cable and indicator switch wires and disconnect transfer case shift lever link at operating lever.

(4) Place support stand under transmission and remove rear crossmember.

(5) Mark transfer case front and rear output shaft yokes and propeller shafts for assembly alignment reference.

(6) Disconnect front and rear propeller shafts at transfer case yokes. Secure shafts to frame rails with wire.

(7) Disconnect parking brake cable guide from pivot located on right frame rail, if necessary.

(8) Remove bolts attaching exhaust pipe support bracket-to-transfer case, if necessary.

(9) Remove transfer case-to-transmission bolts.

(10) Move transfer case assembly rearward until free of transmission output shaft and remove assembly.

(11) Remove all gasket material from rear of transmission adapter housing.

Removal—CJ Models

(1) On models with automatic transmission, remove shift lever knob, trim ring, and boot from transfer case shift lever.

(2) On models with manual transmission, remove shift lever knob, trim ring and boot from transmission and transfer case shift levers.

(3) Remove floor covering, if equipped, and remove transmission access cover from floorpan.

(4) Raise vehicle and drain lubricant from transfer case.

(5) Position support stand under clutch housing to support engine and transmission and remove rear crossmember.

(6) Disconnect front and rear propeller shafts at transfer case. Mark propeller shaft yokes for assembly reference.

(7) Disconnect speedometer cable at transfer case.

(8) If necessary, disconnect parking brake cable at equalizer. Disconnect exhaust pipe support bracket at transfer case, if equipped.

(9) Remove bolts attaching transfer case to transmission and remove transfer case.

TRANSFER CASE INSTALLATION

Installation—Cherokee-Wagoneer-Truck Models

(1) Align and install transfer case assembly on transmission. Be sure transfer case input gear splines are aligned with transmission output shaft. Align splines by rotating transfer case rear output shaft yoke, if necessary.

NOTE: *Do not install any transfer case attaching bolts until the transfer case is completely seated against the transmission.*

(2) Align and install transfer case attaching bolts. Tighten bolts to 40 foot-pounds (54 N•m) torque.

(3) Attach exhaust pipe support bracket to transfer case, if removed.

(4) Align and connect propeller shafts.

(5) Connect parking brake cable guide to pivot bracket on frame rail, if removed.

(6) Connect speedometer cable and indicator switch wires and connect transfer case shift lever link to operating lever.

(7) Install rear crossmember and remove transmission support stand.

(8) Fill transfer case with 10W-30 motor oil.

(9) Lower vehicle.

Installation—CJ Models

(1) Shift transfer case to 4L position.

(2) Rotate transfer case output shaft (by turning yoke) until transmission output shaft gear engages transfer case input shaft. Move transfer case forward until case seats against transmission.

CAUTION: *Be sure the transfer case is flush against the transmission. Severe damage to the transfer case will result if the attaching bolts are tightened while the transfer case is cocked or in a bind.*

(3) Install transfer case attaching bolts. Tighten bolts to 30 foot-pounds (41 N•m) torque.

(4) Fill transfer case with gear lubricant.

(5) Connect speedometer driven gear to transfer case. Also connect transfer case shift lever and control links to transfer case shift rods.

(6) Connect front and rear propeller shafts to transfer case. Be sure to align shafts-to-yokes using reference marks made during removal. Tighten shaft-to-yoke clamp strap nuts to 16 foot-pounds (21 N•m) torque.

(7) Install rear crossmember and remove support stand from under clutch housing.

(8) Connect parking brake cable to equalizer and connect exhaust pipe support bracket to transfer case if disconnected.

(9) Lower vehicle.

(10) Install transmission access cover plate on floorpan. Install floor covering, if equipped.

(11) Install boots, trim rings, and shift knobs.

MODEL 208 TRANSFER CASE

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GENERAL

The model 208 transfer case provides four-wheel high and low ranges, a two-wheel high range and a neutral position. The model 208 is used in Cherokee, Wagoneer and Truck models only. Models equipped with the 208 transfer case are also equipped with manual locking front drive hubs as standard equipment.

The model 208 is a chain drive unit consisting of a two-piece aluminum case containing front and rear output shafts, two drive sprockets, a shift mechanism and a planetary gear assembly. The drive sprockets are connected and operated by the drive chain. The planetary assembly which consists of a four pinion carrier and an annulus gear provide the four-wheel drive low range when engaged. Reduction ratio is 2.61:1 in low range.

Transfer Case Shift Pattern

A floor mounted shift lever is used to select the various operating ranges on all 208 models. The shift lever is located on the floorpan transmission tunnel adjacent to the transmission gearshift lever. Although the transfer case shift pattern is in a straight line for all 208 models, the range positions are different for manual and automatic transmission applications (figs. 2D-4 and 2D-5).

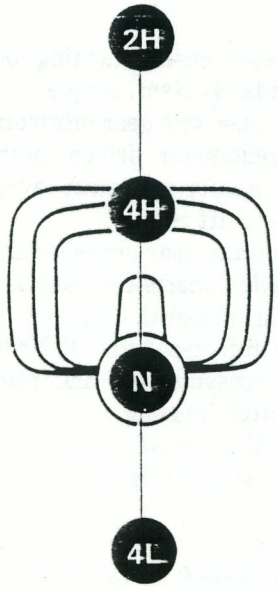

Fig. 2D-4 Model 208 Shift Pattern—Manual Transmission

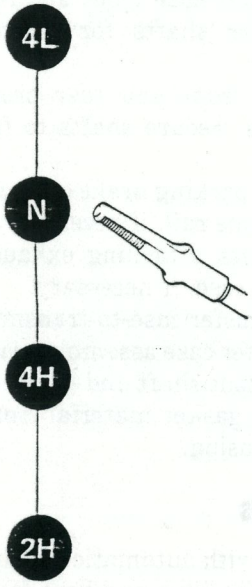

Fig. 2D-5 Model 208 Shift Pattern—Automatic Transmission

Four-Wheel Drive Indicator Lamp

An indicator lamp is mounted in the instrument panel to alert the driver whenever the vehicle is being operated in four-wheel high range. The lamp is controlled by an indicator switch in the transfer case (fig. 2D-6). The switch is a ball and plunger unit that is activated by the transfer case range sector when four-wheel high range is selected. The indicator lamp is illuminated in the four-wheel high range position only.

IDENTIFICATION

An identification tag is attached to the rear half of the transfer case (fig. 2D-6). This tag provides the transfer case model number, low range reduction ratio, and assembly number. The information on this tag is necessary for servicing information. If the tag is removed or becomes dislodged during service operations, it should be reattached using an adhesive sealant such as Loctite 312, or equivalent.

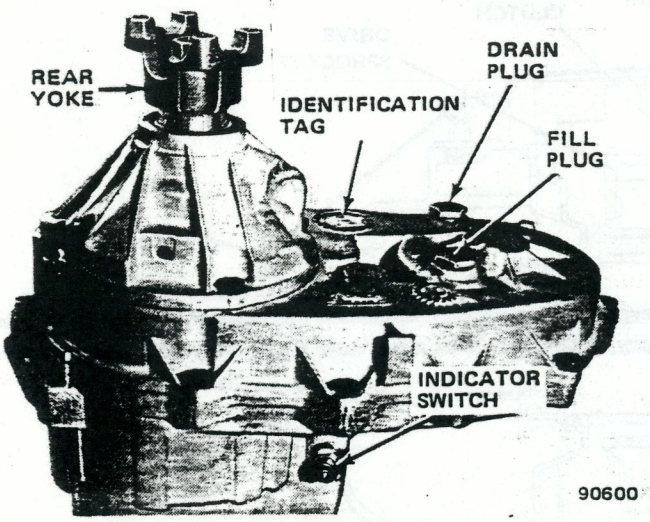

Fig. 2D-6 Model 208 Indicator Switch, Identification Tag and Drain and Fill Plug Location

LUBRICATION

The model 208 transfer case lubricant should be changed at the intervals specified in the Maintenance Schedule. When adding lubricant to or refilling the transfer case after service, use a quality grade 10W-30 motor oil only. Do not use any type of anti-friction type additives or similar substance. Use the specified grade of motor oil only. Refer to the In-Vehicle Service section for lubricant change procedures and fill level. Model 208 lubricant capacity is 6 pints (3 liters).

POWER FLOW

In all drive range positions input torque is transmitted to the transfer case geartrain through the transfer case input gear (fig. 2D-7).

In 2H range, torque flows from the input gear to the planetary assembly and annulus gear which rotate as a unit. Torque is transferred to the mainshaft through the planetary carrier which is splined to the mainshaft. Torque flow continues through the mainshaft and rear yoke which is splined to the mainshaft, and finally to the rear propeller shaft and axle. In 2H range, the sliding clutch remains in a neutral position and does not lock the drive sprocket to the mainshaft. As a result, torque is not transferred to the driven sprocket.

In 4H range, input torque from the input gear is transmitted through the planetary and annulus gear and through the mainshaft in exactly the same fashion as in 2H range. However, in 4H position, the sliding clutch is shifted forward and into engagement with the mainshaft clutch gear. This locks the drive sprocket to the mainshaft through the sliding clutch. Torque is now transmitted through the drive sprocket to the driven sprocket by the connecting drive chain. Since the front output shaft is splined to the driven sprocket, torque now flows through the front output shaft to the front propeller shaft and axle resulting in high range four-wheel drive.

In 4L range, the path of torque through the transfer case is exactly the same as in 4H range but with one major difference. In 4L range, the annulus gear is shifted forward and into engagement with the lockplate. Since the lockplate is fixed in the case, the annulus gear is held stationary and does not rotate. This causes the planetary pinions to rotate about the annulus gear internal teeth producing a gear reduction ratio of 2.61:1.

SERVICE DIAGNOSIS

Before attempting to repair a suspected transfer case malfunction, check all other drive line components beforehand. The actual cause of a problem may be related to such items as the front hubs, axles, propeller shafts, wheels and tires, transmission, or clutch instead. If all other drive line components are in good condition and operating properly, refer to the Service Diagnosis charts for further information.

IN-VEHICLE SERVICE

Changing Lubricant

(1) Raise vehicle.
(2) Position drain pan under transfer case.
(3) Remove drain and fill plugs, and drain lubricant completely.
(4) Install drain plug. Tighten plug to 35 foot-pounds (47 N•m) torque.
(5) Remove drain pan.
(6) Fill transfer case to edge of fill plug opening with 10W-30 motor oil (only).
(7) Install fill plug. Tighten plug to 35 foot-pounds (47 N•m) torque.
(8) Lower vehicle.

Speedometer Gear, Shaft Seal, Rear Bearing and Retainer, Oil Pump and Pump Seal Replacement

NOTE: *The front and rear yokes, output shaft seals, rear retainer and bearing, oil pump, pump seal, and speedometer drive gear can all be serviced with the transfer case in the vehicle. The following combined procedure outlines removal and installation of these components.*

Removal

(1) Raise vehicle.
(2) Remove fill and drain plugs and drain oil from transfer case.
(3) Mark propeller shaft and transfer case yoke for assembly alignment reference.

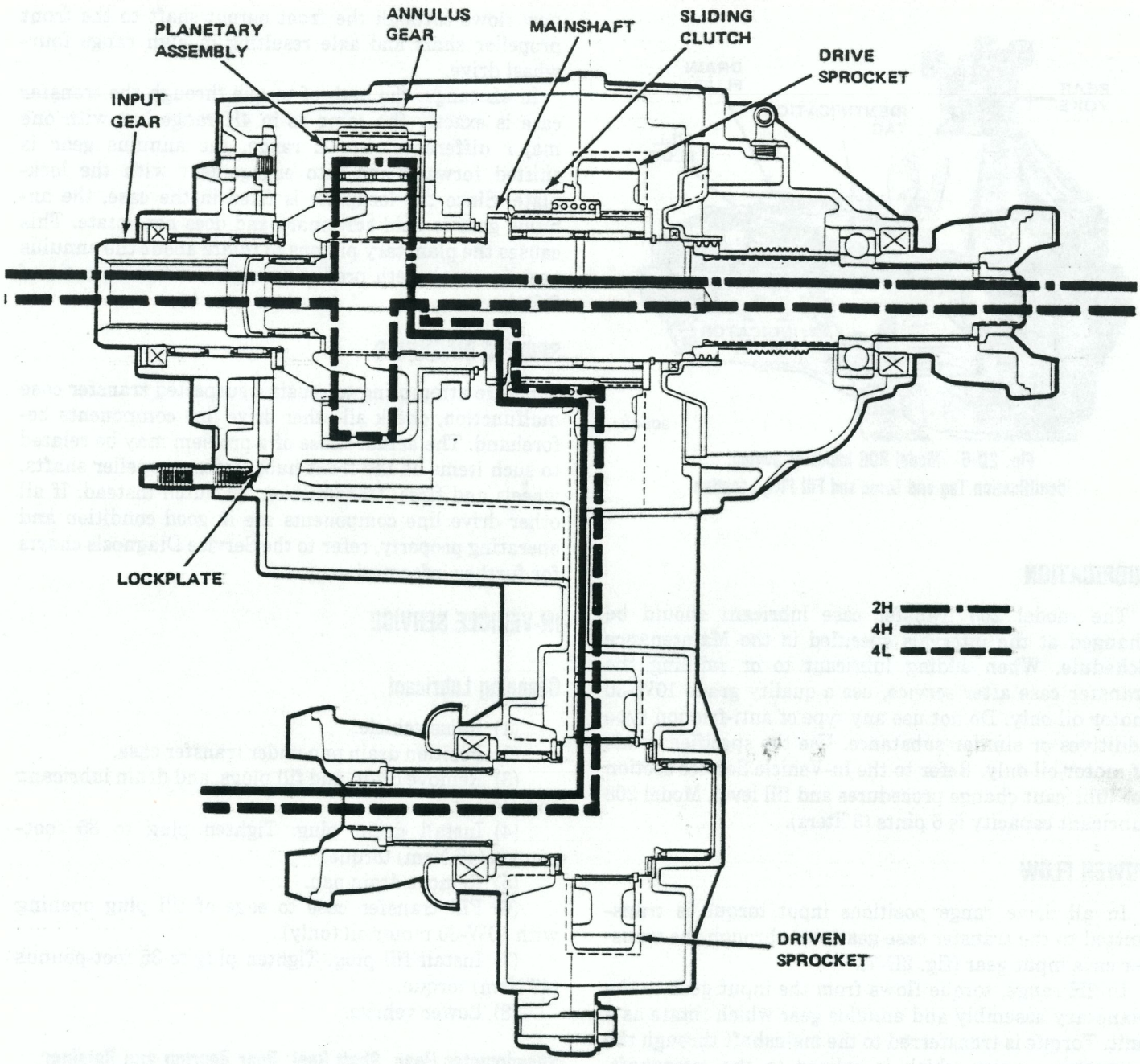

Fig. 2D-7 Power Flow—Model 208 Transfer Case

(4) Disconnect propeller shaft. Secure shaft to underside of vehicle.

(5) Remove and discard transfer case yoke retaining nut and yoke seal washer. Use Tool J-8614-01 to hold yoke while removing nut.

(6) Remove yoke. If necessary, remove yoke using Tools J-8614-01, -02 and -03.

(7) Remove speedometer driven gear sleeve and driven gear from rear retainer.

(8) Mark rear retainer for assembly alignment reference.

(9) Remove retainer attaching bolts and remove retainer. Tap retainer with rawhide or plastic mallet to remove it.

CAUTION: *Do not attempt to pry the retainer off the rear case. Tap the retainer loose using a rawhide or plastic mallet only.*

(10) Remove speedometer drive gear.

(11) Remove pump housing from retainer and remove seal from housing (fig. 2D-8).

(12) If retainer or bearing are to be replaced, remove bearing retaining snap ring from rear retainer and tap bearing out of retainer using plastic mallet.

(13) Remove oil pump from mainshaft (fig. 2D-5).

(14) Remove output shaft seal if seal is to be replaced.

Service Diagnosis

Condition	Possible Cause	Correction
TRANSFER CASE DIFFICULT TO SHIFT OR WILL NOT SHIFT INTO DESIRED RANGE	(1) Vehicle speed too great to permit shifting.	(1) Stop vehicle and shift into desired range. Or reduce speed to 2-3 mph (3-4 km/h) before attempting to shift.
	(2) If vehicle was operated for extended period in 4H mode on dry paved surface, driveline torque load may cause difficult shifting.	(2) Stop vehicle, shift transmission to neutral, shift transfer case to 2H mode and operate vehicle in 2H on dry paved surfaces.
	(3) Transfer case external shift linkage binding.	(3) Lubricate or repair or replace linkage, or tighten loose components as necessary.
	(4) Insufficient or incorrect lubricant.	(4) Drain and refill to edge of fill hole with 10W-30 motor oil having API classification SE only.
	(5) Internal components binding, worn, or damaged.	(5) Disassemble unit and replace worn or damaged components as necessary.
TRANSFER CASE NOISY IN ALL DRIVE MODES	(1) Insufficient or incorrect lubricant.	(1) Drain and refill to edge of fill hole with 10W-30 motor oil only. Check for leaks and repair if necessary. Note: If unit is still noisy after drain and refill, disassembly and inspection may be required to locate source of noise.
NOISY IN — OR JUMPS OUT OF FOUR WHEEL DRIVE LOW RANGE	(1) Transfer case not completely engaged in 4L position.	(1) Stop vehicle, shift transfer case in Neutral, then shift back into 4L position.
	(2) Shift linkage loose or binding.	(2) Tighten, lubricate, or repair linkage as necessary.
	(3) Range fork cracked, inserts worn, or fork is binding on shift rail.	(3) Disassemble unit and repair as necessary.
	(4) Annulus gear or lockplate worn or damaged.	(4) Disassemble unit and repair as necessary.

Service Diagnosis (Continued)

Condition	Possible Cause	Correction
LUBRICANT LEAKING FROM OUTPUT SHAFT SEALS OR FROM VENT	(1) Transfer case overfilled.	(1) Drain to correct level.
	(2) Vent closed or restricted.	(2) Clear or replace vent if necessary.
	(3) Output shaft seals damaged or installed incorrectly.	(3) Replace seals. Be sure seal lip faces interior of case when installed. Also be sure yoke seal surfaces are not scored or nicked. Remove scores, nicks with fine sandpaper or replace yoke(s) if necessary.
ABNORMAL TIRE WEAR	(1) Extended operation on dry hard surface (paved) roads in 4H range.	(1) Operate in 2H on hard surface (paved) roads.

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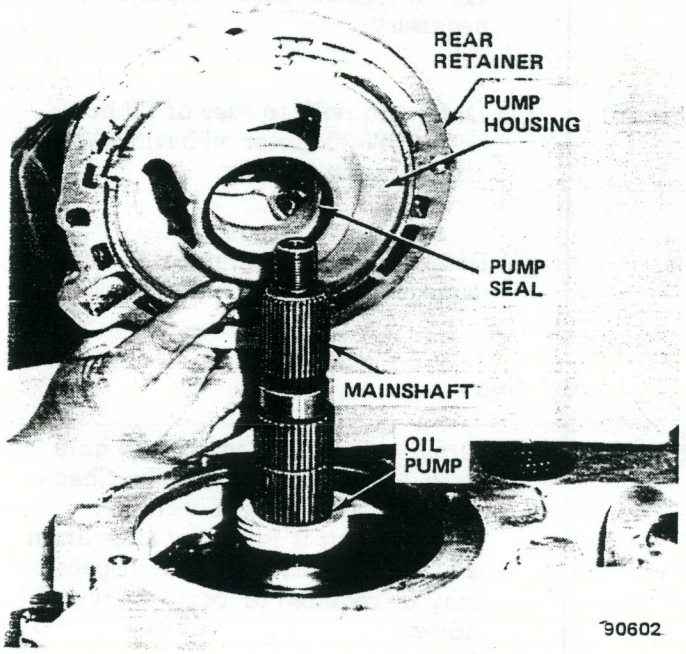


Fig. 2D-8 Rear Retainer Removal/Installation

Installation

(1) Install oil pump on mainshaft.

(2) Install seal in pump housing. Be sure to install seal so lip faces case interior. Lubricate seal lip with petroleum jelly or 10W-30 motor oil before installation.

(3) Install speedometer driven gear.

(4) Install rear output bearing in rear retainer and install snap ring. Be sure shielded side of bearing faces interior of transfer case.

(5) Install pump housing in rear retainer.

(6) Apply Loctite 515, or equivalent sealant, to mating surface of rear retainer.

(7) Align retainer and case reference marks and install retainer on case.

(8) Install and tighten retainer attaching bolts to 23 foot-pounds (31 N•m) torque.

(9) Install output shaft seal.

(10) Install yoke, yoke seal washer and yoke nut. Tighten nut to 120 foot-pounds (163 N•m) torque.

(11) Install speedometer driven gear and sleeve.

(12) Install drain plug. Tighten plug to 35 foot-pounds (47 N•m) torque.

(13) Fill transfer case to edge of fill plug opening with 10W-30 motor oil (only).

(14) Install fill plug. Tighten plug to 35 foot-pounds (47 N•m) torque.

(15) Connect propeller shaft. Tighten clamp strap bolts to 16 foot-pounds (21 N•m) torque.

(16) Lower vehicle.

DISASSEMBLY

(1) Remove fill and drain plugs (fig. 2D-9).

(2) Remove front and rear yokes. Discard yoke seal washers and yoke nuts.

(3) Turn transfer on end and position front case on wood blocks. Cut "V" notches in wood blocks to clear mounting studs in front case if necessary.

(4) Remove lock mode indicator switch and washer (fig. 2D-9).

(5) Remove detent bolt, spring and ball (fig. 2D-10).

(6) Mark rear retainer and case for assembly alignment reference.

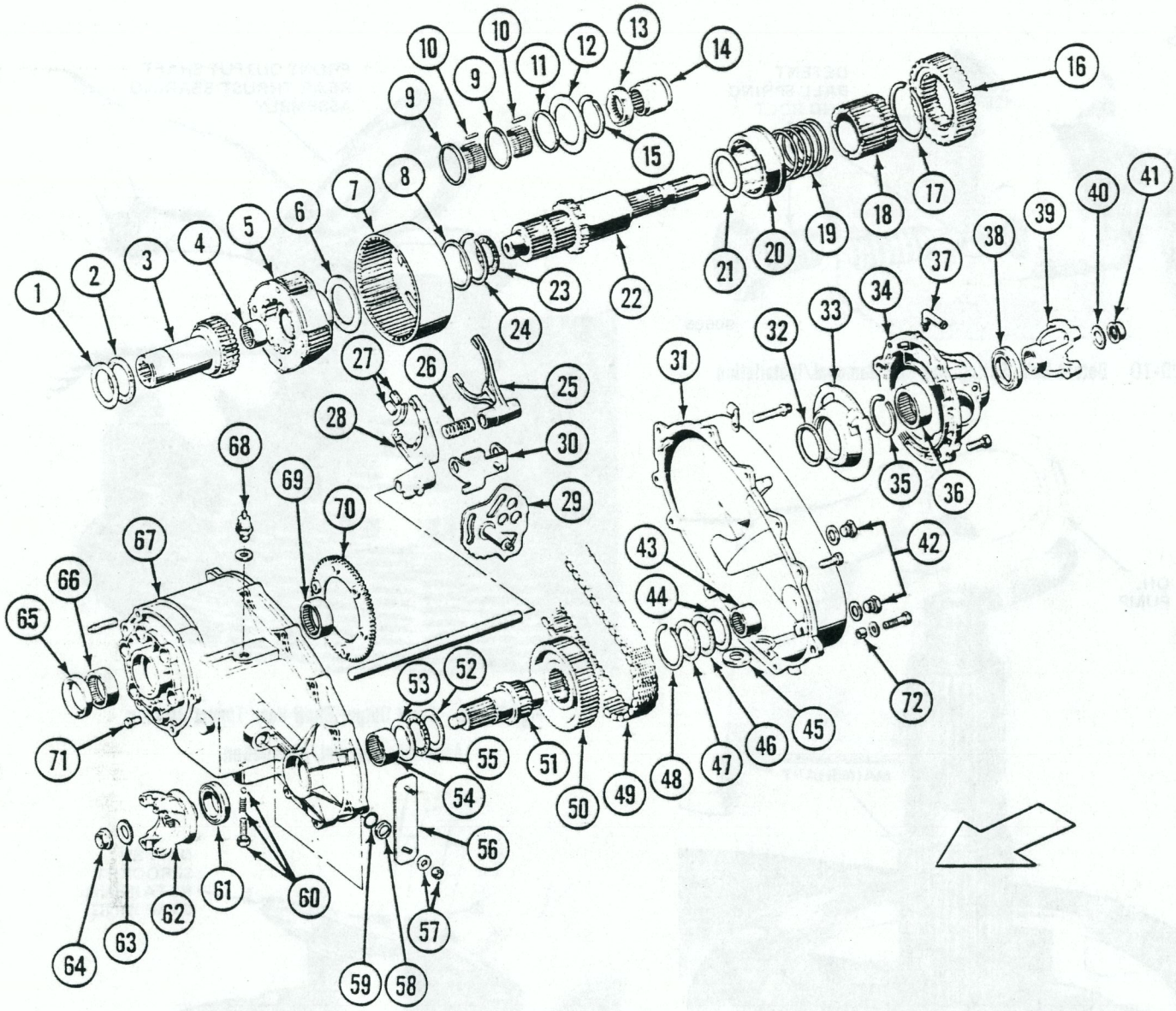
(7) Remove rear retainer attaching bolts and remove retainer and pump housing as assembly (fig. 2D-8). Tap retainer from case using plastic mallet only. Do not pry.

(8) Remove pump housing from retainer and remove pump seal from housing (fig. 2D-8). Discard seal.

(9) Remove speedometer drive gear from mainshaft.

(10) Remove oil pump from mainshaft. Note position of pump for assembly reference. Side facing case interior has recess in it (fig. 2D-11).

(11) Remove bolts attaching rear case to front case and remove rear case.



1. INPUT GEAR THRUST WASHER
2. INPUT GEAR THRUST BEARING
3. INPUT GEAR
4. MAINSHAFT PILOT BEARING
5. PLANETARY ASSEMBLY
6. PLANETARY THRUST WASHER
7. ANNULUS GEAR
8. ANNULUS GEAR THRUST WASHER
9. NEEDLE BEARING SPACERS
10. MAINSHAFT NEEDLE BEARINGS (120)
11. NEEDLE BEARING SPACER
12. THRUST WASHER
13. OIL PUMP
14. SPEEDOMETER GEAR
15. DRIVE SPROCKET RETAINING RING
16. DRIVE SPROCKET
17. SPROCKET CARRIER STOP RING
18. SPROCKET CARRIER
19. CLUTCH SPRING
20. SLIDING CLUTCH
21. THRUST WASHER
22. MAINSHAFT
23. MAINSHAFT THRUST BEARING
24. ANNULUS GEAR RETAINING RING
25. MODE FORK
26. MODE FORK SPRING
27. RANGE FORK INSERTS
28. RANGE FORK
29. RANGE SECTOR
30. MODE FORK BRACKET
31. REAR CASE
32. SEAL
33. PUMP HOUSING
34. REAR RETAINER
35. REAR OUTPUT BEARING
36. BEARING SNAP RING
37. VENT TUBE
38. REAR SEAL
39. REAR YOKE
40. YOKE SEAL WASHER
41. YOKE NUT
42. DRAIN AND FILL PLUGS
43. FRONT OUTPUT SHAFT REAR BEARING
44. FRONT OUTPUT SHAFT REAR THRUST BEARING RACE (THICK)
45. CASE MAGNET
46. FRONT OUTPUT SHAFT REAR THRUST BEARING
47. FRONT OUTPUT SHAFT REAR THRUST BEARING RACE (THIN)
48. DRIVEN SPROCKET RETAINING RING
49. DRIVE CHAIN
50. DRIVEN SPROCKET
51. FRONT OUTPUT SHAFT
52. FRONT OUTPUT SHAFT FRONT THRUST BEARING RACE (THIN)
53. FRONT OUTPUT SHAFT FRONT THRUST BEARING RACE (THICK)
54. FRONT OUTPUT SHAFT FRONT BEARING
55. FRONT OUTPUT SHAFT FRONT THRUST BEARING
56. OPERATING LEVER
57. WASHER AND LOCKNUT
58. RANGE SECTOR SHAFT SEAL RETAINER
59. RANGE SECTOR SHAFT SEAL
60. DETENT BALL, SPRING AND RETAINER BOLT
61. FRONT SEAL
62. FRONT YOKE
63. YOKE SEAL WASHER
64. YOKE NUT
65. INPUT GEAR OIL SEAL
66. INPUT GEAR FRONT BEARING
67. FRONT CASE
68. LOCK MODE INDICATOR SWITCH AND WASHER
69. INPUT GEAR REAR BEARING
70. LOCKPLATE
71. LOCKPLATE BOLTS
72. CASE ALIGNMENT DOWELS

Fig. 2D-9 Model 208 Transfer Case

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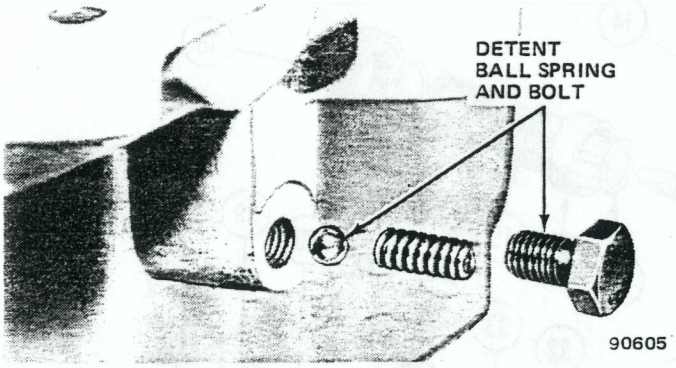

Fig. 2D-10 Detent Ball, Spring and Bolt Removal/Installation

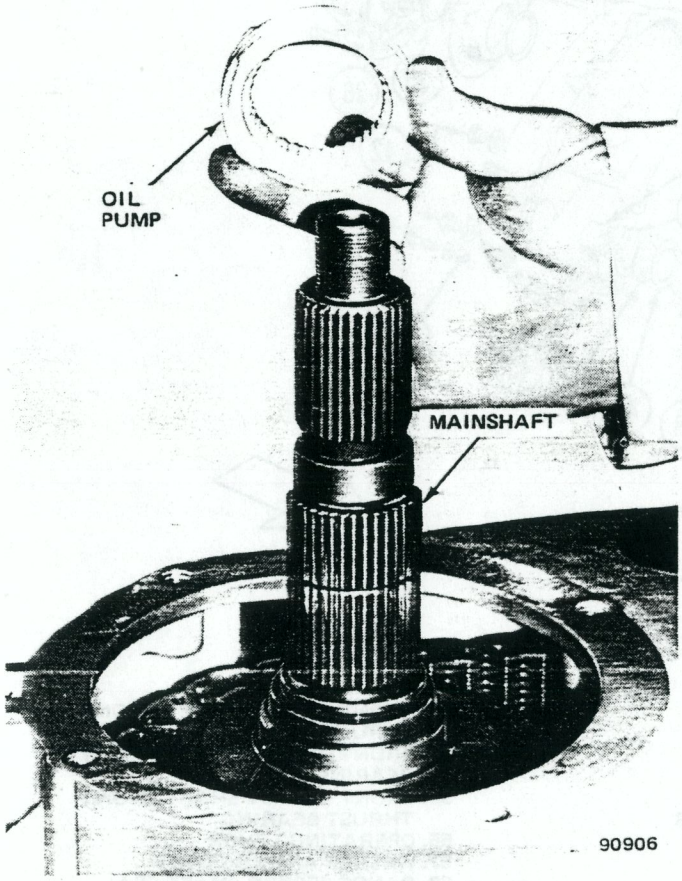

Fig. 2D-11 Oil Pump Removal/Installation

CAUTION: *To remove the rear case, insert screwdrivers into the slots cast in the case ends and gently pry upward. Do not attempt to wedge the case halves apart at any point on the mating surfaces.*

(12) Remove front output shaft rear thrust bearing assembly (fig. 2D-12). Note position of bearing and races for assembly reference.

(13) Remove driven sprocket retaining snap ring (fig. 2D-13).

(14) Remove drive sprocket retaining snap ring and remove thrust washer and spacer washer, if equipped (fig. 2D-14).

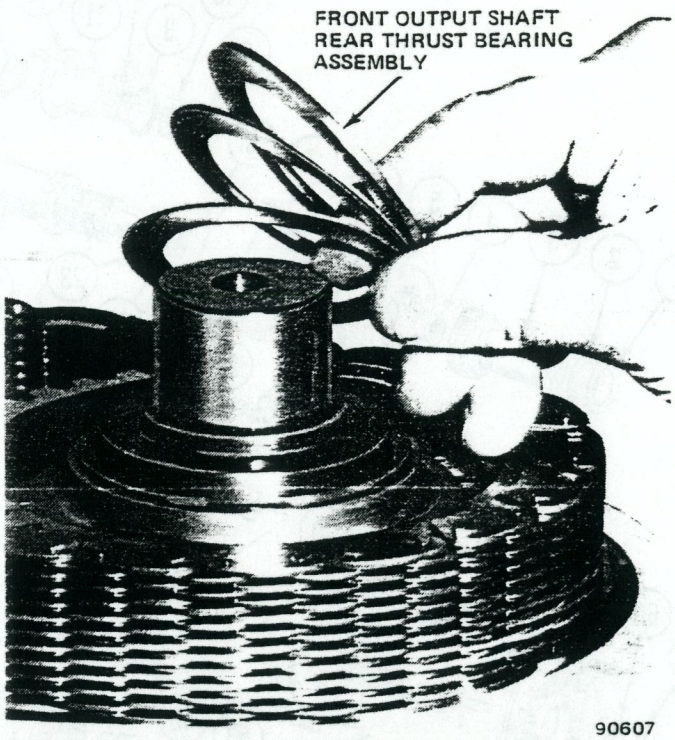

Fig. 2D-12 Front Output Shaft Rear Thrust Bearing Assembly Removal/Installation

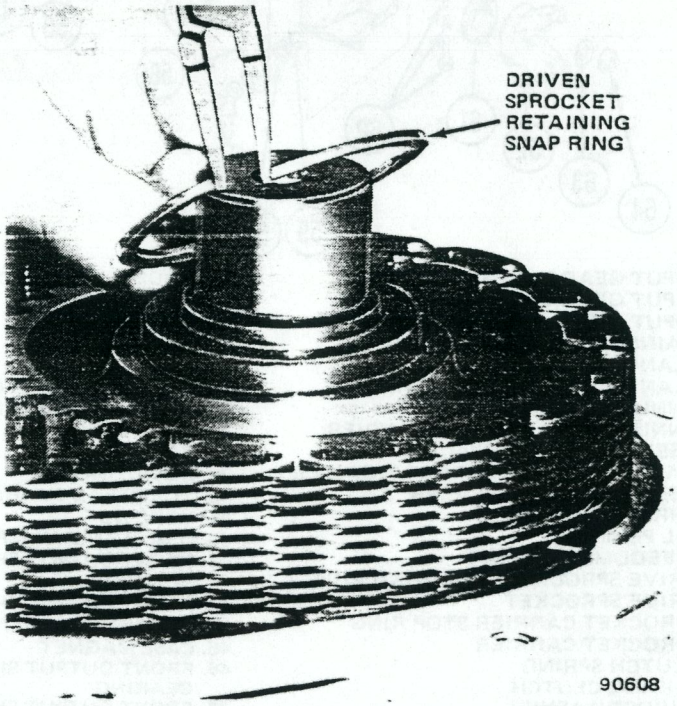

Fig. 2D-13 Driven Sprocket Retaining Snap Ring Removal/Installation

(15) Remove drive and driven sprockets and drive chain as assembly (fig. 2D-15). Lift evenly on both sprockets to remove assembly.

(16) Remove front output shaft and front thrust bearing assembly (fig. 2D-16).

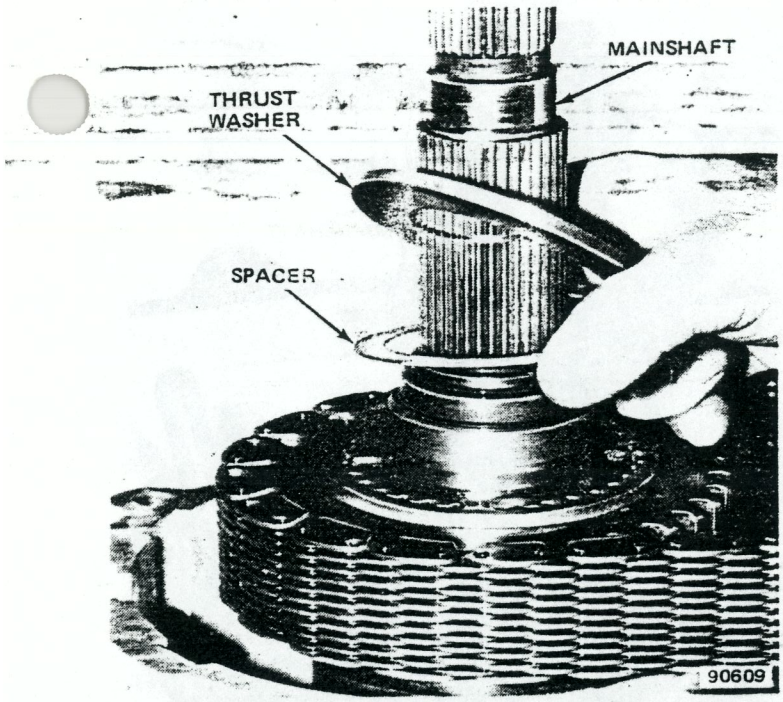

Fig. 2D-14 Drive Sprocket Thrust Washer and Spacer Removal/Installation

(17) Remove sprocket carrier stop ring (fig. 2D-17).

(18) Remove clutch spring (fig. 2D-17).

(19) Remove sliding clutch, mode fork, mode fork spring and bracket as assembly (fig. 2D-18). Remove shift rail.

(20) Remove sprocket carrier, needle bearing upper retainer, thrust washer and mainshaft needle bearings as assembly (fig. 2D-19).

(21) Remove mainshaft (fig. 2D-20).

(22) Remove annulus gear retaining ring and thrust washer (fig. 2D-20).

(23) Remove annulus gear and range fork as assembly. Turn fork counterclockwise to disengage fork lug from range sector and lift assembly out of case (fig. 2D-21).

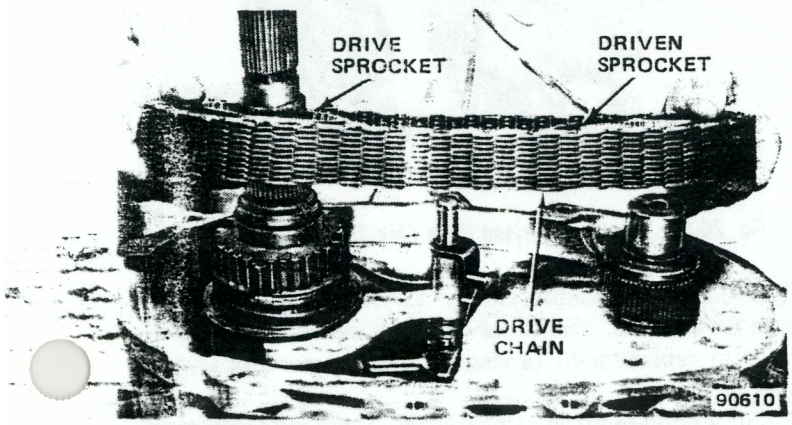

Fig. 2D-15 Sprocket and Chain Removal/Installation

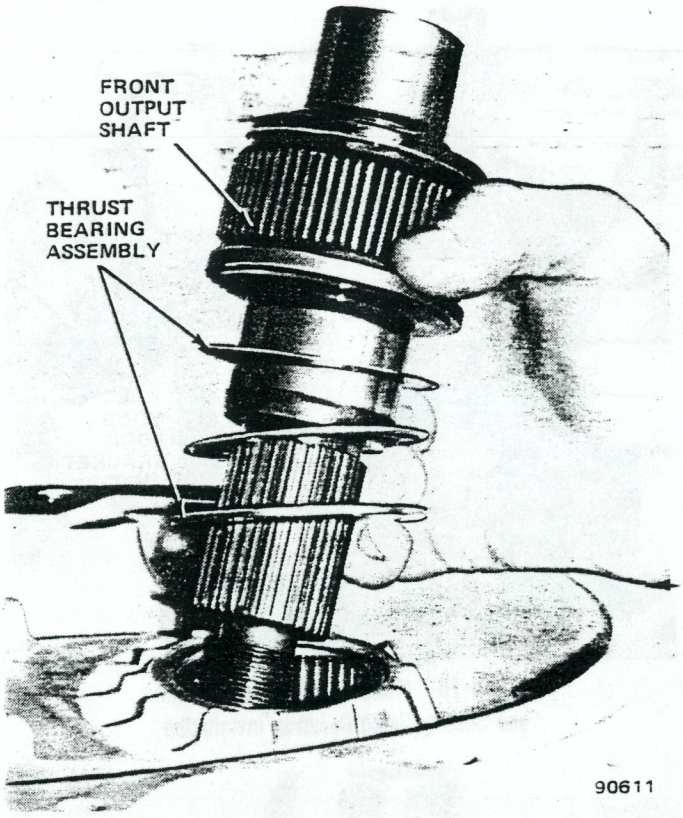

Fig. 2D-16 Front Output Shaft and Front Thrust Bearing Assembly Removal/Installation

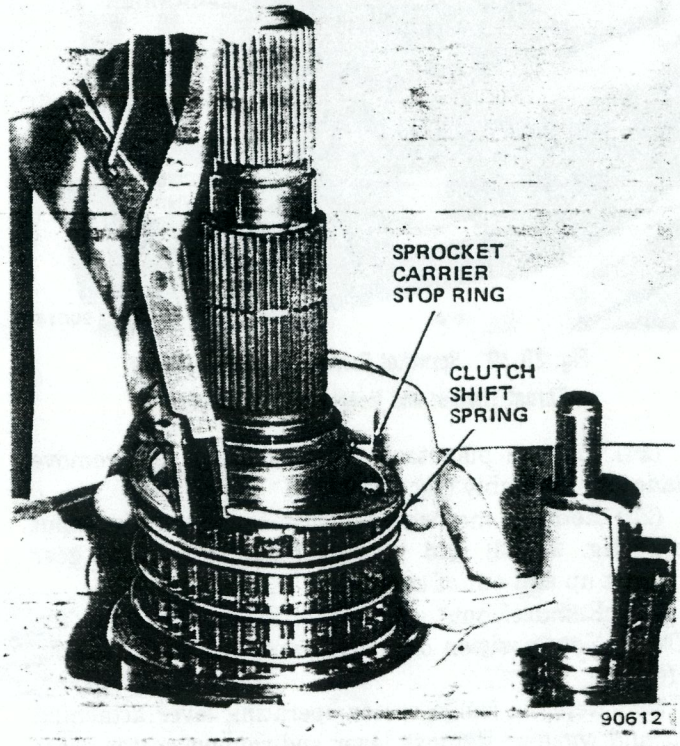

Fig. 2D-17 Sprocket Carrier Stop Ring and Clutch Spring Removal/Installation

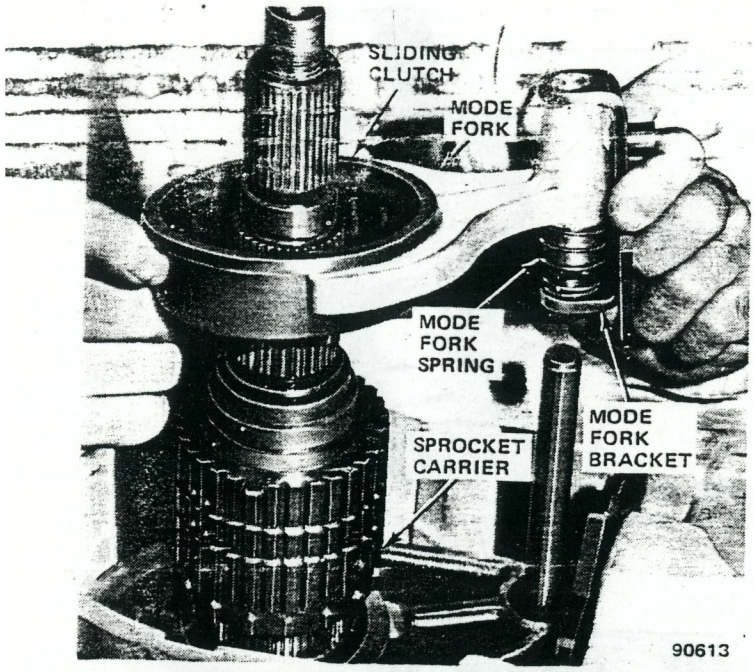

Fig. 2D-18 Mode Fork, Spring, Bracket and Sliding Clutch Removal/Installation

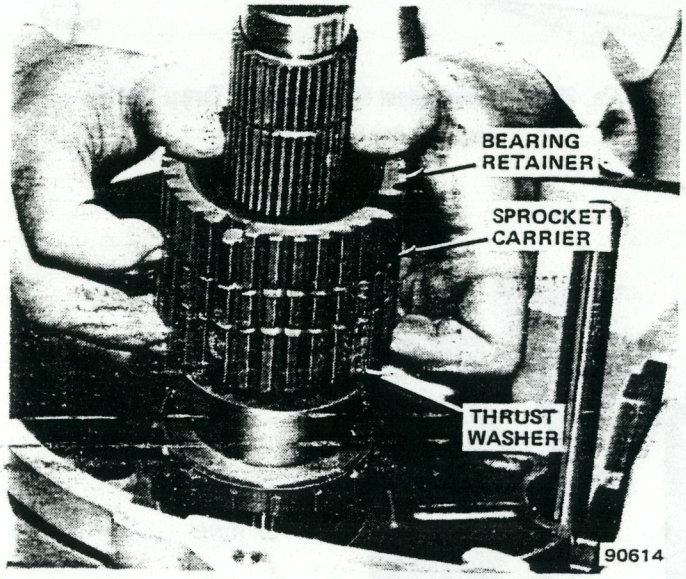

Fig. 2D-19 Sprocket Carrier, Bearing Retainers, Thrust Washer and Needle Bearing Removal

(24) Remove planetary thrust washer and remove planetary assembly (fig. 2D-22).

(25) Remove mainshaft thrust bearing from input gear (fig. 2D-23) and remove input gear. Lift gear straight up and out of case.

(26) Remove input gear thrust bearing and race (fig. 2D-24). Note position of bearing and race for assembly reference.

(27) Remove range sector operating lever attaching nut and washer. Remove lever and remove sector shaft seal and seal retainer (fig. 2D-9).

(28) Remove range sector.

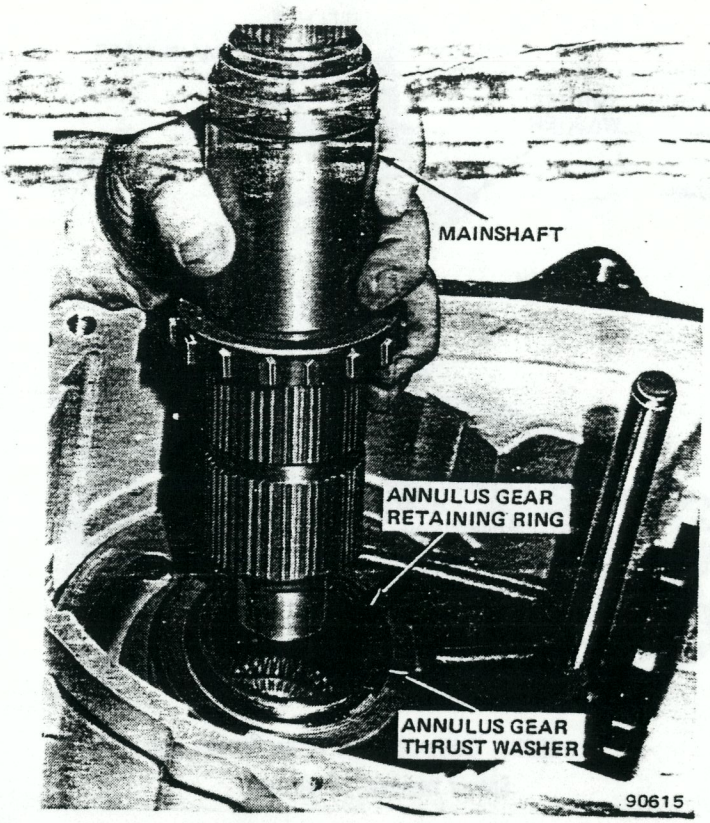

Fig. 2D-20 Mainshaft Removal/Installation

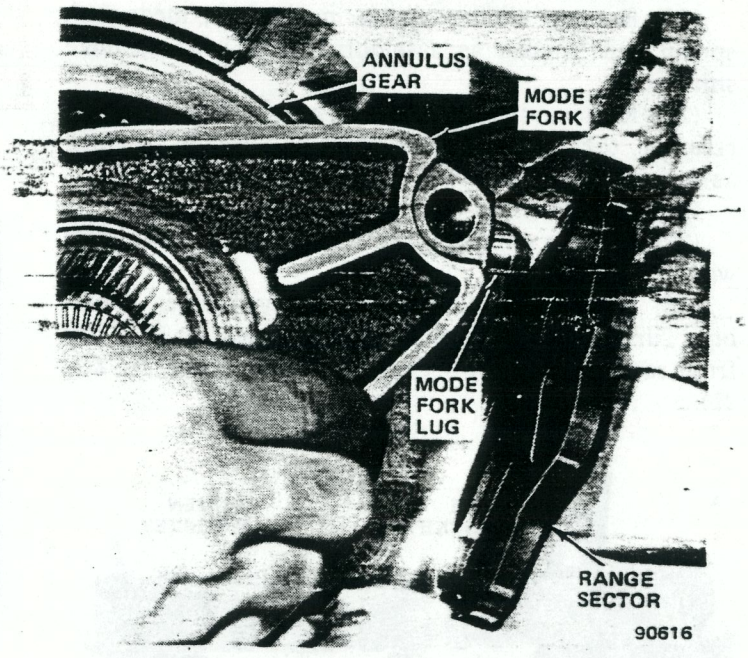

Fig. 2D-21 Annulus Gear and Mode Fork Removal/Installation

(29) Inspect lockplate (fig. 2D-24). If lockplate is loose or is worn, broken or cracked, remove lockplate. Refer to replacement procedure in Subassembly Overhaul section.

(30) Remove output shaft seals from front and rear case seal bores.

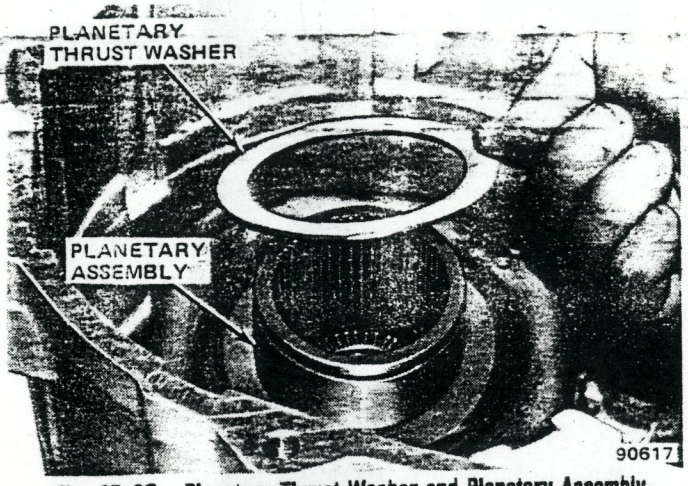

Fig. 2D-22 Planetary Thrust Washer and Planetary Assembly

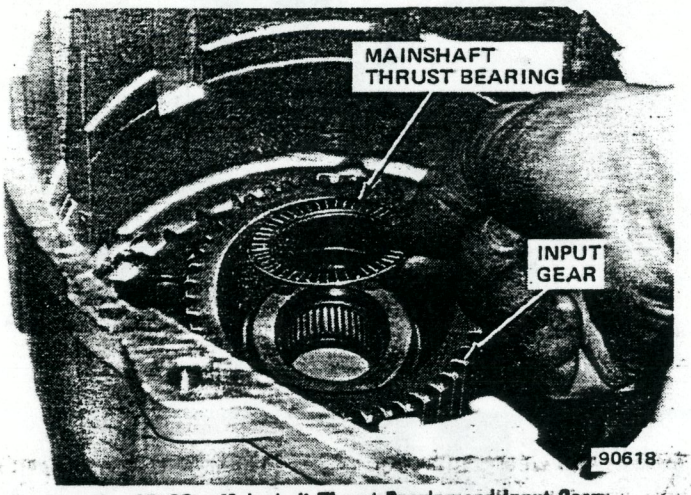

Fig. 2D-23 Mainshaft Thrust Bearing and Input Gear

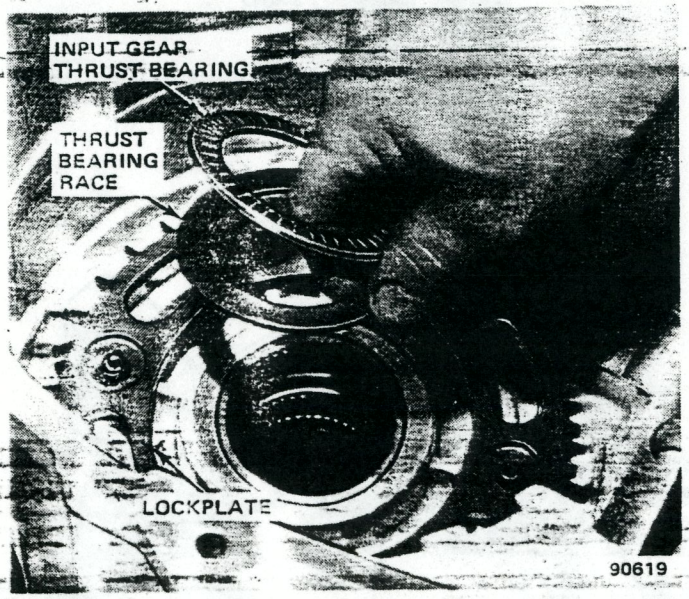

Fig. 2D-24 Input Gear Thrust Bearing and Race Removal—Installation

CLEANING AND INSPECTION

Wash all parts thoroughly in clean solvent. Be sure all old lubricant, metallic particles, dirt, or foreign material are removed from the surfaces of every part. Apply compressed air to each oil feed port and channel in each case half to remove any obstructions or cleaning solvent residue.

Inspect all gear teeth for signs of excessive wear or damage and check all gear splines for burrs, nicks, wear or damage. Remove minor nicks or scratches on oil stone. Replace any part exhibiting excessive wear or damage.

Inspect all snap rings and thrust washers for evidence of excessive wear, distortion, or damage. Replace any of these parts if they exhibit these conditions.

Inspect the two case halves for cracks, porosity, damaged mating surfaces, stripped bolt threads, or distortion. Replace any part that exhibits these conditions.

Inspect the low range lockplate in the front case. If the lockplate teeth or the plate hub is cracked, broken, chipped, or excessively worn, replace the lockplate and the lockplate attaching bolts. Refer to the Low Range Lockplate Replacement procedure in the Subassembly Overhaul section.

Inspect the condition of all needle, roller, ball and thrust bearings in the front and rear case halves and the input gear. Also check the condition of the bearing bores in both cases and in the input gear, rear output shaft, side gear, and rear retainer. Replace any part that exhibits signs of excessive wear or damage. If the case or input gear bearings require replacement, refer to Bearing Replacement in the Subassembly Overhaul section.

SUBASSEMBLY OVERHAUL

Lockplate Replacement

(1) Remove and discard lockplate attaching bolts.

(2) Remove lockplate from case.

(3) Coat case and lockplate surfaces around bolt holes with Loctite 515, or equivalent sealant.

(4) Position new lockplate in case and align bolt holes in lockplate and case.

(5) Coat new lockplate attaching bolts with Loctite 271, or equivalent adhesive sealant.

(6) Install and tighten lockplate attaching bolts to 30 foot-pounds (41 N•m) torque.

Bearing/Bushing Replacement

CAUTION: *All of the bearings used in the transfer case must be correctly positioned to avoid covering the bearing oil feed holes. After replacing any bearings check the bearing position to be sure the feed hole is not obstructed or blocked by the bearing.*

Rear Output Bearing and Rear Seal Replacement

(1) Remove bearing retaining snap ring and tap bearing out of retainer using mallet or brass drift.

(2) Remove rear seal using screwdriver or brass drift.

(3) Install new bearing using Tool J-7818 (fig. 2D-25). Be sure shielded side of bearing faces interior of case.

(4) Install bearing retaining snap ring.

(5) Install new rear seal using Tools J-8092 and J-29162 (fig. 2D-26).

Front Output Shaft Front Bearing Replacement

(1) Remove bearing using Tools J-8092 and J-29168 (fig. 2D-27).

(2) Install new bearing using Tools J-8092 and J-29167 (fig. 2D-28).

(3) Remove installer tools and check bearing position to be sure oil feed hole is not covered.

Front Output Shaft Rear Bearing Replacement

(1) Remove bearing using Remover J-26941 and Slide Hammer J-2619-01 (fig. 2D-29).

(2) Install new bearing using Driver Handle J-8092 and Installer J-29163 (fig. 2D-30).

(3) Remove installer tools and check bearing position to be sure oil feed hole is not covered. Also be sure bearing is seated flush with edge of case bore to allow room for thrust bearing assembly.

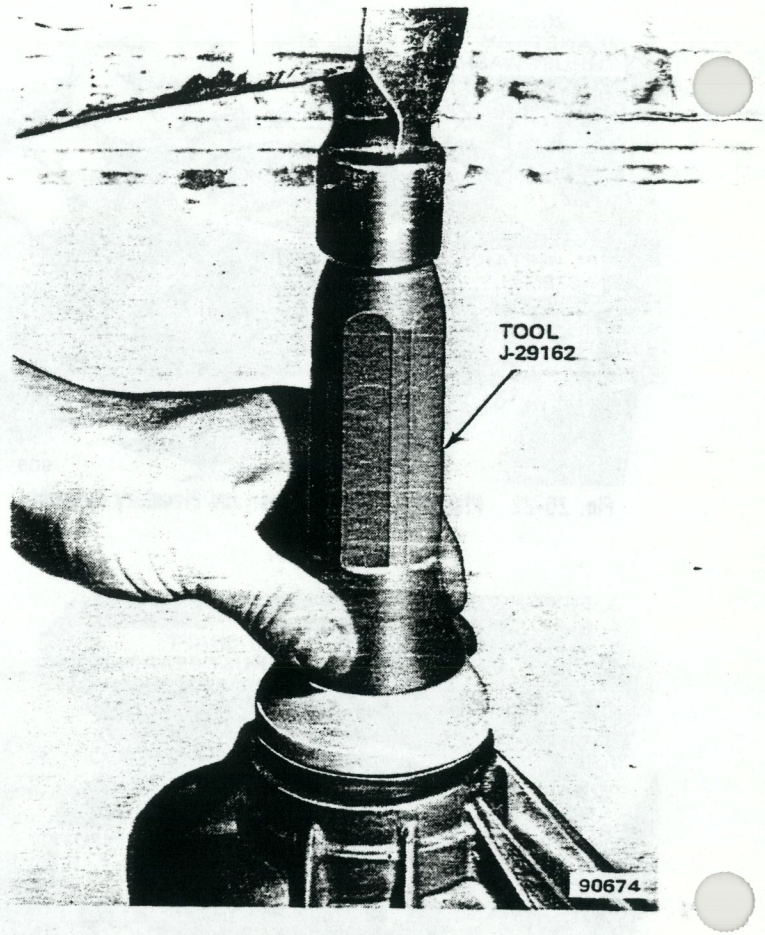

Fig. 2D-26 Rear Seal Installation

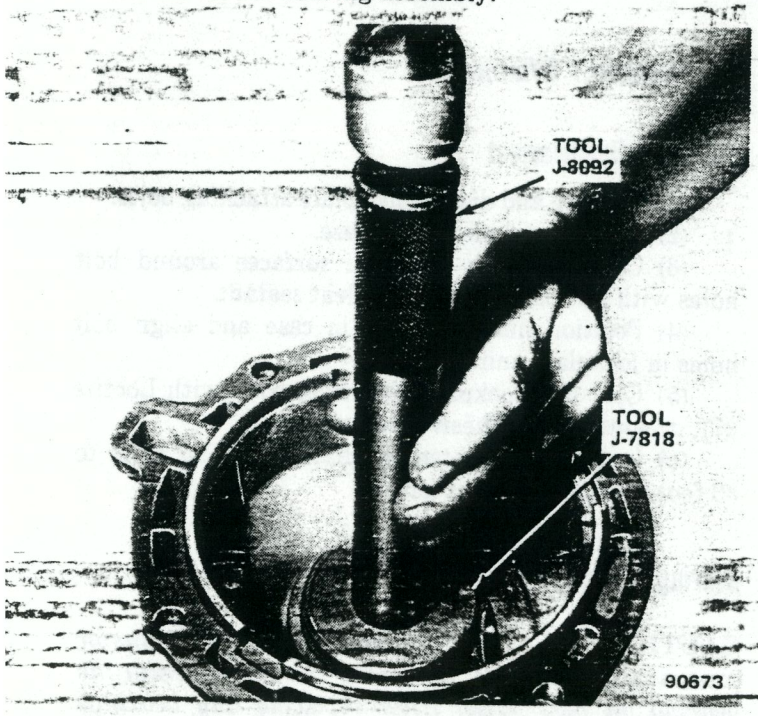

Fig. 2D-25 Rear Output Bearing Installation

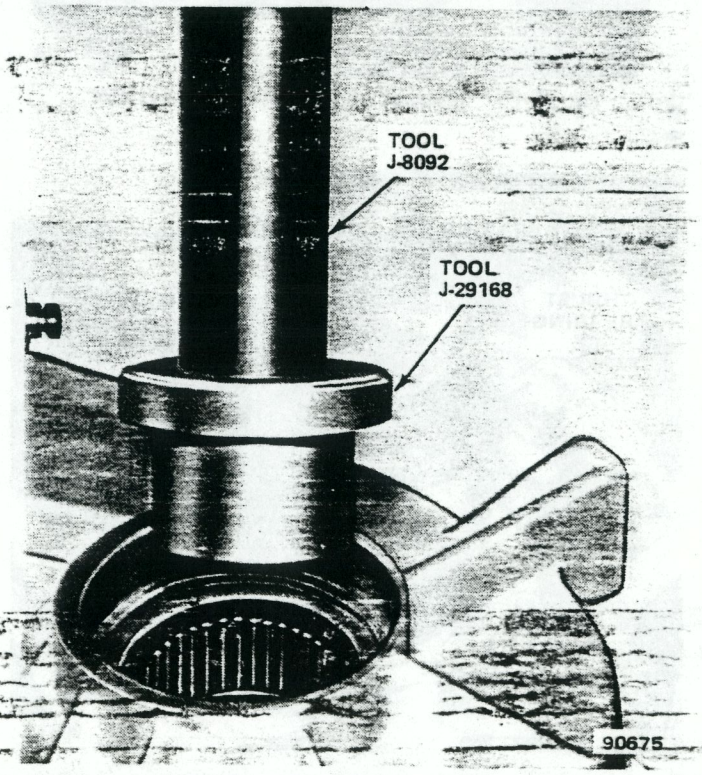

Fig. 2D-27 Front Output Shaft Front Bearing Removal

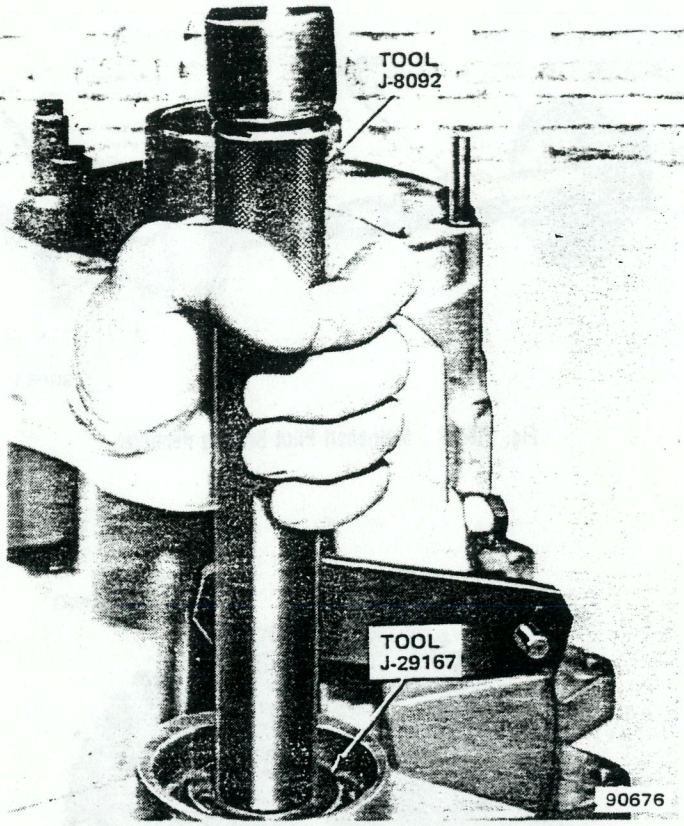

Fig. 2D-28 Front Output Shaft Front Bearing Installation

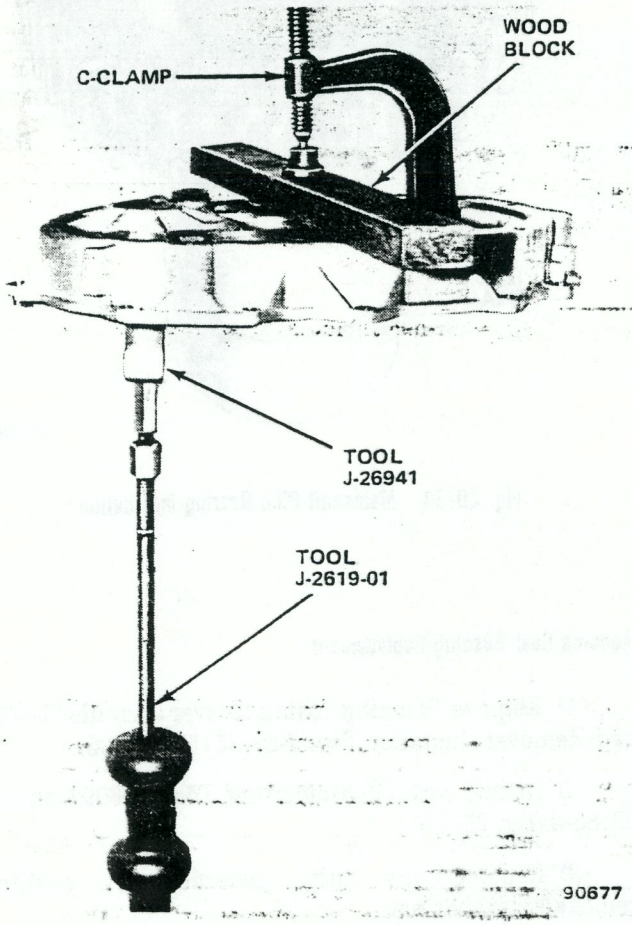

Fig. 2D-29 Front Output Shaft Rear Bearing Removal

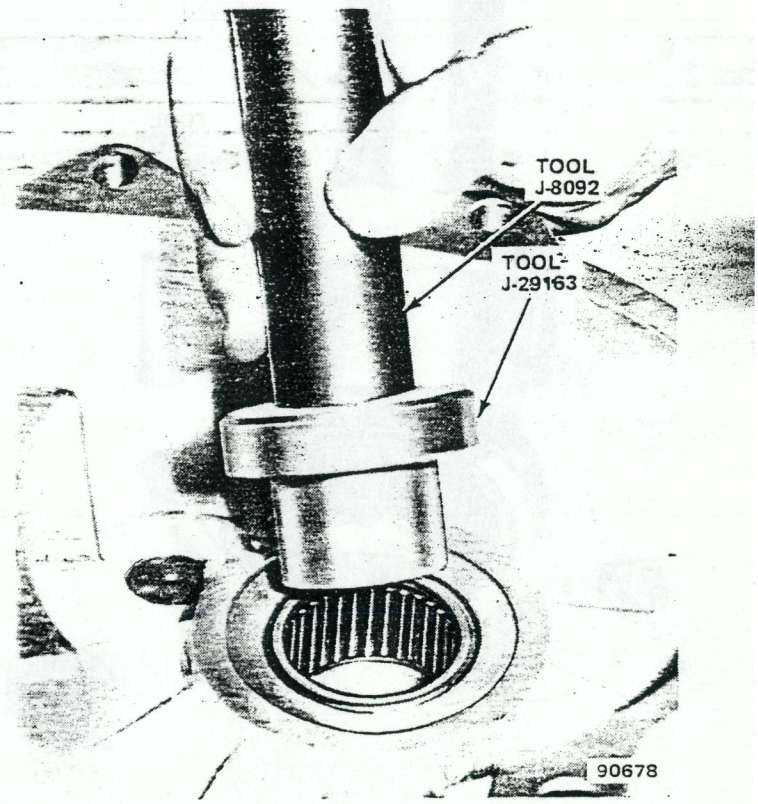

Fig. 2D-30 Front Output Shaft Rear Bearing Installation

Input Gear Front/Rear Bearing Replacement

(1) Remove both bearings simultaneously using Driver Handle J-8092 and Remover J-29170 (fig. 2D-31).

(2) Install new bearings one at a time. Install rear bearing first; then install front bearing. Use Driver Handle J-8092 and Installer J-29169 (fig. 2D-32).

(3) Remove installer tools and check bearing position to be sure oil feed holes are not covered. Also be sure bearings are flush with case bore surfaces.

Mainshaft Pilot Bearing Replacement

(1) If bearing cannot be removed by hand, remove it using Slide Hammer J-2619-01 and Remover J-29369-1 or similar internal type blind hole bearing puller (fig. 2D-33).

(2) If necessary, install new bearing using Driver Handle J-8092 and Installer J-29174 (fig. 2D-34).

(3) If bearing was seated using installer tools, check bearing position to be sure hole feed hole is not covered. Also be sure bearing is seated flush with edge of bearing bore.

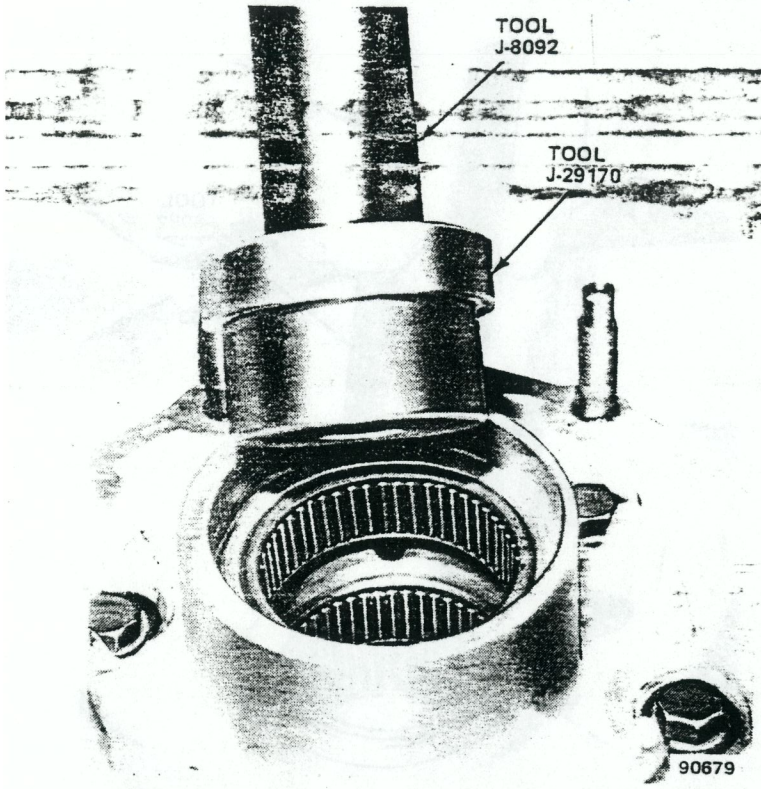

Fig. 2D-31 Input Gear Bearing Removal

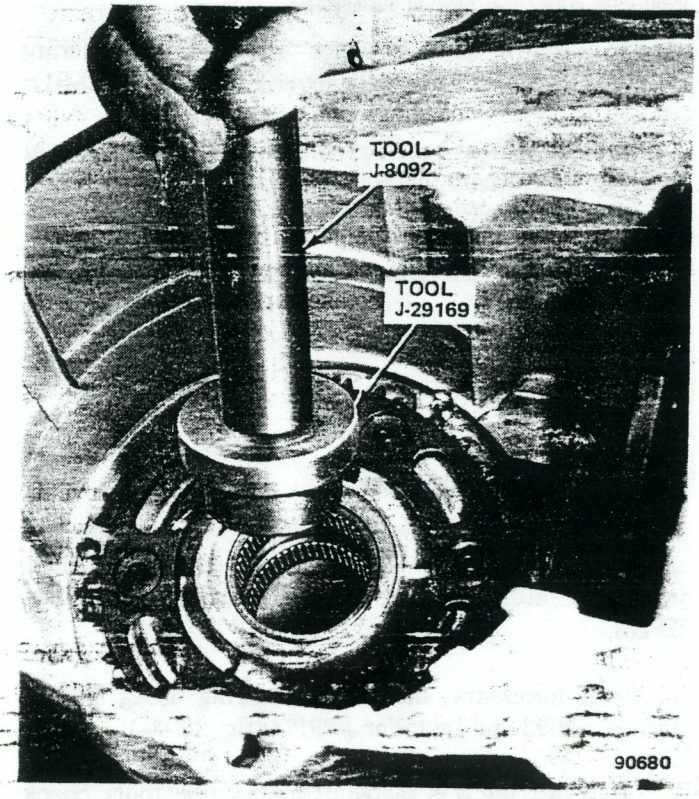

Fig. 2D-32 Input Gear Bearing Installation

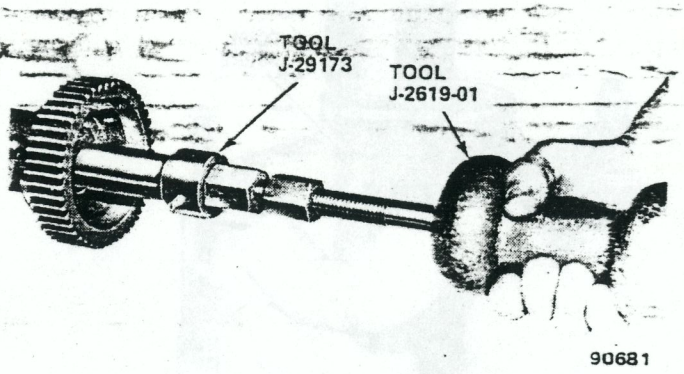

Fig. 2D-33 Mainshaft Pilot Bearing Removal

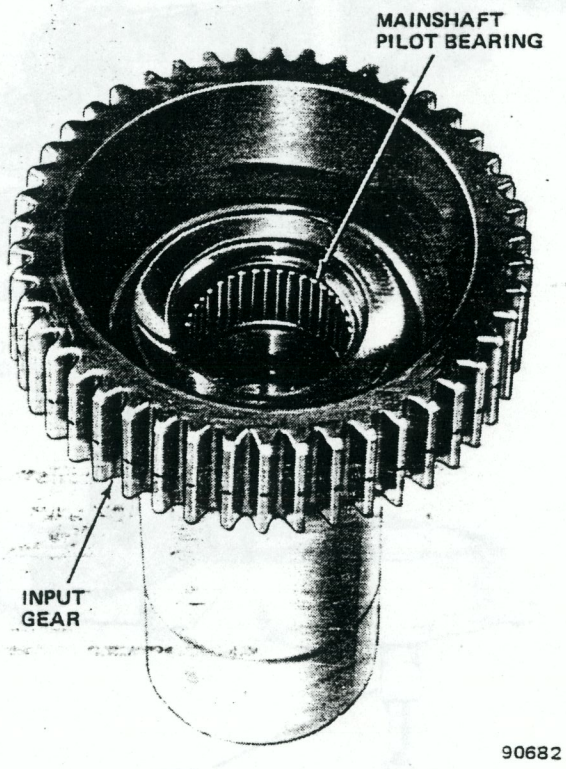

Fig. 2D-34 Mainshaft Pilot Bearing Installation

Annulus Gear Bushing Replacement

(1) Remove bushing using Driver Handle J-8092 and Remover/Installer Tool J-29185 (fig. 2D-35).

(2) Install new bushing using Tools J-8092 and J-29185-2 (fig. 2D-36).

(3) Remove any chips generated by bushing removal/installation.

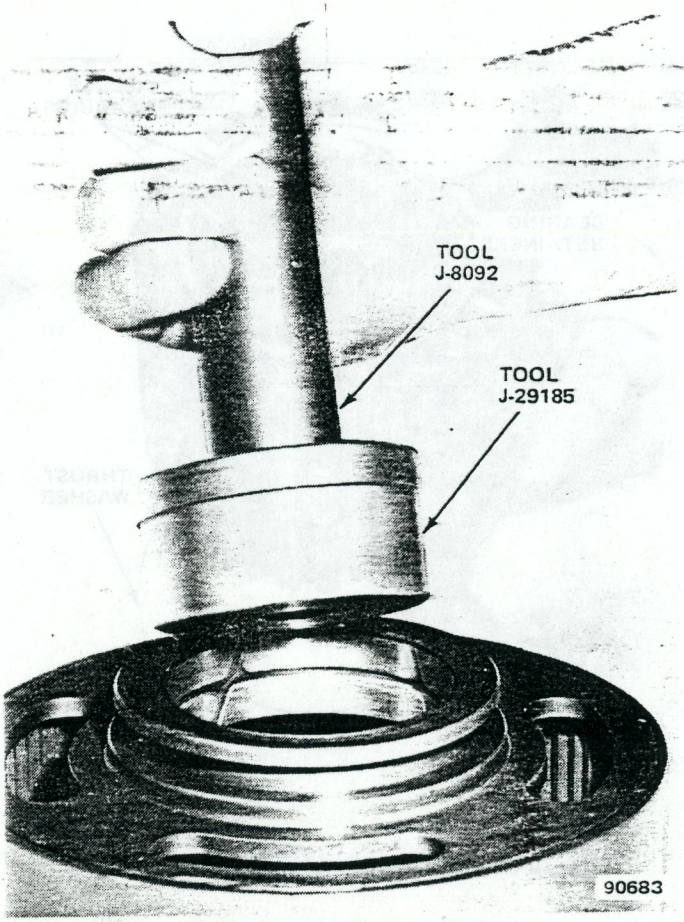

Fig. 2D-35 Annulus Gear Bushing Removal

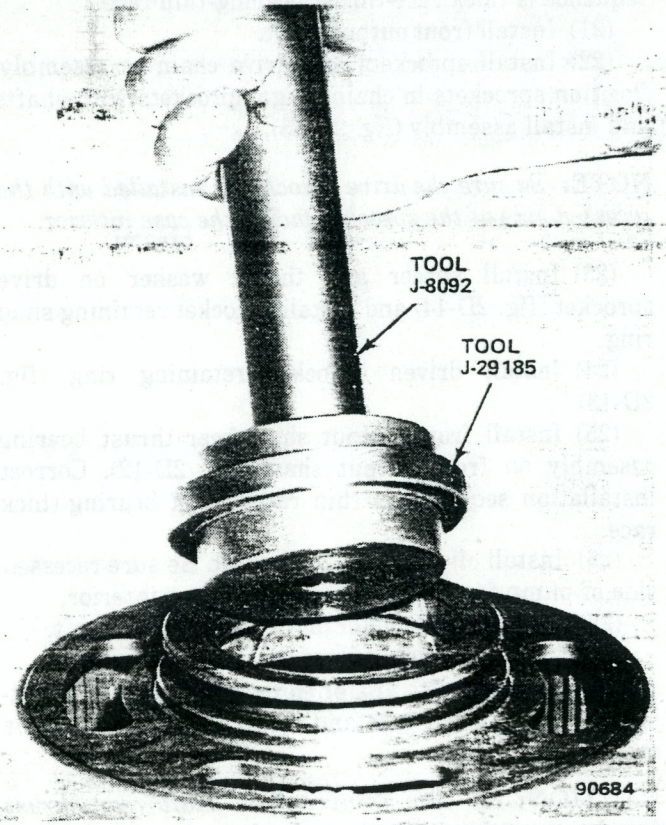

Fig. 2D-36 Annulus Gear Bushing Installation

ASSEMBLY

NOTE: *During assembly, lubricate all components with 10W-30 motor oil or petroleum jelly where indicated only. Do not use any other type of lubricants.*

(1) Install input gear race and thrust bearing in front case (fig. 2D-24).

(2) Install input gear.

(3) Install mainshaft thrust bearing in input gear (fig. 2D-37).

(4) Install range sector shaft seal and seal retainer (fig. 2D-9).

(5) Install range sector.

(6) Install operating lever on range sector shaft. Install and tighten shaft washer and locknut to 18 foot-pounds (24 N•m) torque.

(7) Install planetary assembly over input gear (fig. 2D-37). Be sure planetary is fully seated and meshed with gear.

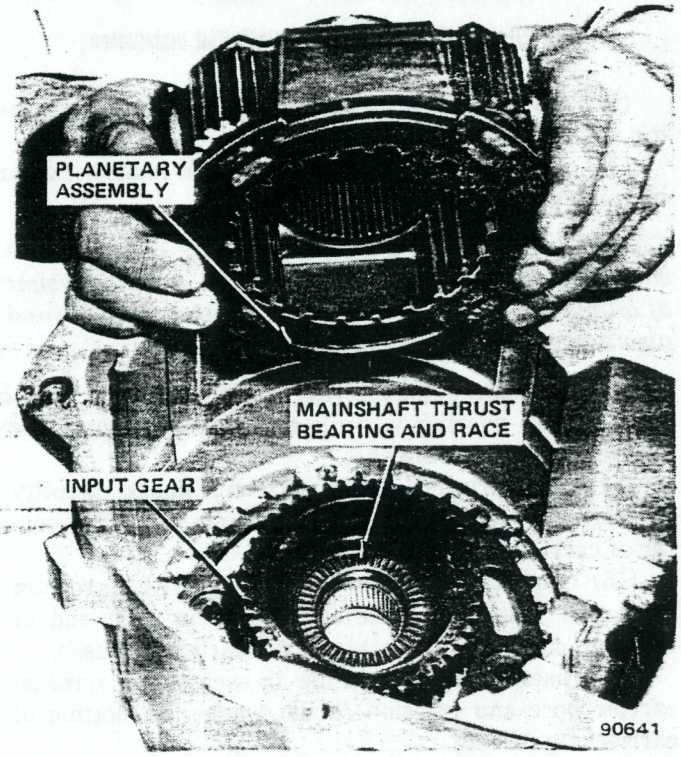

Fig. 2D-37
Input Gear, Mainshaft Thrust Bearing and Planetary Installation

(8) Install planetary thrust washer on planetary hub (fig. 2D-22).

(9) Install inserts in range fork, if removed.

(10) Engage range fork in annulus gear and install annulus gear over planetary assembly (fig. 2D-38).

NOTE: *Be sure the range fork lug is fully inserted in the range sector slot (fig. 2D-21).*

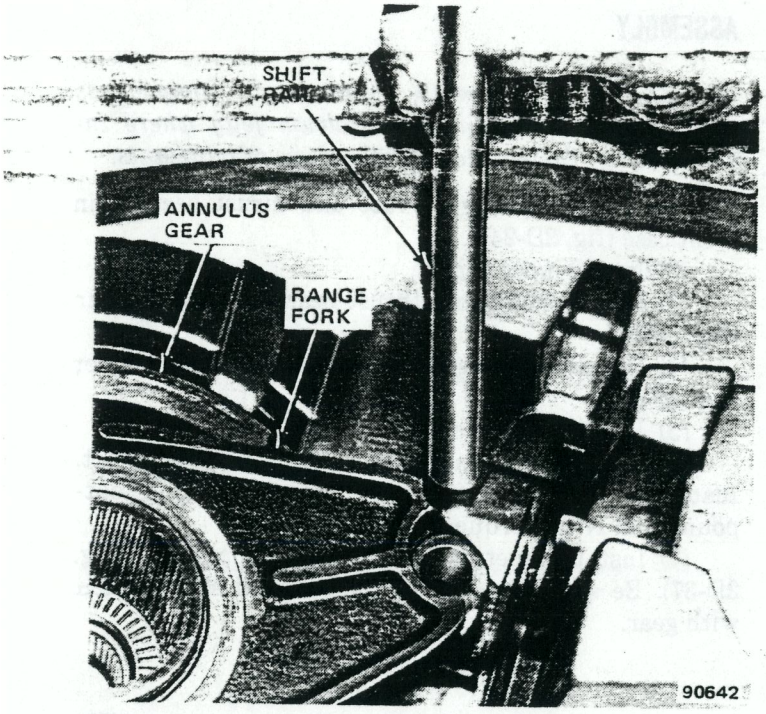

Fig. 2D-38 Annulus Gear and Shift Rail Installation

(11) Install annulus gear thrust washer and retaining snap ring (fig. 2D-20).

(12) Align shift rail bores in case and range fork and install shift rail (2D-38).

CAUTION: *The shift rail bore in the case must be completely dry and not contain any oil. A small amount of oil may prevent the rail from seating completely and also prevent front case installation.*

(13) Install mainshaft (fig. 2D-20). Be sure mainshaft thrust bearing is properly seated in input gear before installing mainshaft.

(14) Coat sprocket carrier bore with liberal quantity of petroleum jelly and position bearing retainer at center of carrier bore.

(15) Coat mainshaft needle bearings with petroleum jelly and install 60 needle bearings in each end of sprocket carrier bore. Total of 120 bearings are used.

(16) Install bearing retainer in each end of sprocket carrier bore and position thrust washer on bottom of carrier (fig. 2D-39).

(17) Align assembled carrier and needle bearings with mainshaft and install assembly on mainshaft (fig. 2D-16). Take care to avoid displacing needle bearings during installation.

(18) Assemble mode fork, fork spring and bracket. Engage fork in sliding clutch and install assembly on shift rail and mainshaft (fig. 2D-18).

(19) Install clutch spring and stop ring on sprocket carrier (fig. 2D-17).

NOTE: *If the sprocket carrier has two ring grooves, install the stop ring in the upper groove only.*

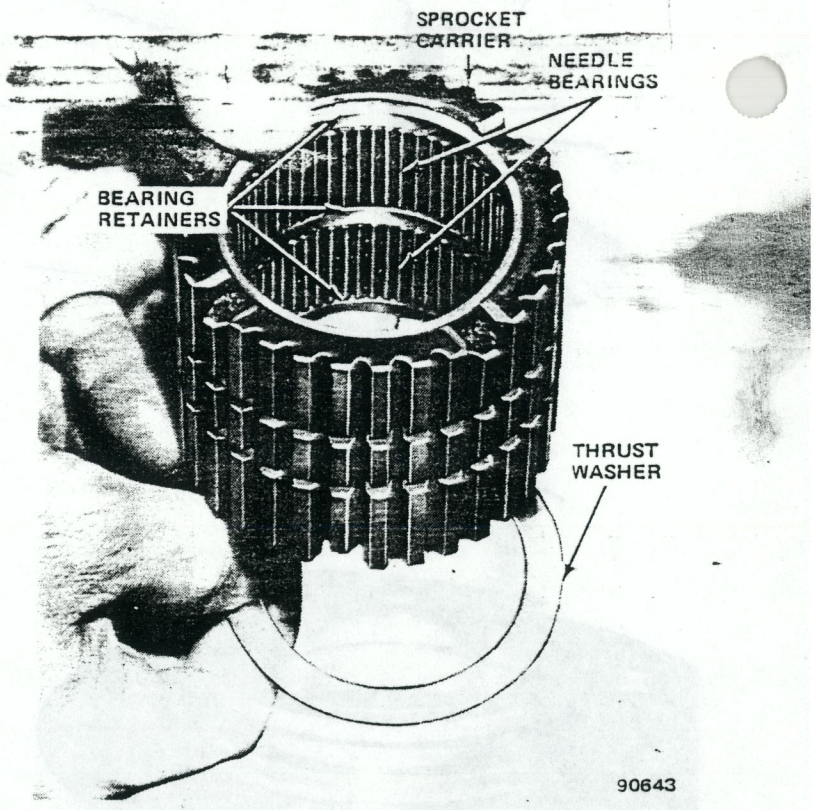

Fig. 2D-39 Assembling Sprocket Carrier Components

(20) Install front output shaft front thrust bearing assembly in front case (fig. 2D-16). Correct installation sequence is thick race-thrust bearing-thin race.

(21) Install front output shaft.

(22) Install sprockets and drive chain as assembly. Position sprockets in chain, align sprockets with shafts and install assembly (fig. 2D-15).

NOTE: *Be sure the drive sprocket is installed with the recessed side of the sprocket facing the case interior.*

(23) Install spacer and thrust washer on drive sprocket (fig. 2D-14) and install sprocket retaining snap ring.

(24) Install driven sprocket retaining ring (fig. 2D-13).

(25) Install front output shaft rear thrust bearing assembly on front output shaft (fig. 2D-12). Correct installation sequence is thin race-thrust bearing-thick race.

(26) Install oil pump on mainshaft. Be sure recessed side of pump faces downward toward case interior.

(27) Install speedometer drive gear on mainshaft.

(28) Install magnet in front case, if removed.

(29) Apply Loctite 515, or equivalent sealant, to mating surface of front case and install rear case on front case.

CAUTION: *Be sure front output shaft rear thrust bearing assembly is seated in the rear case.*

(30) Align case bolt holes and alignment dowels and install bolts. Tighten bolts alternately and evenly to 23 foot-pounds (31 N•m) torque.

NOTE: *Be sure to install flat washers on the two bolts installed at the opposite ends of the case.*

(31) Install rear output bearing in rear retainer and install snap ring.

(32) Install seal in pump housing. Apply petroleum jelly to pump housing tabs and install housing in rear retainer.

(33) Apply Loctite 515, or equivalent sealant, to mating surface of rear retainer.

(34) Align rear retainer and case index marks and install retainer. Install and tighten retainer bolts to 23 foot-pounds (23 N•m) torque.

(35) Install oil seal in rear retainer bore. Coat seal lip with petroleum jelly before installation.

(36) Install washer and indicator switch. Tighten switch to 18 foot-pounds (24 N•m) torque.

(37) Apply small quantity of Loctite 515, or equivalent sealant, to detent retainer bolt and install detent ball, spring and bolt (fig. 2D-10). Tighten bolt to 23 foot-pounds (31 N•m) torque.

(38) Install drain plug and gasket. Tighten plug to 35 foot-pounds (47 N•m) torque.

(39) Install oil seal in front case output shaft bore.

(40) Install front and rear yokes. Be sure to install yoke, with collar on it, on front output shaft.

(41) Install yoke seal washers and yoke nuts. Tighten nuts to 120 foot-pounds (163 N•m) torque.

(42) Pour 6 pints (3 liters) of 10W-30 motor oil into transfer case through fill plug hole and install and tighten fill plug to 18 foot-pounds (24 N•m) torque.

SPECIFICATIONS

Specifications—Model 208 Transfer Case

Transfer Case Type	4-position, dual range, part-time 4-wheel drive unit with integral low range
Torque Transmittal Mode	Dual sprockets with interconnecting drive chain
Low Range Reduction Ratio and Mode	2.6:1 through annulus gear and planetary carrier assembly
Drive positions and shift controls	2H, 4H, 4L, Neutral — Ranges selected via floor-mounted shift lever. (4-wheel drive ranges are undifferentiated)
Case Configuration	Two-piece aluminum casting with removable rear retainer
Lubricant Capacity and Type	6 pints (3 liters) 10W-30 motor oil (only).

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Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft-lbs)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Detent Retainer Bolt	23	20-25	31	27-34
Drain and Fill Plugs	35	30-40	47	40-54
Front/Rear Yoke Nuts	120	90-130	163	122-176
Indicator Switch	18	15-20	24	20-34
Operating Lever Locknut	18	14-20	24	19-27
Rear Case-to-Front Case Bolts (All)	23	20-25	31	27-34
Rear Retainer Bolts	23	20-25	31	27-34

All torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

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MODEL 219 QUADRA-TRAC TRANSFER CASE

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GENERAL

The model 219 Quadra-Trac transfer case provides four-wheel high and low ranges, a neutral position and a four-wheel high-lock position for use when the vehicle is immobile due to excessive wheel spin.

Model 219 provides full-time, fully differentiated operation in 4H range only. The 4L and Lock ranges provide undifferentiated drive modes. In 4H range, differentiation is accomplished through a torque biasing viscous coupling and an open differential connected to the coupling. Two drive sprockets and an interconnecting drive chain are used to distribute input torque.

Drive range selection is by means of a floor mounted shift lever. A straight line shift pattern is used for all models equipped with the 219 (fig. 2D-40).

Fig. 2D-40 Model 219 Shift Pattern

Four-Wheel High-Lock Position Indicator Lamp

An indicator lamp is mounted in the instrument panel to alert the driver whenever the vehicle is being operated in four-wheel high-lock range. The lamp is controlled by an indicator switch in the transfer case. The switch is a ball and plunger unit that is activated by the transfer case range sector when four-wheel high-lock range is selected. The indicator lamp is illuminated in the four-wheel high-lock position only.

IDENTIFICATION

An identification tag is attached to the rear half of the transfer case (fig. 2D-3). This tag provides the transfer case-model number, low range reduction ratio, and assembly number. The information on this tag is necessary for servicing information. If the tag is removed or becomes dislodged during service operations, it should be reattached using an adhesive sealant such as Loctite 312, or equivalent.

LUBRICATION

The model 219 transfer case lubricant should be changed at the intervals specified in the Maintenance Schedule. When adding lubricant to or refilling the transfer case after service, use a quality grade 10W-30 motor oil only. Do not use any type of anti-friction type additives or similar substance. Use the specified grade of motor oil only. Refer to the In-Vehicle Service section for lubricant change procedures and fill level. Model 219 lubricant capacity is 4 pints (2 liters).

POWER FLOW

Four-Wheel High (4H) Range

In all drive range positions, input torque is transmitted to the transfer case geartrain through the input gear (fig. 2D-41).

In four high range (4H), torque flows from the input gear to the planetary assembly and annulus gear which rotate as a unit. Torque is transferred to the mainshaft through the planetary carrier which is splined to the mainshaft (fig. 2D-41).

In 4H range, the clutch sleeve is not engaged with the mainshaft. Torque flows through the mainshaft to the differential pinions which are splined to the mainshaft. Torque is then transmitted through the pinions to the gear teeth on the side gear and rear output shaft. Since the side gear is splined to the drive sprocket, torque is also transmitted to the front output shaft through the driven sprocket which is connected to the drive sprocket by the drive chain (fig. 2D-41).

Viscous Coupling and Differential Operation in 4H Range

The differential assembly consists of the side gear, rear output shaft and the viscous coupling and differential pinion gear assembly. The differential operates in the same fashion as an open-type axle differential. In straight-ahead driving, the differential and coupling rotate as a unit. On turns, the differential allows the front and rear axles to operate at their own speeds. This occurs because the pinions are then free to rotate around the side gear and rear output shaft gear teeth at differing speeds.

The viscous coupling functions as a torque biasing slip limiting unit. If consists of an enclosed housing containing two sets of fixed clutch plates and a special silicone fluid. The differential pinion gears are located in the open center section of the coupling.

The coupling is connected to the front propeller shaft through the side gear and drive sprocket which operates the driven sprocket and front output shaft via the drive chain. The rear propeller shaft is connected to the coupling through the rear output shaft side gear teeth which are meshed with the differential pinions. In normal operation, the coupling is not active. Front/rear

The coupling does not provide limited slip operation in 4L or Lock positions. In these ranges the coupling is locked to the shafts and torque flow bypasses the differential. Transfer case operation is undifferentiated in these drive modes.

Four-Wheel Low (4L) Range

In 4L range, the torque path through the transfer case is similar to 4H range (fig. 2D-41). However, in 4L the clutch sleeve is engaged with the mainshaft and the annulus gear is shifted forward into engagement with the fixed (stationary) lockplate. This prevents the annulus gear from rotating. The planetary pinions are forced to rotate around the annulus internal teeth producing a gear reduction ratio of 2.61:1. Because the mainshaft, side gear and sprocket and coupling are all locked together in 4L position, the differential is bypassed resulting in undifferentiated four-wheel drive.

Lock Position

In Lock position, the clutch sleeve is moved forward into engagement with the mainshaft. Since the sleeve is still engaged with the side gear clutch, it locks the side gear and drive sprocket, which is splined to the side gear, to the mainshaft as well. Torque now flows through the side gear directly to the viscous coupling housing through the clutch gear which is splined to the side gear. Because the rear output shaft is also splined to the coupling housing, the differential is bypassed resulting in an undifferentiated four-wheel drive-lock mode. This range should be used only when the vehicle is immobile due to excessive wheel spin.

SERVICE DIAGNOSIS

Before attempting to repair a suspected transfer case malfunction, check all other drive line components beforehand. The actual cause of a problem may be related to such items as the front hubs, axles, propeller shafts, wheels and tires, transmission, or clutch instead. If all other drive line components are in good condition and operating properly, refer to the service diagnosis charts for further information.

Torque Bias Check—Model 219

A method for checking viscous coupling operation, both in and out of the vehicle, has been developed. The procedure involves measuring the torque required to rotate the coupling when it is in a static (at rest) condition. Whenever diagnosis indicates a possible coupling malfunction, check coupling torque bias (static rotating torque) as outlined in the following two procedures.

In-Vehicle Torque Bias Check

(1) Place vehicle on level surface. Stop engine.

(2) Place transmission shift lever in NEUTRAL and transfer case shift lever in 4 HIGH position.

(3) Raise one front wheel off floor.

(4) Remove hub cap from wheel just raised.

(5) Assemble socket and torque wrench and install on any lug nut of wheel just raised.

(6) Rotate wheel using torque wrench and measure torque required to rotate wheel.

(7) If coupling is operating properly, it should require minimum of 45 foot-pounds (61 N•m) to rotate wheel.

(8) If rotating torque is at or above specified limit, remove wrench, install hub cap and lower wheel.

(9) If rotating torque is below specified limit, remove wrench, install hub cap, lower wheel and refer to On-Bench Torque Bias Check.

On-Bench Torque Bias Check

NOTE: *The following procedure can be used as both a diagnostic procedure and a means of verifying coupling operation prior to reassembly and installation of the transfer case.*

(1) Remove and disassemble transfer case as outlined in 1980 Jeep Technical Service Manual.

(2) Install clutch gear on side gear (fig. 2D-42).

(3) Install assembled clutch gear and side gear in viscous coupling.

(4) Mount assembled coupling and gears in vise. Place wood blocks between vise jaws and side gear and clamp side gear firmly (fig. 2D-43).

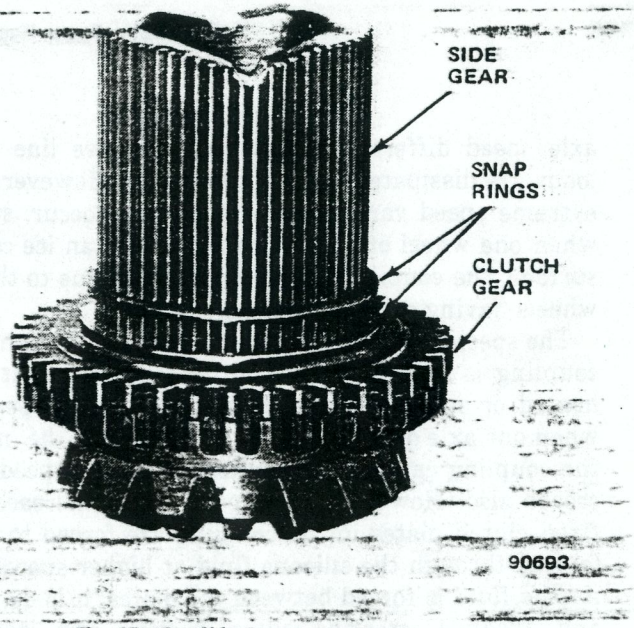

Fig. 2D-42 Side Gear Components

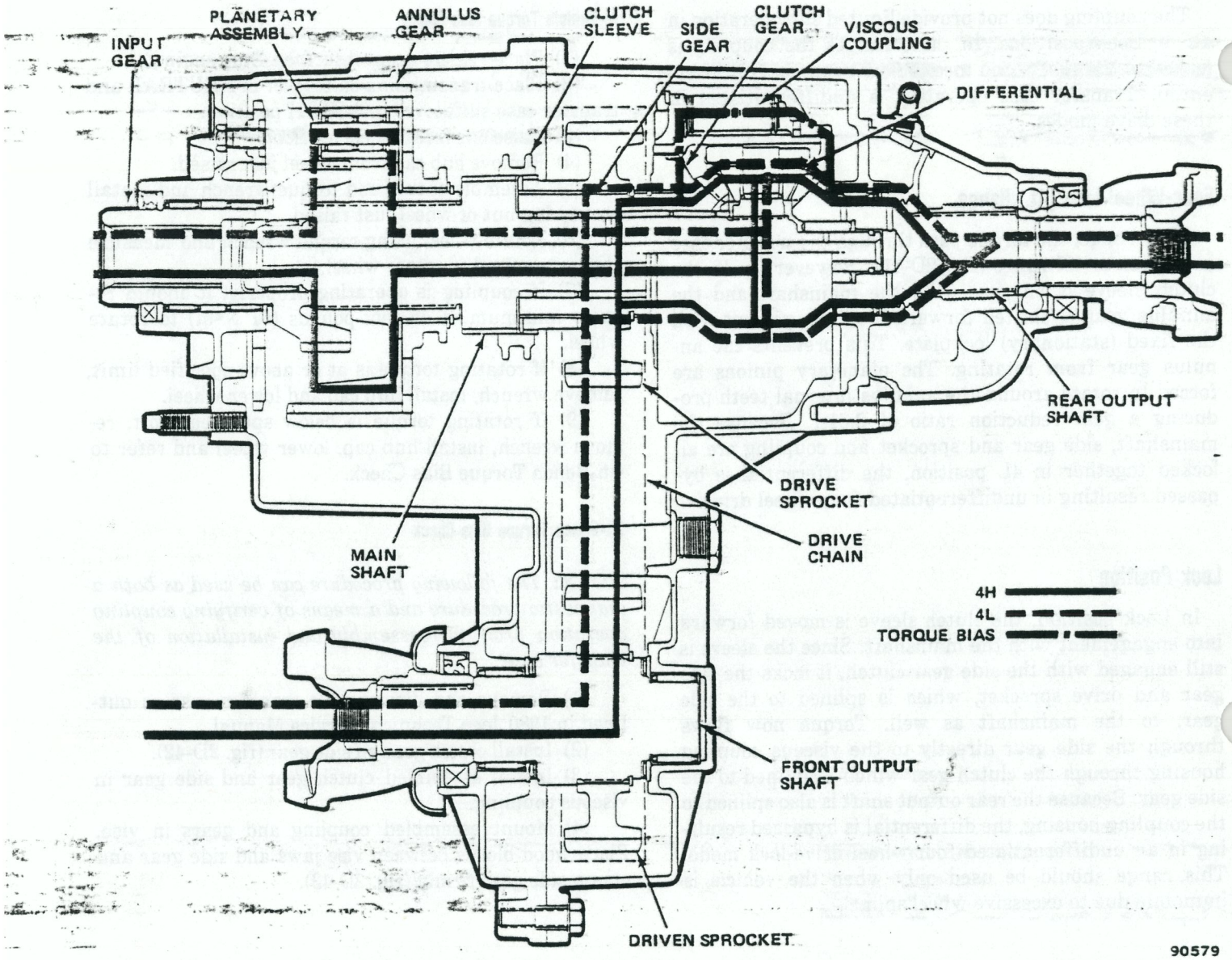

Fig. 2D-41 Power Flow—Model 219 Quadra-Trac Transfer Case

axle speed differences that produce drive line torque loads are dissipated by the differential. However, when extreme speed variations between axles occur, such as when one wheel or set of wheels spin on an ice covered surface, the coupling acts to transfer torque to the axle wheels having greater traction.

The special silicone fluid in the enclosed portion of the coupling is quite viscous and does not thin out when heated or subjected to high shear forces. In operation, when one axle overspeeds due to wheel slip, the input to the coupling causes the coupling rotational speed to increase also. However, as coupling speed increases, the fixed clutch plates in the coupling are forced to rotate (shear) through the silicone-fluid at higher speeds also. As the fluid is forced between the plates, it is displaced and expands, creating shear friction and increased resistance to further increases in input speed. This resistance to rotating speed increases in direct proportion to the increase in input speed from the front or rear axle through the propeller shaft.

In situations where the coupling becomes operational, the coupling does not lock the axles together to produce undifferentiated four-wheel drive. The coupling merely limits (controls) the amount of slippage while delivering maximum torque to the axle having greater traction.

NOTE: *The coupling and pinion assembly is not a serviceable component. It is a sealed unit and is not refillable. If the coupling or pinions become damaged in some way, it must be replaced as an assembly only. Do not attempt to disassemble the unit.*

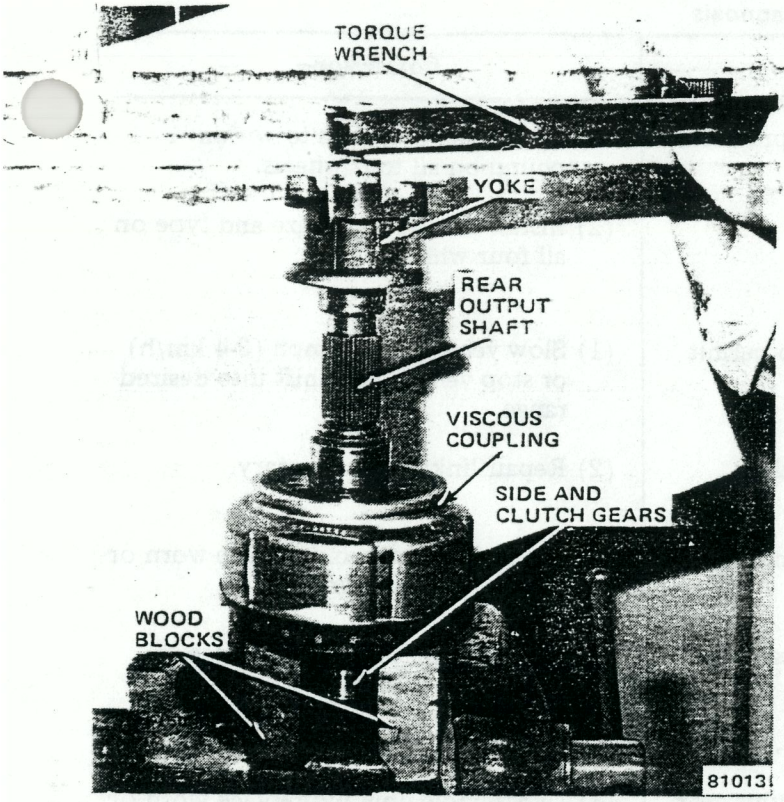

Fig. 2D-43 Torque Bias Check—On-Bench

CAUTION: *Wood blocks must be placed between the vise jaws and side gear to avoid damaging the gear.*

(5) Check engagement of clutch gear in viscous coupling. Be sure gear is fully engaged in coupling before proceeding. If necessary, loosen vise and reposition wood blocks so they support gear in coupling.

(6) Install rear output shaft in viscous coupling (fig. 2D-43).

(7) Install yoke on rear output shaft and install yoke retaining nut.

(8) Assemble and install socket and torque wrench on yoke retaining nut (fig. 2D-43).

(9) Rotate rear output shaft using torque wrench and measure torque required to rotate shaft in coupling.

(10) Torque required to rotate shaft in coupling should be minimum of 25 foot-pounds (34 N•m) torque.

(11) If rotating torque is less than specified, coupling has malfunctioned. If torque is at or above specified limit, coupling is in good condition.

IN-VEHICLE SERVICE

Changing Lubricant

(1) Raise vehicle.

(2) Position drain pan under transfer case.

(3) Remove fill and drain plugs and drain lubricant.

(4) Install drain plug. Tighten plug to 35 foot-pounds (47 N•m) torque.

(5) Fill transfer case to bottom edge of fill plug hole with 10W-30 motor oil only.

(6) Install and tighten fill plug to 35 foot-pounds (47 N•m) torque.

(7) Remove drain pan and lower vehicle.

Speedometer Gear, Rear Bearing, Rear Seal, and Shaft Yoke Replacement

NOTE: *The front and rear yokes, seals, rear retainer and bearing and speedometer gear can all be serviced in the vehicle. The following combined procedure outlines replacement of these components.*

Removal

(1) Raise vehicle.

(2) Position drain pan under transfer case.

(3) Remove fill and drain plugs. Drain oil from transfer case.

(4) Mark propeller shaft and transfer case yoke for assembly reference.

(5) Disconnect propeller shaft. Secure shaft to underside of vehicle.

(6) Remove and discard transfer case yoke nut and seal washer. Use Tool J-8614-01 to hold yoke while removing nut.

(7) Remove yoke. Use Tools J-8614-01, -02, -03 to remove yoke, if necessary.

(8) Mark rear retainer for assembly reference and remove retainer.

(9) Remove differential shims and speedometer driven gear.

(10) Remove rear output bearing snap ring and remove bearing from retainer.

(11) Remove rear seal from retainer using punch or screwdriver.

(12) Install bearing in retainer. Be sure shielded side of bearing is facing case interior. Install bearing snap ring.

(13) Install rear yoke seal using Tool J-29162 (fig. 2D-26).

(14) Install speedometer gear and differential shim.

(15) Apply Loctite 515, or equivalent sealant, to mating surface of rear retainer and install retainer. Tighten retainer bolts to 23 foot-pounds (31 N•m) torque.

(16) Install yoke, seal washer and yoke nut. Tighten nut to 120 foot-pounds (163 N•m) torque.

(17) Connect propeller shaft.

(18) Install drain plug and fill transfer case to bottom edge of fill plug hole with 10W-30 motor oil only.

(19) Install fill plug. Tighten fill and drain plugs to 18 foot-pounds (24 N•m) torque.

(20) Remove drain pan and lower vehicle.

Service Diagnosis

Condition	Possible Cause	Correction
FRONT OR REAR OF VEHICLE TENDS TO PULL OR WANDER OCCASIONALLY WHEN DRIVING IN STRAIGHT DIRECTION	(1) Incorrect or unequal tire pressures	(1) Adjust tire pressures to within ½ - 1 pound on all four wheels.
	(2) Mismatched tires	(2) Install tires of equal size and type on all four wheels.
TRANSFER CASE DIFFICULT TO SHIFT OR WILL NOT SHIFT INTO DESIRED RANGE	(1) Vehicle speed too great to permit shifting.	(1) Slow vehicle to 2-3 mph (3-4 km/h) or stop vehicle and shift into desired range
	(2) External shift linkage binding, bent, loose.	(2) Repair linkage as necessary.
	(3) Internal components worn, binding or damaged.	(3) Disassemble unit and replace worn or damaged components.
NOISY IN – OR JUMPS OUT OF 4L RANGE	(1) Transfer case not completely engaged in 4L.	(1) Stop vehicle, shift transfer case to neutral; then shift back into 4L.
	(2) Shift linkage binding bent, loose.	(2) Repair linkage as necessary.
	(3) Range fork, shift rail, annulus gear, or clutch sleeve lockplate, worn or damaged.	(3) Disassemble unit and replace worn or damaged components.
NOISY IN ALL DRIVE MODES	(1) Insufficient or incorrect lubricant.	(1) Drain and refill with 10W-30 motor oil. Check for leaks if fluid level was low and repair as necessary. NOTE: If unit is still noisy after drain and refill, disassembly and inspection may be necessary to locate source of noise.
SEVERE LOW SPEED SHUDDER NOTED DURING ROAD TEST ON 219 TRANSFER CASE	(1) Indicates low or loss of viscous silicone fluid.	(1) Check transfer case lubricant for burnt fluid containing viscous silicone fluid.
		(2) If verified remove transfer case and disassemble. Check viscous coupling for case cracks, blown seal.
		(3) Replace as necessary.
		(4) Inspect front and rear axle for correct ratio.
LUBRICANT LEAKS FROM OUTPUT SHAFT SEALS OR FROM VENT	(1) Transfer case overfilled.	(1) Drain to correct level.
	(2) Vent closed or restricted.	(2) Clean or replace vent.
	(3) Shaft seals damaged or installed incorrectly.	(3) Replace seals. Be sure seal lip faces interior of case when installed. Also check yoke seal surfaces for nicks, scratches. Use crocus cloth to remove minor surface irregularities.

DISASSEMBLY

(1) Remove fill and drain plugs. Drain lubricant from transfer case.

(2) Remove front and rear output shaft yokes (fig. 2D-44). Discard yoke seal washers and yoke nuts.

(3) Mark rear retainer and rear case for assembly alignment reference.

(4) Remove rear retainer attaching bolts and remove retainer. Use plastic mallet to loosen retainer if necessary. Do not pry retainer off rear case.

(5) Remove differential shim(s) and speedometer drive gear from rear output shaft (fig. 2D-45). Tag shim(s) for assembly reference.

NOTE: *The speedometer gear fits on the shaft one way only. The long end should face the case. Note gear position for assembly reference.*

(6) Remove rear output bearing snap ring and remove bearing from retainer using plastic mallet.

NOTE: *The rear output bearing has one side shielded. Note bearing position for assembly reference.*

(7) Remove rear output shaft seal from rear retainer using screwdriver or punch.

(8) Position front case assembly on wood blocks (fig. 2D-46).

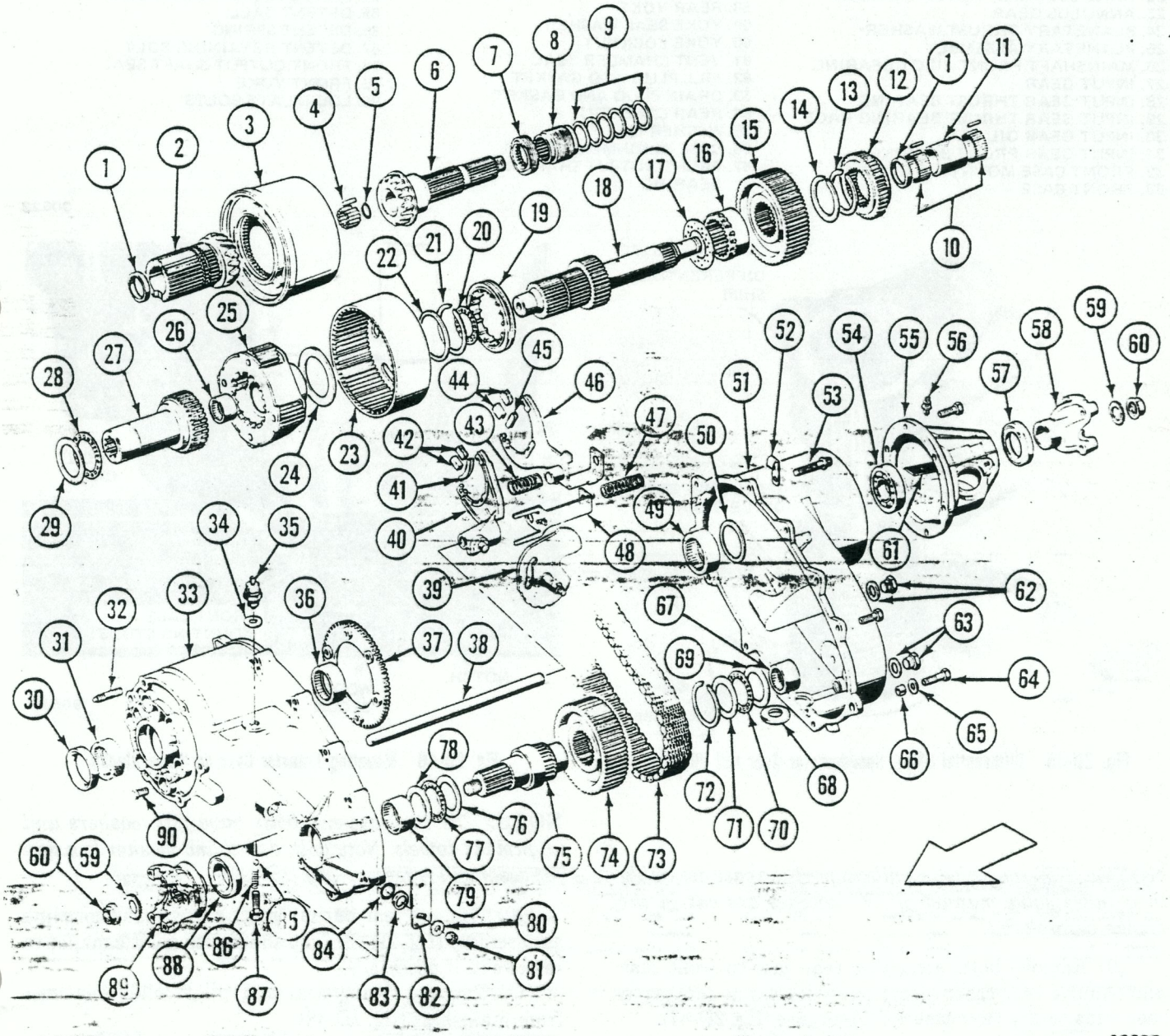

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Fig. 2D-44 Model 219 Quadra-Trac Transfer Case

1. MAINSHAFT REAR BEARING SPACER – SHORT (2)
2. SIDE GEAR
3. VISCOUS COUPLING AND DIFFERENTIAL ASSEMBLY
4. MAINSHAFT REAR PILOT ROLLER BEARINGS (15)
5. MAINSHAFT O-RING
6. REAR OUTPUT SHAFT
7. OIL PUMP
8. SPEEDOMETER GEAR
9. DIFFERENTIAL END PLAY SHIMS (SELECTIVE)
10. MAINSHAFT NEEDLE BEARINGS (82)
11. MAINSHAFT REAR BEARING SPACER
12. CLUTCH GEAR
13. CLUTCH GEAR LOCATING RING
14. DRIVE SPROCKET LOCATING RING
15. DRIVE SPROCKET
16. SIDE GEAR CLUTCH
17. MAINSHAFT THRUST WASHER
18. MAINSHAFT
19. CLUTCH SLEEVE
20. MAINSHAFT THRUST BEARING
21. ANNULUS GEAR RETAINING RING
22. ANNULUS GEAR THRUST WASHER
23. ANNULUS GEAR
24. PLANETARY THRUST WASHER
25. PLANETARY ASSEMBLY
26. MAINSHAFT FRONT PILOT BEARING
27. INPUT GEAR
28. INPUT GEAR THRUST BEARING
29. INPUT GEAR THRUST BEARING RACE
30. INPUT GEAR OIL SEAL
31. INPUT GEAR FRONT BEARING
32. FRONT CASE MOUNTING STUD (6)
33. FRONT CASE
34. LOCK MODE INDICATOR SWITCH GASKET
35. LOCK MODE INDICATOR SWITCH
36. INPUT GEAR REAR BEARING
37. LOW RANGE LOCKPLATE
38. SHIFT RAIL
39. RANGE SECTOR
40. RANGE FORK
41. RANGE FORK INSERT
42. RANGE FORK PADS
43. MODE FORK SPRING
44. MODE FORK PADS
45. MODE FORK INSERT
46. MODE FORK
47. SHIFT RAIL SPRING
48. MODE FORK BRACKET
49. REAR OUTPUT SHAFT BEARING
50. REAR OUTPUT SHAFT BEARING SEAL
51. REAR CASE
52. WIRING CLIP
53. SPLINE BOLT
54. REAR OUTPUT BEARING
55. REAR RETAINER
56. VENT
57. OUTPUT SHAFT OIL SEAL
58. REAR YOKE
59. YOKE SEAL WASHER
60. YOKE LOCKNUT
61. VENT CHAMBER SEAL
62. FILL PLUG AND GASKET
63. DRAIN PLUG AND GASKET
64. REAR CASE BOLT
65. WASHER (2)
66. CASE ALIGNMENT DOWEL
67. FRONT OUTPUT SHAFT REAR BEARING
68. MAGNET
69. FRONT OUTPUT SHAFT REAR THRUST BEARING RACE (THICK)
70. FRONT OUTPUT SHAFT REAR THRUST BEARING
71. FRONT OUTPUT SHAFT REAR THRUST BEARING RACE (THIN)
72. DRIVEN SPROCKET RETAINING SNAP RING
73. DRIVE CHAIN
74. DRIVEN SPROCKET
75. FRONT OUTPUT SHAFT
76. FRONT OUTPUT SHAFT FRONT THRUST BEARING RACE (THIN)
77. FRONT OUTPUT SHAFT FRONT THRUST BEARING
78. FRONT OUTPUT SHAFT FRONT THRUST BEARING RACE (THICK)
79. FRONT OUTPUT SHAFT FRONT BEARING
80. WASHER
81. LOCKNUT
82. OPERATING LEVER
83. RANGE SECTOR SHAFT SEAL RETAINER
84. RANGE SECTOR SHAFT SEAL
85. DETENT BALL
86. DETENT SPRING
87. DETENT RETAINING BOLT
88. FRONT OUTPUT SHAFT SEAL
89. FRONT YOKE
90. LOCKPLATE BOLTS

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Fig. 2D-45 Differential Shim, Speedometer Gear and Oil Pump

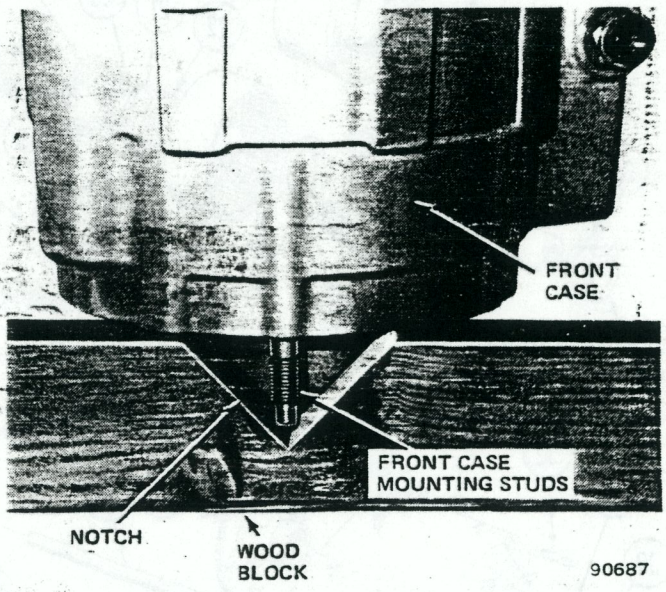

Fig. 2D-46 Mounting Transfer Case on Wood Blocks

NOTE: The wood blocks will support the case assembly in a more solid manner if "V" notches are cut in the blocks beforehand.

(9) Remove bolts attaching rear case to front case and remove rear case. Insert screwdrivers in notches at case ends to pry rear case off front case (fig. 2D-47).

NOTE: *The two case-end bolts have flat washers and alignment dowels. Note bolt, dowel and washer location for assembly reference (fig. 2D-44).*

(10) Remove rear output shaft and viscous coupling as assembly (fig. 2D-48). Tap shaft with plastic mallet to remove it, if necessary.

(11) Remove O-ring seal and pilot roller bearings from mainshaft (fig. 2D-48).

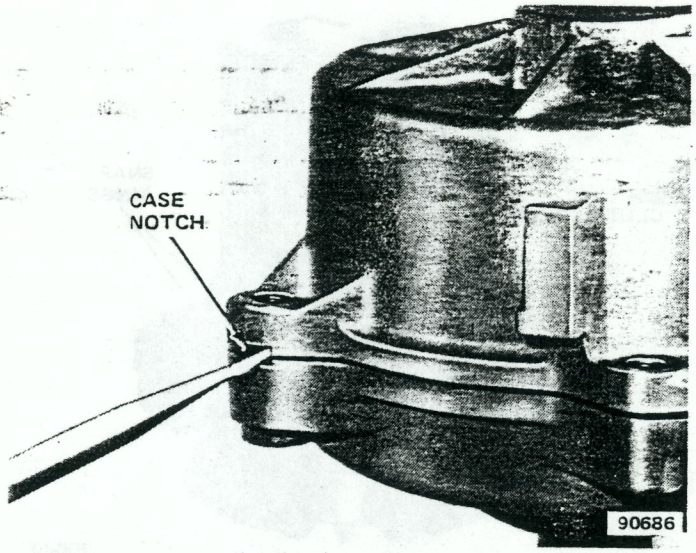

Fig. 2D-47 Rear Case Removal

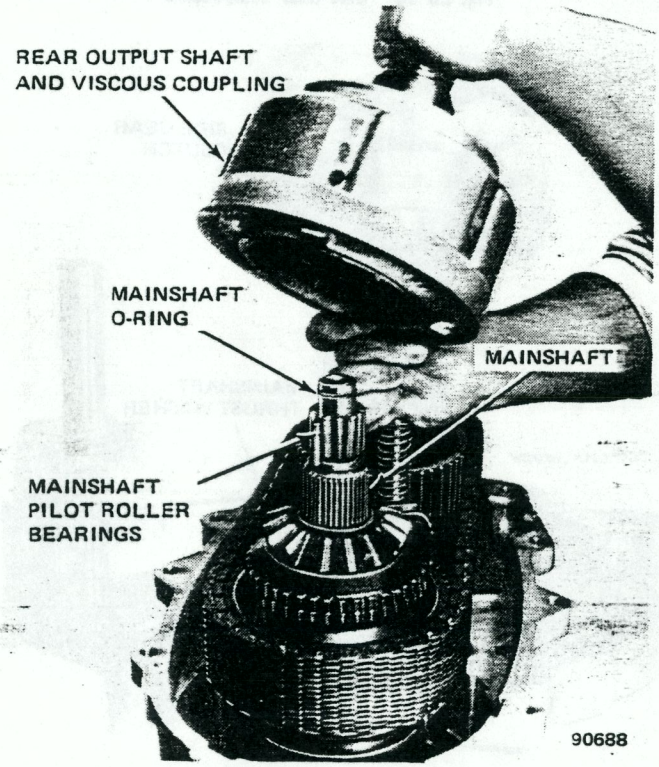

Fig. 2D-48 Viscous Coupling and Rear Output Shaft Removal/Installation

(12) Remove rear output shaft from viscous coupling.

(13) Remove shift rail spring from rail.

(14) Remove plastic oil pump from shaft bore in rear case. Note pump position for assembly reference. End with recess in it must face shaft bore when installed.

(15) Remove rear output shaft bearing seal from case. Use screwdriver to pry seal out of seal bore.

(16) Remove front output shaft thrust bearing assembly (fig. 2D-49). Remove thick washer, bearing and thin washer. Tag assembly for installation reference.

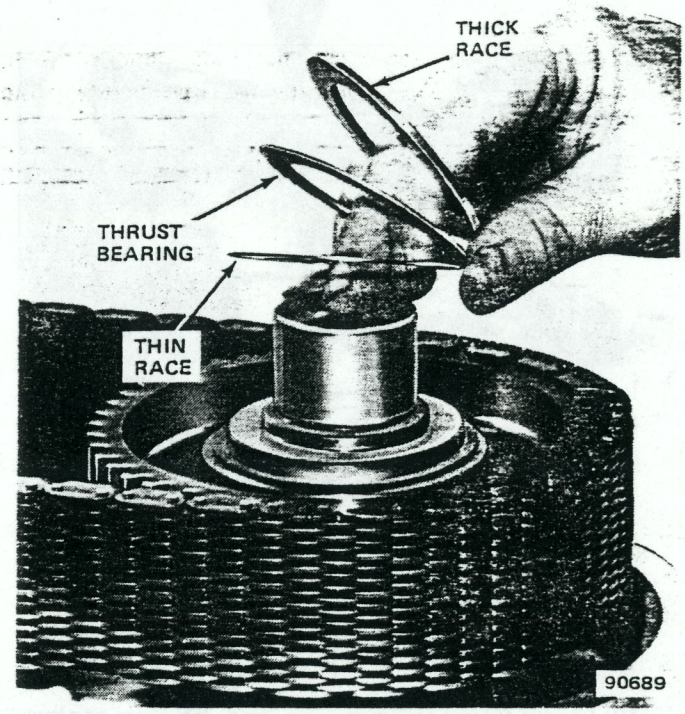

Fig. 2D-49 Front Output Shaft Rear Thrust Bearing Assembly Removal/Installation

(17) Remove driven sprocket retaining snap ring (fig. 2D-50).

(18) Remove drive sprocket, drive chain, driven sprocket, side gear clutch and clutch gear as assembly (fig. 2D-51). Place assembly on workbench and mark components for assembly installation reference, especially sprockets.

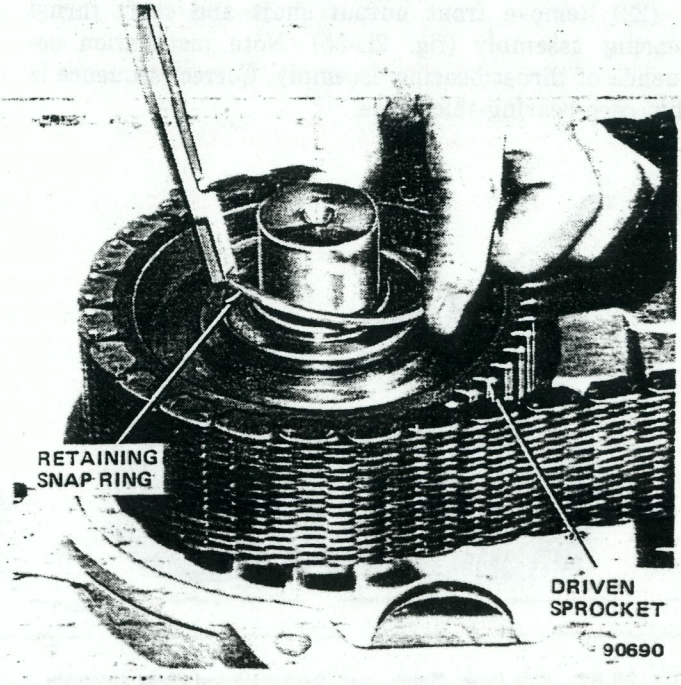

Fig. 2D-50 Driven Sprocket Retaining Snap Ring Removal/Installation

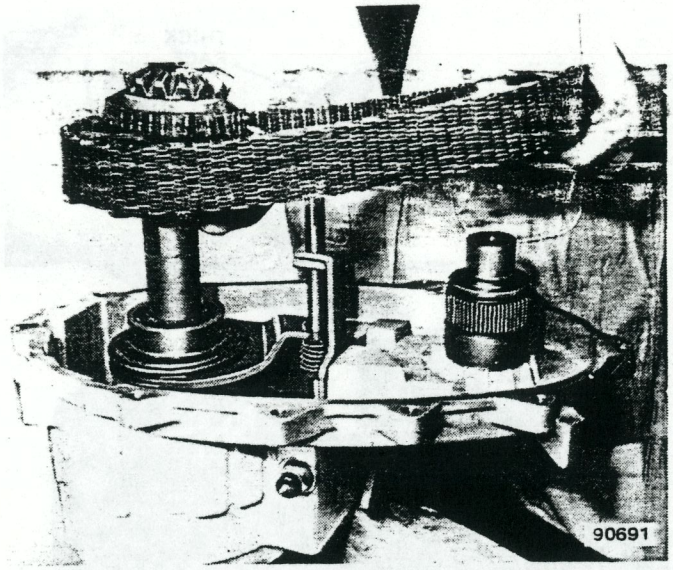

Fig. 2D-51 Sprocket and Chain Removal—Installation

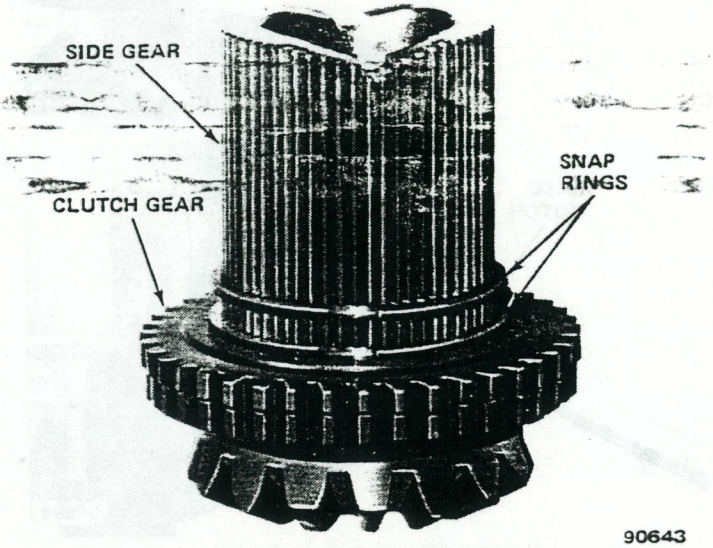

Fig. 2D-53 Side Gear Components

(19) Remove needle bearings and bearing spacers from mainshaft or side gear bore. Total of 82 needle bearings and three spacers are used.

(20) Remove side gear/clutch gear assembly from drive sprocket (fig. 2D-52). Remove two snap rings and remove clutch gear from side gear. Note position of snap rings and gears for assembly reference (fig. 2D-53).

(21) Remove side gear clutch (fig. 2D-54), mainshaft thrust washer and remaining (short) mainshaft needle bearing spacer.

(22) Remove front output shaft and shaft thrust bearing assembly (fig. 2D-55). Note installation sequence of thrust bearing assembly. Correct sequence is thin race-bearing-thick race.

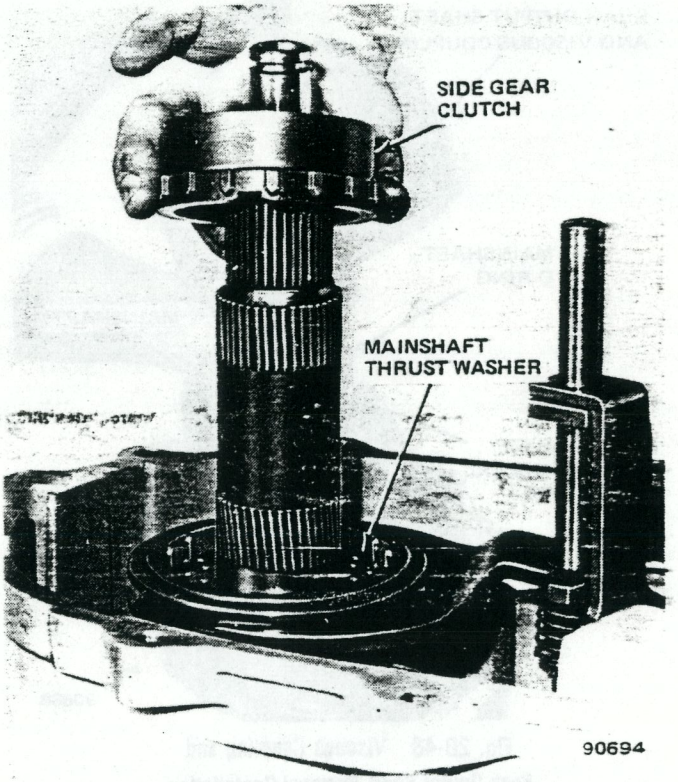

Fig. 2D-54 Side Gear Clutch Removal/Installation

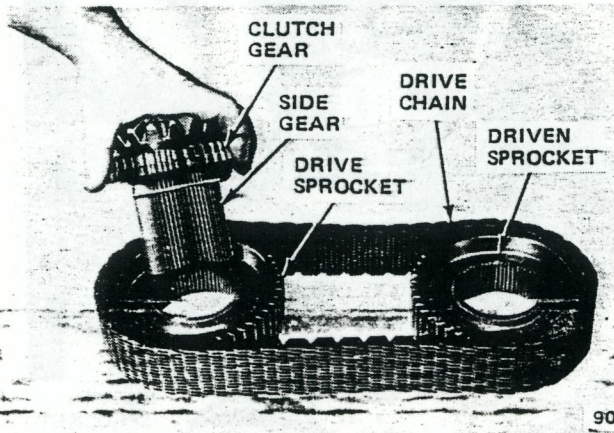

Fig. 2D-52 Side Gear, Clutch Gear, Sprockets and Chain Assembly

(23) Remove front output shaft seal from front case using screwdriver or punch.

(24) Remove shift rail spring from shift rail if not already removed. Tag spring for assembly reference.

(25) Remove clutch sleeve, mode fork and mode fork spring as assembly (fig. 2D-56). Note position of components for assembly reference. Disassemble components for cleaning and inspection.

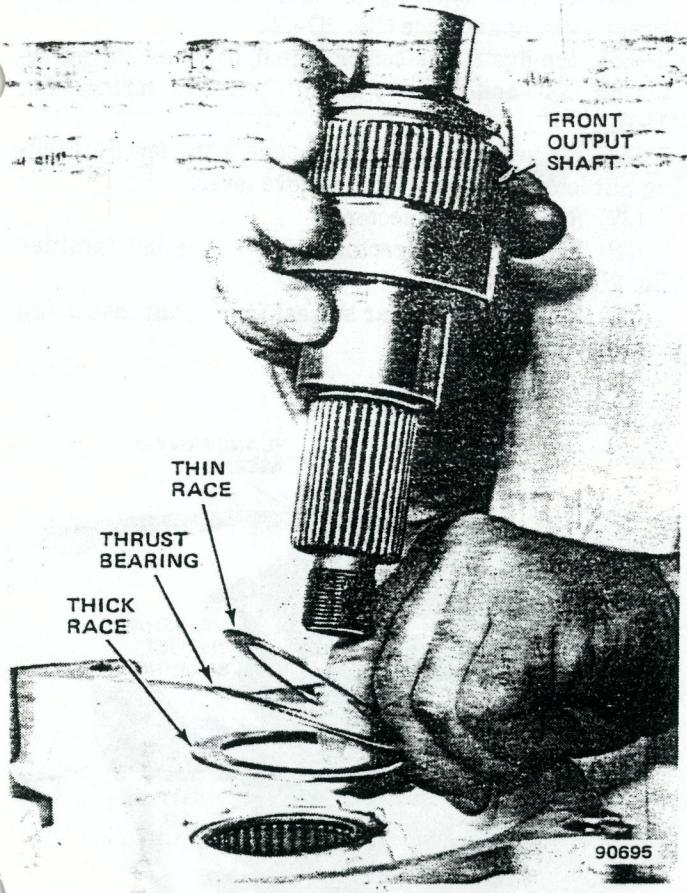

Fig. 2D-55 Front Output Shaft and Shaft Front Thrust Bearing Removal/Installation

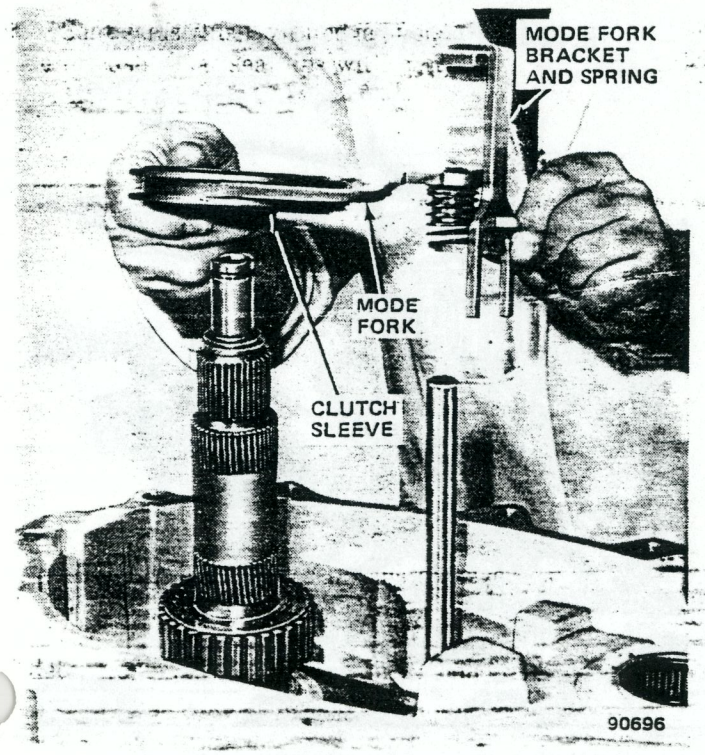

Fig. 2D-56 Clutch Sleeve and Mode Fork Removal/Installation

(26) Remove mainshaft thrust washer and remove mainshaft (fig. 2D-57). Grasp shaft and pull straight up to remove.

(27) Move range operating lever downward to last detent position.

(28) Disengage range fork lug from range sector slot (fig. 2D-21).

(29) Remove annulus gear retaining snap ring and thrust washer (fig. 2D-58).

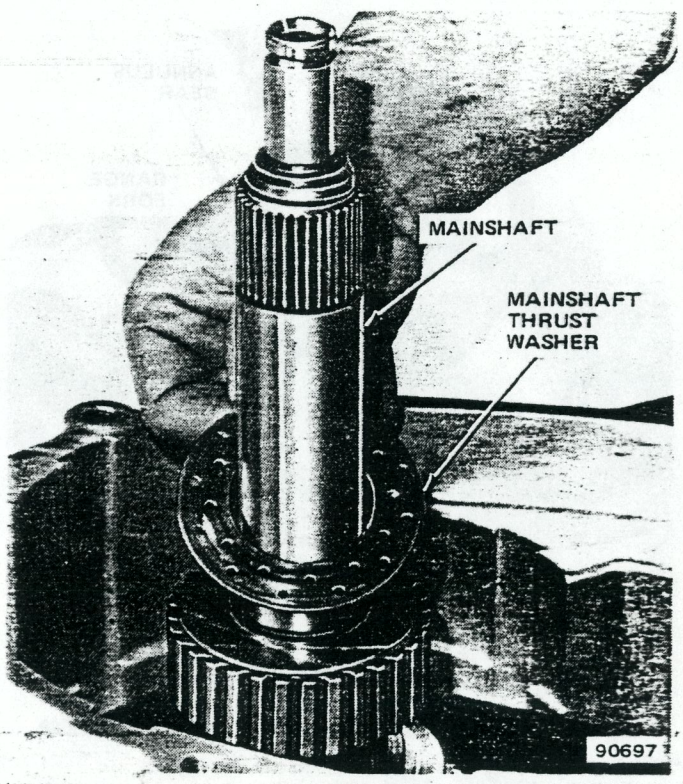

Fig. 2D-57 Mainshaft and Thrust Washer

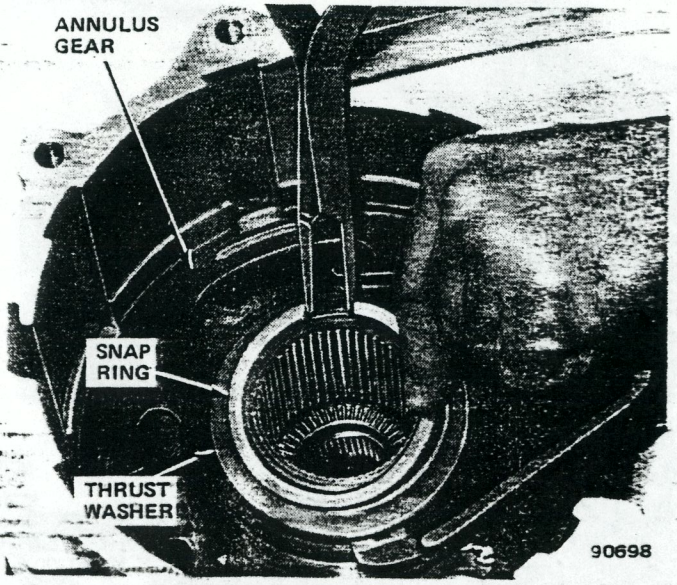

Fig. 2D-58 Annulus Gear Snap Ring and Thrust Washer Removal/Installation

(30) Remove annulus gear and range fork as assembly (fig. 2D-59). Separate components for cleaning and inspection.

(31) Remove planetary thrust washer from planetary assembly hub (fig. 2D-60).

(32) Remove planetary assembly (fig. 2D-61). Grasp planetary hub and lift assembly upward to remove it.

(33) Remove mainshaft thrust bearing from input gear (fig. 2D-61).

(34) Remove input gear and remove input gear thrust bearing and race (fig. 2D-62).

(35) Remove range sector detent ball and spring retaining bolt and remove detent ball and spring (fig. 2D-10).

(36) Remove range sector and operating lever attaching nut and lockwasher and remove lever.

(37) Remove range sector.

(38) Remove range sector shaft O-ring and retainer (fig. 2D-44).

(39) Remove input gear oil seal from front case using screwdriver or punch.

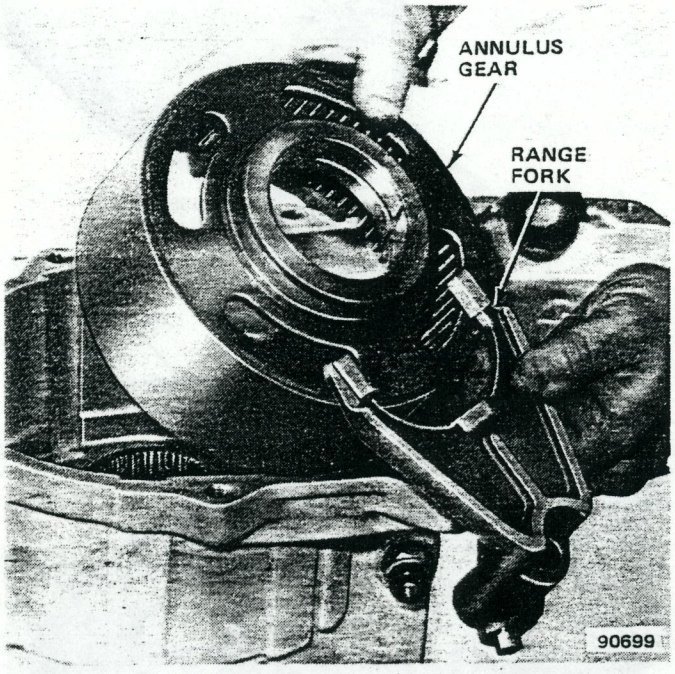

Fig. 2D-59 Annulus Gear and Range Fork Removal/Installation

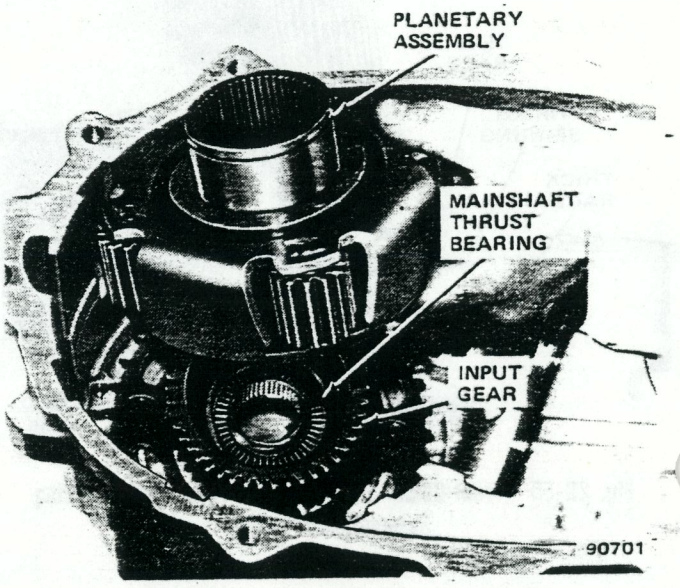

Fig. 2D-61 Planetary Assembly Removal/Installation

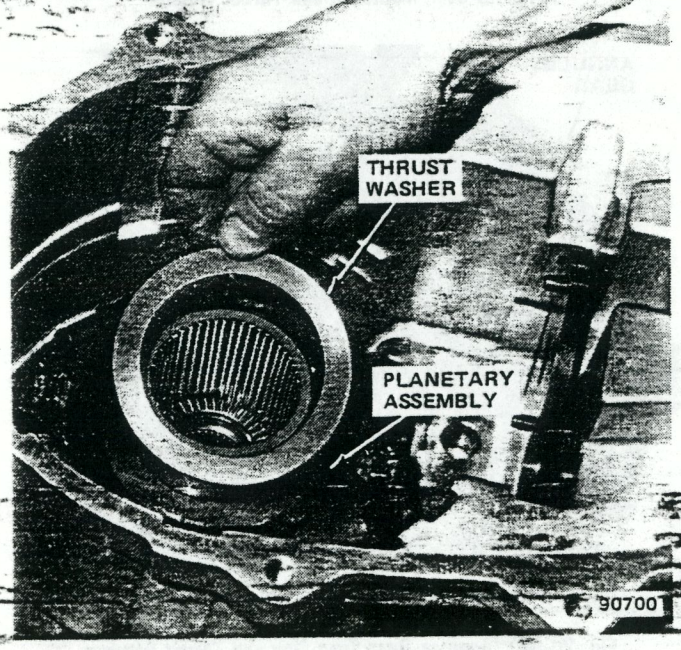

Fig. 2D-60 Planetary Thrust Washer Removal/Installation

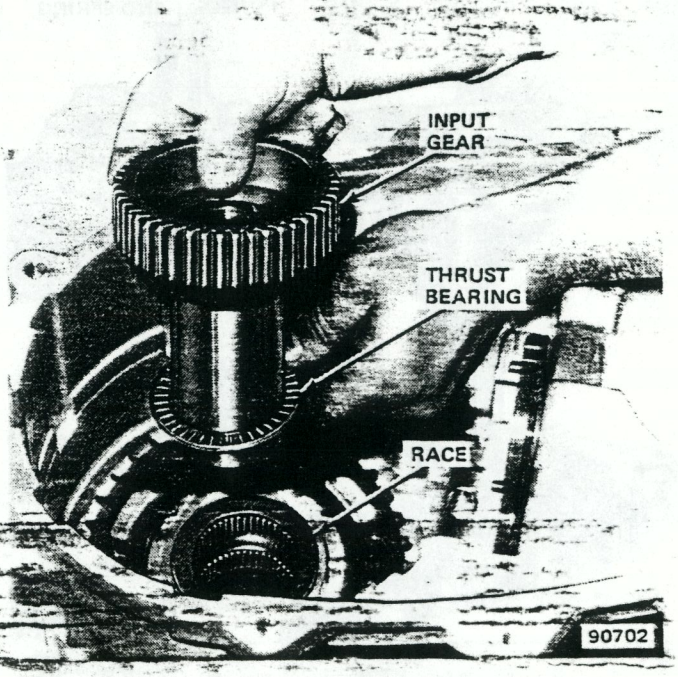

Fig. 2D-62 Input Gear and Thrust Bearing Removal/Installation

CLEANING AND INSPECTION

Wash all parts thoroughly in clean solvent. Be sure all old lubricant, metallic particles, dirt, or foreign material are removed from the surfaces of every part. Apply compressed air to each oil feed port and channel in each case half to remove any obstructions or cleaning solvent residue.

Inspect all gear teeth for signs of excessive wear or damage and check all gear splines for burrs, nicks, wear or damage. Remove minor nicks or scratches with an oilstone. Replace any part exhibiting excessive wear or damage.

Inspect all snap rings and thrust washers for evidence of excessive wear, distortion, or damage. Replace any of these parts if they exhibit these conditions.

Inspect the two case halves for cracks, porosity, damaged mating surfaces, stripped bolt threads, or distortion. Replace any part that exhibits these conditions.

Inspect the low range lockplate in the front case. If the lockplate teeth or the plate hub is cracked, broken, chipped, or excessively worn, replace the lockplate and the lockplate attaching bolts. Refer to the Low Range Lockplate Replacement procedure in the Subassembly Overhaul section.

Inspect the condition of all needle, roller, ball and thrust bearings in the front and rear case halves, and the input gear. Also check the condition of the bearing bores in both cases and in the input gear, rear output shaft, side gear, and rear retainer. Replace any part that exhibits signs of excessive wear or damage. If the case or input gear bearings require replacement, refer to Bearing Replacement in the Subassembly Overhaul section.

Inspect the coupling and pinion gears. If the coupling is leaking fluid or the gears are worn or damaged in any way, replace the coupling as an assembly only. Do not attempt to service the unit.

SUBASSEMBLY OVERHAUL

Lockplate Replacement

(1) Remove and discard lockplate attaching bolts.
(2) Remove lockplate from case.
(3) Coat case and lockplate surfaces around bolt holes with Loctite 515, or equivalent sealant.
(4) Position new lockplate in case and align bolt holes in lockplate and case.
(5) Coat new lockplate attaching bolts with Loctite 271, or equivalent adhesive sealant.
(6) Install and tighten lockplate attaching bolts to 30 foot-pounds (41 N•m) torque.

Bearing and Bushing Replacement

CAUTION: *All of the bearings used in the transfer case must be correctly positioned to avoid covering the bearing oil feed holes. After replacing any bearing, check the bearing position to be sure the feed hole is not covered by the bearing.*

Rear Output Shaft Bearing

(1) Remove bearing using Driver Handle J-8092 and Remover J-29165. Refer to figure 2D-27 for similar tool setup.
(2) Install bearing using Driver Handle J-8092 and Installer J-29166.
(3) Remove bearing installer tools and check bearing position to be sure the bearing oil feed hole is not covered.

Front Output Shaft Front Bearing

(1) Remove bearing using Driver Handle J-8092 and Remover J-29168 (fig. 2D-27).
(2) Install new bearing using Driver Handle J-8092 and Installer J-29167 (fig. 2D-28).
(3) Remove installer tools and check bearing position to be sure oil feed hole is not covered.

Front Output Shaft Rear Bearing

(1) Remove bearing using Remover J-26941 and Slide Hammer J-2619-01 (fig. 2D-29).
(2) Install new bearing using Driver Handle J-8092 and Installer J-29163 (fig. 2D-30).
(3) Remove installer tools and check bearing position to be sure oil feed hole is not covered. Also be sure bearing is seated flush with edge of bore in case to allow room for thrust bearing assembly.

Input Gear Front/Rear Bearings

(1) Remove both bearings simultaneously using Driver Handle J-8092 and Remover J-29170 (fig. 2D-31).
(2) Install new bearings one at a time. Install rear bearing first; then install front bearing. Use Driver Handle J-8092 and Installer J-29169 (fig. 2D-32).
(3) Remove installer tools and check bearing position to be sure oil feed holes are not covered. Also be sure bearings are flush with case bore surfaces.

Mainshaft Front Pilot Bearing

(1) If bearing cannot be removed by hand, remove it using Slide Hammer J-2619-01 and Remover J-29369-1 or similar internal type blind hole bearing puller (fig. 2D-33).
(2) If necessary, install new bearing using Driver Handle J-8092 and Installer J-29174. Be sure bearing is flush with bore (fig. 2D-34).

(3) If bearing was seated using installer tools, check bearing position to be sure hole feed hole is not covered. Also be sure bearing is seated flush with edge of bearing bore.

Rear Output Bearing and Seal

(1) Remove snap ring and remove bearing using rawhide mallet or brass punch.

(2) Install new bearing using Tools J-8092 and J-7818 (fig. 2D-25).

CAUTION: *Be sure the shielded side of the bearing faces the interior of the transfer case after installing it.*

(3) Install bearing snap ring.

(4) Install seal using Tool J-29162 (fig. 2D-26).

Annulus Gear Bushing Replacement

(1) Remove bushing using Driver Handle J-8092 and Remover—Installer Tool J-29185 (fig. 2D-35).

(2) Install new bushing using Tools J-8092 and J-29185 (fig. 2D-36).

(3) Remove any chips generated by bushing removal/installation.

ASSEMBLY

NOTE: *During assembly, prelubricate all transfer case internal components with 10W-30 motor oil or petroleum jelly where indicated. Do not use chassis lubricant or similar "heavy" type lubricants.*

(1) Install new input gear and rear output shaft bearing oil seals. Seat seals flush with edge of seal bore or in seal groove in case. Coat seal lips with petroleum jelly after installation.

(2) Install input gear thrust bearing race in case counterbore (fig. 2D-62).

(3) Install input gear thrust bearing on input gear and install gear and bearing in case (fig. 2D-62).

(4) Install mainshaft thrust bearing in bearing recess in input gear (fig. 2D-61).

(5) Install planetary assembly on input gear. Be sure planetary pinion teeth mesh fully with input gear (fig. 2D-61).

(6) Install planetary thrust washer on planetary hub (fig. 2D-60).

(7) Install new sector shaft O-ring and retainer in shaft bore in case.

(8) Install range sector in front case (fig. 2D-63). Install operating lever on sector shaft and install lever attaching washer and locknut on shaft. Tighten locknut to 17 foot-pounds (23 N•m) torque.

(9) Install detent spring, ball and retaining bolt in front case detent bore. Tighten bolt to 22 foot-pounds (30 N•m) torque (fig. 2D-10).

(10) Move range sector to last detent position.

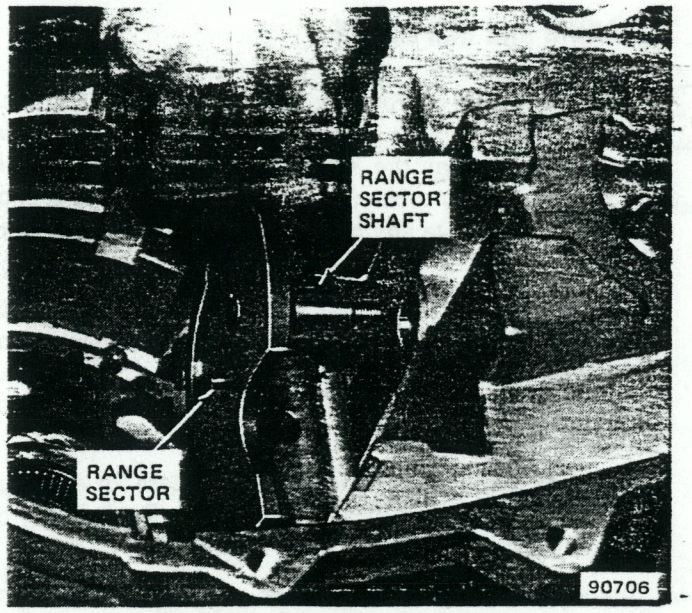

Fig. 2D-63 Range Sector Installation

(11) Assemble annulus gear and range fork. Install assembled fork and gear on and over planetary assembly. Be sure annulus gear is fully meshed with planetary pinions (fig. 2D-59).

(12) Insert range fork lug in range sector detent slot (fig. 2D-21).

(13) Install annulus thrust washer and annulus retaining ring on annulus gear hub (fig. 2D-58).

(14) Align mainshaft thrust washer in input gear, if necessary.

(15) Install mainshaft. Be sure shaft is fully seated in input gear.

(16) Install mainshaft thrust washer on mainshaft (fig. 2D-64).

(17) Install short mainshaft needle bearing spacer on shaft.

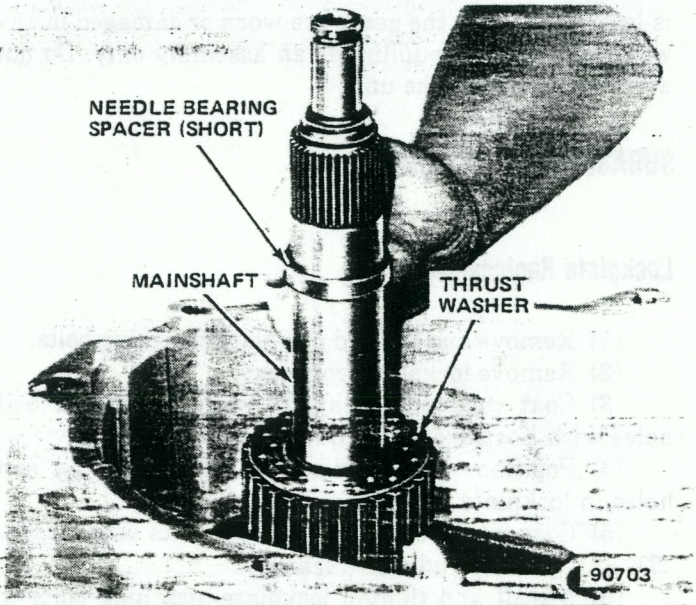

Fig. 2D-64 Mainshaft and Thrust Washer Installation

(18) Apply liberal coating of petroleum jelly to mainshaft needle bearing surface and to all 82 needle bearings. Install 41 bearings on shaft. Be sure bearings are in vertical position and seat on short spacer. Use additional petroleum jelly to hold bearings in place if necessary (fig. 2D-65).

(19) Install long mainshaft needle bearing spacer on shaft (fig. 2D-65). Lower spacer onto previously installed needle berings carefully to avoid displacing bearings.

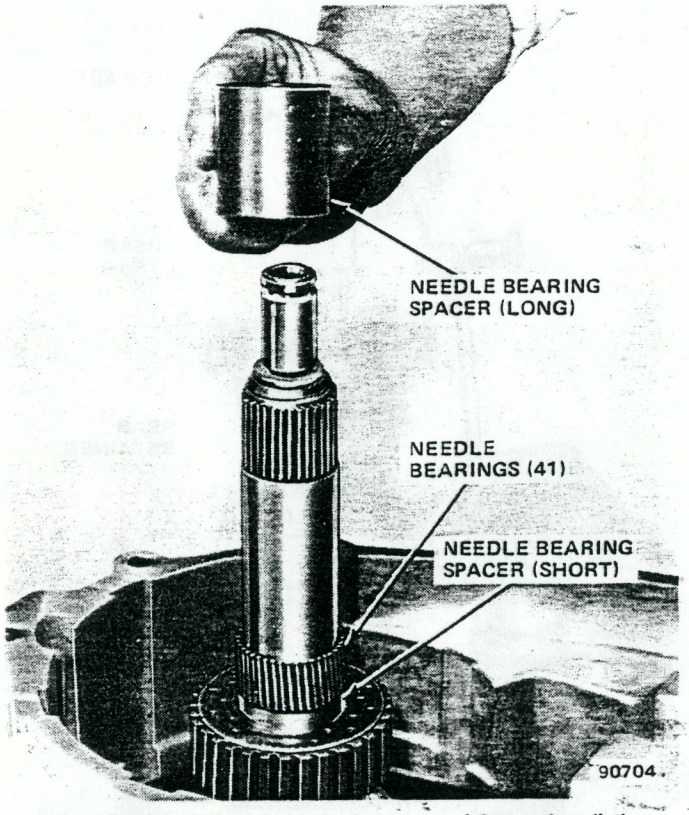

Fig. 2D-65 Mainshaft Needle Bearings and Spacer Installation

(20) Align shift rail bore in case with bore in range fork and install shift rail.

NOTE: *Remove all traces of oil from the case shift rail bore before installing the rail. Oil in the case bore may prevent the rail from seating completely and prevent rear case installation.*

(21) Assemble mode fork, mode fork spring and mode fork bracket (fig. 2D-66).

(22) Install clutch sleeve in mode fork (fig. 2D-56). Be sure sleeve is positioned so I.D. numbers on sleeve face upward after sleeve is installed.

(23) Align clutch sleeve and mode fork assembly with shift rail and install assembly on shift rail and mainshaft. Be sure clutch sleeve is meshed with mainshaft gear.

(24) Lubricate remaining 41 mainshaft needle bearings and position bearings on shaft. Use additional petroleum jelly to hold bearings on shaft, if necessary.

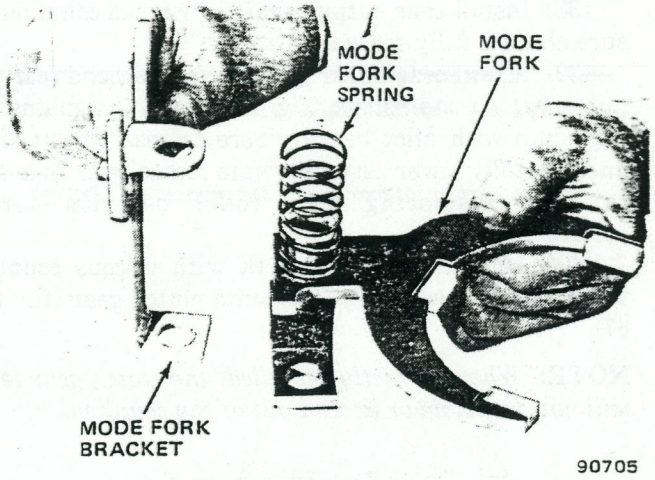

Fig. 2D-66 Assembling Mode Fork, Spring and Bracket

(25) Install side gear clutch on mainshaft with clutch gear teeth facing downward (fig. 2D-54). Be sure gear teeth mesh with clutch sleeve.

(26) Install remaining short mainshaft needle bearing spacer. Install spacer carefully to avoid displacing previously installed bearings.

(27) Install front output shaft front thrust bearing assembly in front case. Correct installation sequence is thick race-thrust bearing-thin race.

(28) Install front output shaft in front case (fig. 2D-55).

(29) Install clutch gear on side gear (fig. 2D-53). Tapered side of clutch gear teeth must face side gear teeth.

(30) Install clutch gear and drive sprocket locating snap rings on side gear. Install snap rings so snap rings face each other (fig. 2D-53).

(31) Position drive and driven sprockets in drive chain and install assembled side and clutch gears in drive sprocket (fig. 2D-52).

(32) Install assembled drive chain, sprockets and side gear on mainshaft and front output shaft (fig. 2D-51). Align sprockets with shafts, keep assembly level and carefully lower assembly onto both shafts simultaneously. Take care to avoid displacing mainshaft needle bearings during installation.

(33) Install driven sprocket retaining snap ring (fig. 2D-50).

(34) Install front output shaft rear thrust bearing assembly on front output shaft. Correct installation sequence is thin race-thrust bearing-thick race (fig. 2D-49).

(35) Install shift rail spring on shift rail.

(36) Install new O-ring on mainshaft pilot bearing hub (fig. 2D-48).

(37) Coat mainshaft pilot roller bearing hub and pilot roller bearings with liberal quantity of petroleum jelly and install rollers on shaft. Use enough petroleum jelly to hold bearing rollers on shaft (fig. 2D-48).

(38) Install rear output shaft in viscous coupling. Be sure shaft is fully seated.

(39) Install assembled viscous coupling and rear output shaft on mainshaft (fig. 2D-48). Align mainshaft pilot hub with pilot bearing bore in rear output shaft and carefully lower assembly onto mainshaft. Take care to avoid displacing pilot roller bearings during installation.

(40) Align clutch gear teeth with viscous coupling teeth and seat coupling fully onto clutch gear (fig. 2D-67).

NOTE: *When correctly installed, the clutch gear teeth will not be visible or extend out of the coupling.*

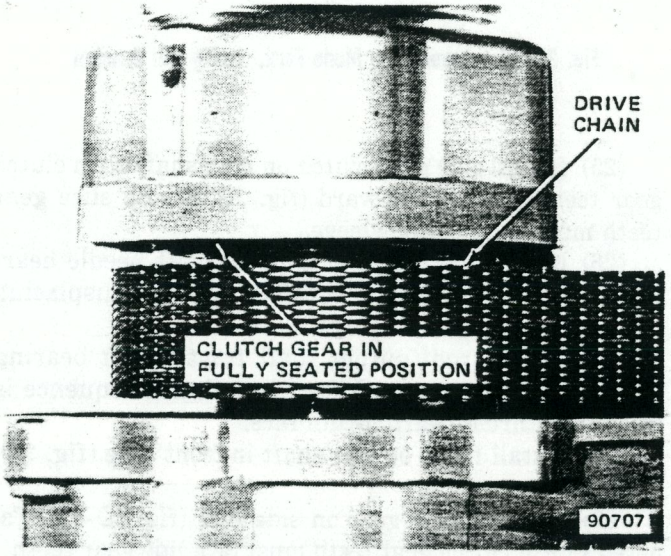

Fig. 2D-67 Seating Viscous Coupling on Clutch Gear

(41) Install magnet in front case, if removed.

(42) Clean mating surfaces of front and rear cases thoroughly.

(43) Apply Loctite 515, or equivalent sealant, to mating surface of front case and to all case attaching bolts.

(44) Install rear case on front case. Align case dowels and install case attaching bolts. Tighten bolts to 22 foot-pounds (30 N•m) torque.

NOTE: *The two case-end dowel bolts require flat washers.*

(45) Install oil pump on rear output shaft and seat it in case. Install pump so side with recess faces interior of case (fig. 2D-45).

(46) Install speedometer drive gear and differential shim on output shaft (fig. 2D-45).

(47) Install vent chamber seal in rear retainer, if removed.

(48) Align and install rear retainer on rear case. Tighten retainer bolts finger-tight only.

(49) Install yoke on rear output shaft. Tighten yoke nut finger-tight only.

(50) Mount Dial Indicator J-8001 on rear retainer. Position indicator stylus so it contacts top of yoke nut (fig. 2D-68).

(51) Install yoke on front output shaft and rotate front shaft ten complete revolutions.

(52) Rotate front output shaft again and note end play registered on dial indicator. End play should be 0.002 to 0.010 inches (0.05 to 0.25 mm). If end play is correct, go to next step. If end play must be adjusted, remove rear retainer, add or subtract differential shims as required, and check end play again.

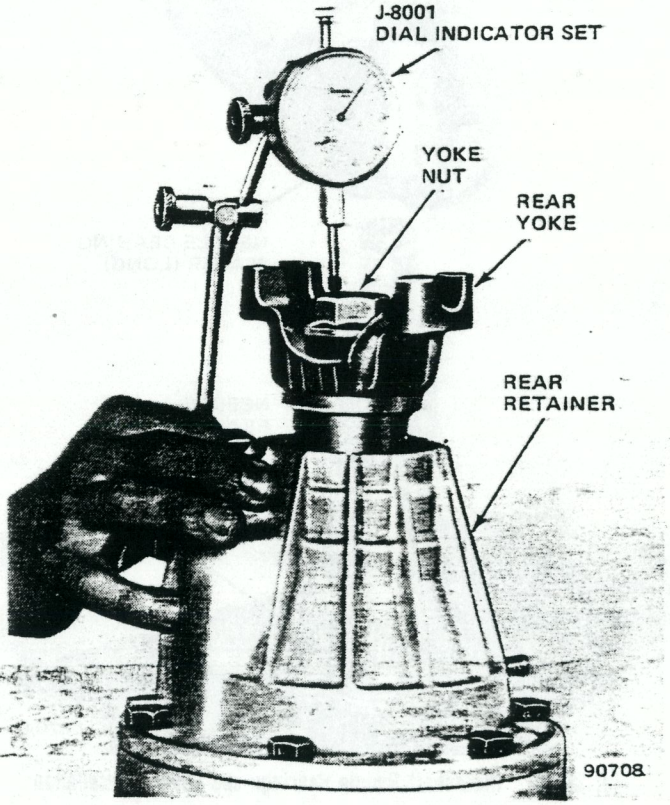

Fig. 2D-68 Checking Differential End Play

(53) Remove both output shaft yokes. Discard old yoke nuts.

(54) Install new front and rear yoke seals if not installed previously.

(55) Remove rear retainer bolts, apply Loctite 515, or equivalent sealant, to mating surface of retainer and to bolts and reinstall bolts. Tighten bolts to 22 foot-pounds (30 N•m) torque.

(56) Install new yoke seal washers on output shafts, install yokes on shafts and install new yoke nuts. Tighten nuts to 110 foot-pounds (149 N•m) torque.

(57) Install drain plug. Tighten plug to 35 foot-pounds (47 N•m) torque.

(58) Pour 4 pints (1.9 liters) of 10W-30 motor oil into transfer case through fill plug hole, and install fill plug. Tighten plug to 35 foot-pounds (47 N•m) torque.

SPECIFICATIONS

Specifications—Model 219 Quadra-Trac Transfer Case

Transfer Case Type	4 position, dual range, full time 4-wheel drive unit with integral low range and a neutral and lock position
Torque Transmittal Mode	Dual sprockets with connecting drive chain and an interaxle differential — viscous coupling unit
Low Range Reduction Ratio and Mode	2.61:1 through annulus gear and planetary carrier assembly
Drive Positions and Shift Controls	4H, 4L, Neutral, Lock. Ranges selected via floor mounted shift lever (4H range is fully differentiated. 4L and Lock ranges are undifferentiated
Lubricant Capacity and Type	4 pints (1.9 liters) 10W-30 motor oil (only)

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Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft-lbs)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Detent Retainer Bolt	23	20-25	31	27-34
Drain and Fill Plugs	35	30-40	47	40-54
Front/Rear Yoke Nuts	120	90-130	163	122-176
Indicator Switch	18	15-20	24	20-34
Operating Lever Locknut	18	14-20	24	19-27
Rear Case-to-Front Case Bolts (All)	23	20-25	31	27-34
Rear Retainer Bolts	23	20-25	31	27-34

All torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

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MODEL 300 TRANSFER CASE

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GENERAL

The model 300 transfer case is used in CJ models only. It is a gearbox unit having the gears positioned in a layshaft-type of arrangement. The 300 has a cast iron case, four gear positions and employs an external floor mounted gearshift linkage for range control. The 300 is a part-time four-wheel drive unit providing four-wheel high and low ranges, a neutral position and two-wheel high range. The four-wheel high and low ranges are undifferentiated. Manual locking front hubs are standard equipment with this transfer case. In addition, the 300 is used with both manual and automatic transmission applications. In four-wheel low range, reduction ratio is 2.6:1.

Transfer Case Shift Pattern

Transfer case shifting is controlled by a floor-mounted shift lever located on the floorpan transmission tunnel. The shift pattern is in a straight line for all CJ models (fig. 2D-69). Shift knob sequence is 4H (four-wheel high), 2H (two-wheel high), N (neutral) and 4L (four-wheel low).

IDENTIFICATION

An identification tag that displays the vendor and Jeep part numbers is attached to the intermediate shaft lockplate bolt. This information is necessary to obtain correct service replacement parts.

LUBRICATION

The model 300 lubricant should be changed and the level inspected at the intervals specified in the Maintenance Schedule. When adding lubricant or refilling the transfer case after service, use SAE 85W-90, API grade GL-5 gear lubricant only. Lubricant capacity of the model 300 is 4 pints (1.9 liters).

POWER FLOW

In all drive ranges, incoming torque from the transmission is transmitted to the geartrain through the input shaft and rear output shaft gear (fig. 2D-70).

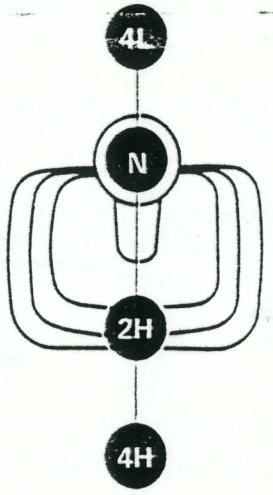

Fig. 2D-69 Transfer Case Shift Pattern—Model 300

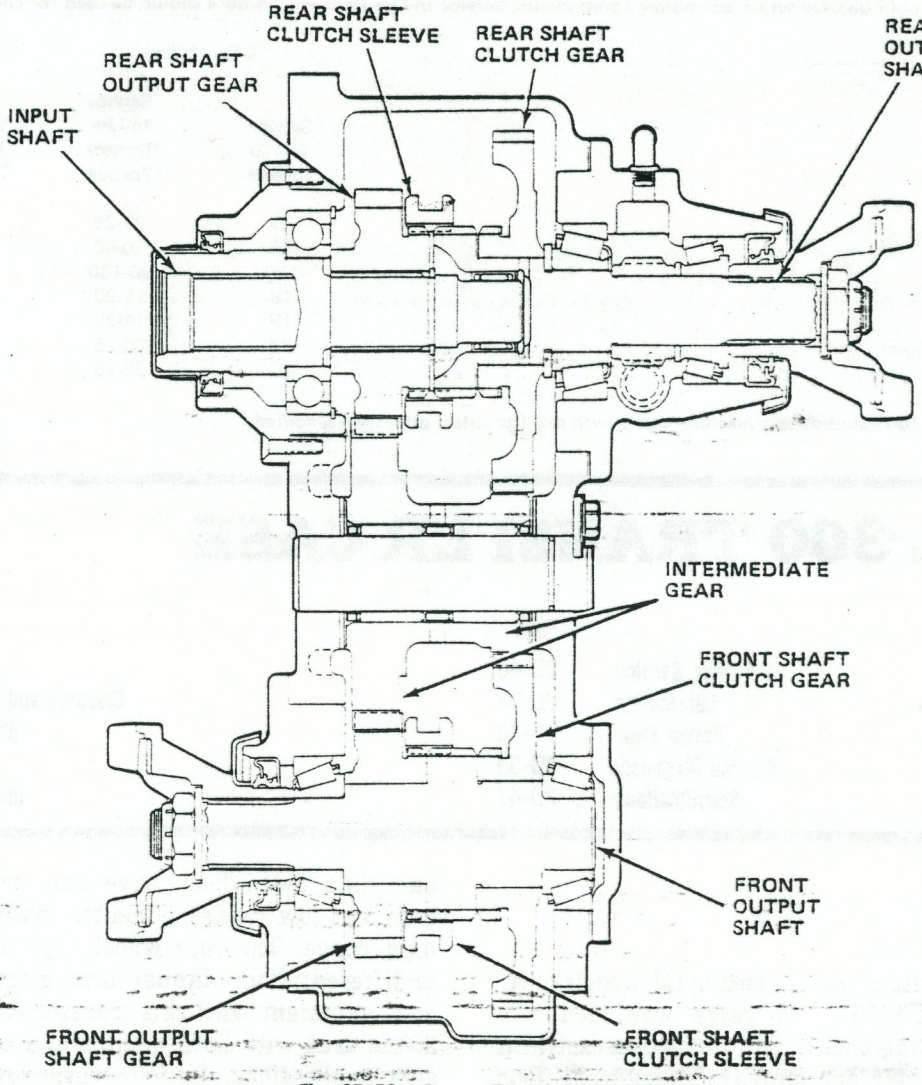

Fig. 2D-70 Power Flow—Model 300

In 2H range, the front output shaft clutch sleeve is not shifted and remains in a neutral position. The rear output shaft clutch sleeve is shifted into engagement with the input gear. Torque flows from the input shaft and gear through the sleeve and to the rear output shaft and yoke. The intermediate gear idles on the input gear but does not transfer torque to the front output shaft. This occurs because the front shaft sleeve is in neutral and the front output gear idles on the intermediate gear.

In 4H range, both clutch sleeves are shifted into engagement with the front and rear output shaft gears. Torque flows through the input shaft and rear output shaft gear to the larger intermediate gear. This intermediate gear transmits torque to the front output shaft through the front output shaft gear which is meshed with the larger intermediate gear.

In 4L range, the path of torque is similar to 4H range but with one major exception. In this range, the clutch sleeves are shifted into engagement with the front and rear output shaft clutch gears. Torque transfer now flows from the input shaft to the front and rear output shafts through the clutch gears. The clutch gears are now meshed with the smaller intermediate gear to produce a gear reduction ratio of 2.6:1.

SERVICE DIAGNOSIS

Before attempting to repair a suspected transfer case malfunction, check all other drive line components beforehand. The actual cause of a problem may be related to such items as the front hubs, axles, propeller shafts, wheels and tires, transmission, engine, or clutch instead. If all drive line components are in good condition and operating properly, refer to the Service Diagnosis charts for further information.

Service Diagnosis

Condition	Possible Cause	Correction
TRANSFER CASE DIFFICULT TO SHIFT OR WILL NOT SHIFT INTO DESIRED RANGE	(1) Vehicle speed too great to permit shifting.	(1) Stop vehicle and shift into desired range. Or reduce speed to 2-3 mph (3-4 km/h) before attempting to shift.
	(2) If vehicle was operated for extended period in 4H mode on dry paved surface, driveline torque load may cause difficult shifting.	(2) Stop vehicle, shift transmission to neutral, shift transfer case to 2H mode and operate vehicle in 2H on dry paved surfaces.
	(3) Transfer case external shift linkage binding.	(3) Lubricate or repair or replace linkage, or tighten loose components as necessary.
	(4) Insufficient or incorrect lubricant.	(4) Drain and refill to edge of fill hole with 10W-30 motor oil having API classification SE only.
	(5) Internal components binding, worn, or damaged.	(5) Disassemble unit and replace worn or damaged components as necessary.
TRANSFER CASE NOISY IN ALL DRIVE MODES	(1) Insufficient or incorrect lubricant.	(1) Drain and refill to edge of fill hole with 10W-30 motor oil only. Check for leaks and repair if necessary. Note: If unit is still noisy after drain and refill, disassembly and inspection may be required to locate source of noise.
NOISY IN — OR JUMPS OUT OF FOUR WHEEL DRIVE LOW RANGE	(1) Transfer case not completely engaged in 4L position.	(1) Stop vehicle, shift transfer case in Neutral, then shift back into 4L position.
	(2) Shift linkage loose or binding.	(2) Tighten, lubricate, or repair linkage as necessary.
	(3) Shift fork cracked, inserts worn, or fork is binding on shift rail.	(3) Disassemble unit and repair as necessary.

Service Diagnosis (Cont'd.)

Condition	Possible Cause	Correction
LUBRICANT LEAKING FROM OUTPUT SHAFT SEALS OR FROM VENT	(1) Transfer case overfilled.	(1) Drain to correct level.
	(2) Vent closed or restricted.	(2) Clear or replace vent if necessary.
	(3) Output shaft seals damaged or installed incorrectly.	(3) Replace seals. Be sure seal lip faces interior of case when installed. Also be sure yoke seal surfaces are not scored or nicked. Remove scores, nicks with fine sandpaper or replace yoke(s) if necessary.
ABNORMAL TIRE WEAR	(1) Extended operation on dry hard surface (paved) roads in 4H range.	(1) Operate in 2H on hard surface (paved) roads.

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IN-VEHICLE SERVICE

Shift Rod Oil Seal Replacement

(1) If left-side shift rod seal is to be replaced, shift transfer case into 4L position.

(2) Raise vehicle.

(3) Remove clevis pins connecting control links to transfer case shift rods.

(4) Remove shift rod oil seal using Tool J-25175 (fig. 2D-71).

(5) Install replacement seal using Thimble and Driver Tool J-25167 (fig. 2D-72).

(6) Install clevis pins connecting control links to transfer case shift rods. Use replacement cotter pins to secure pins.

(7) Lower vehicle.

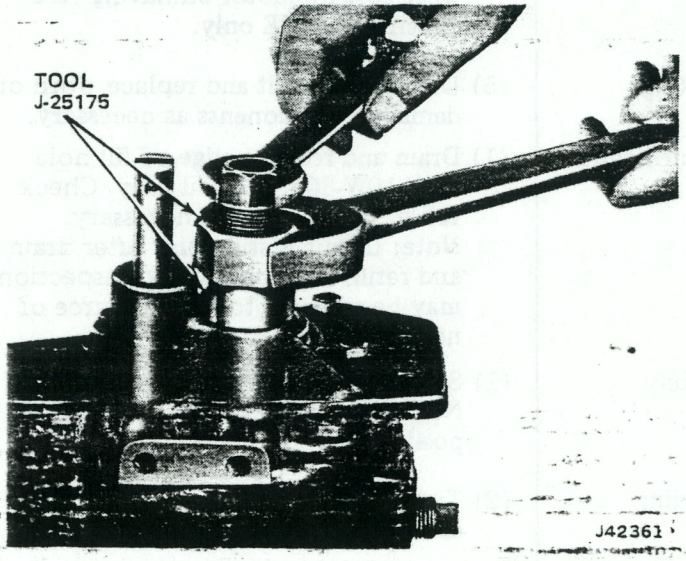


Fig. 2D-71 Shift Rod Oil Seal Removal

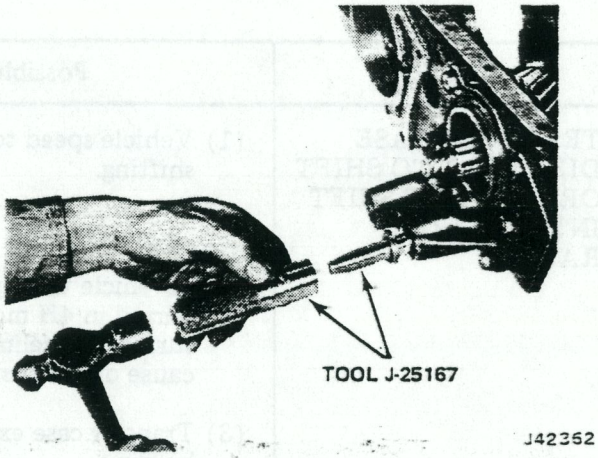


Fig. 2D-72 Shift Rod Oil Seal Installation

Front—Rear Yoke Oil Seal Replacement

(1) Raise vehicle.

(2) Place support stand under transmission and remove rear crossmember.

(3) Disconnect front or rear propeller shaft at the transfer case yoke. Place alignment marks on shaft and yoke for assembly reference before disconnecting shaft.

(4) Remove transfer case yoke nut and washer using Tool J-8614-01 (fig. 2D-73).

(5) Remove transfer yoke using Tools J-8614-01, 02, 03, (fig. 2D-74).

(6) Remove oil seal using Tool J-25180 (fig. 2D-75).

(7) Install replacement seal using Tool J-25160.

(8) Install yoke, washer and nut. Tighten nut to 120 foot-pounds (163 N•m) torque. Use Tool J-8614-01 to hold yoke while tightening nut.

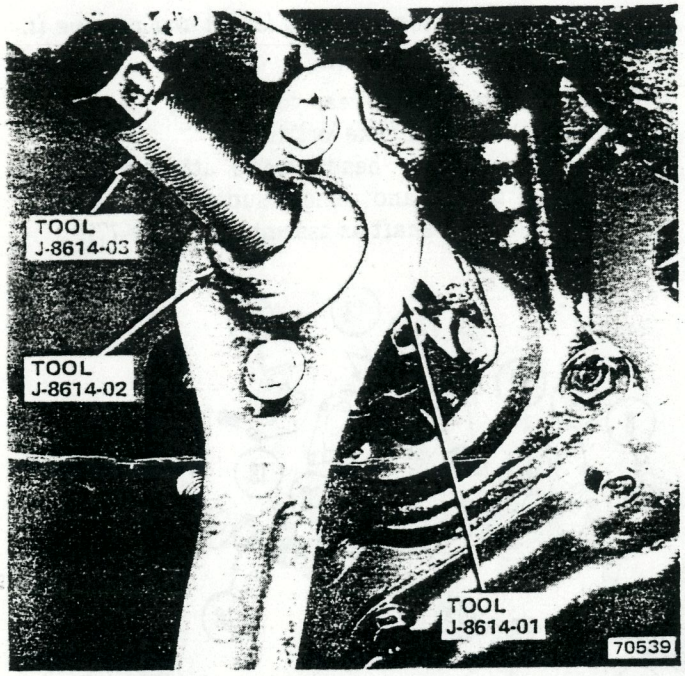


Fig. 2D-73 Output Shaft Yoke Nut Removal

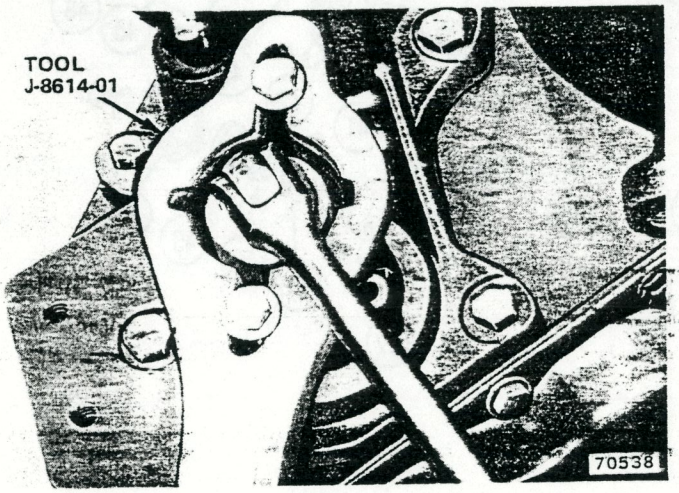


Fig. 2D-74 Yoke Removal

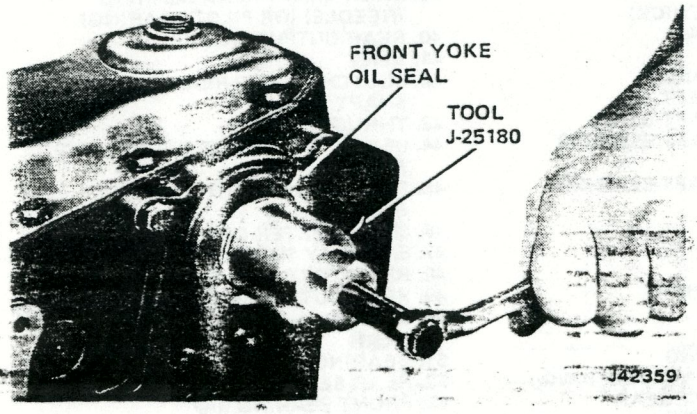


Fig. 2D-75 Yoke Oil Seal Removal

Rear Bearing Cap—Speedometer Drive Gear Service

Removal

(1) Disconnect rear propeller shaft at transfer case yoke. Tie shaft to frame with wire.

(2) Disconnect speedometer cable.

(3) Remove speedometer driven gear sleeve and driven gear.

(4) Remove transfer case vent hose.

(5) Remove output shaft yoke using Tools J-8614-01. -02, -03.

(6) Remove bearing cap-to-transfer case bolts and remove bearing cap.

NOTE: *The bearing cap has been coated with a sealant. Use a putty knife to break the seal, and work the knife around the bearing cap to loosen and remove it.*

(7) Remove shims and speedometer drive gear from output shaft.

NOTE: *Keep the shims together for use in assembly.*

(8) Remove speedometer driven gear bushing from bearing cap, if necessary.

Assembly

(1) Install speedometer driven gear bushing using Tool J-25169 if bushing was removed.

(2) Install speedometer drive gear and shims on shaft.

(3) Apply a bead of Loctite 515, or equivalent sealant, to mating surface of cap and install cap. Use two cap screws to align bolt holes. Use plastic mallet to tap cap into position.

(4) Tighten bearing cap bolts to 35 foot-pounds (47 N•m) torque.

(5) Install output shaft yoke and tighten locknut to 120 foot-pounds (163 N•m) torque. Use Tool J-8614-01 to hold yoke while tightening nut.

(6) Check rear output shaft end play as follows:

(a) Attach Dial Indicator J-8001 to bearing cap and position indicator stylus against output shaft.

(b) Pry output shaft back and forth to check end play. End play should be 0.001 to 0.005 inches (0.025 to 0.127 mm).

(c) If end play is not correct, remove or add shims between speedometer drive gear and output shaft rear bearing.

(7) Install transfer case vent hose.

(8) Install speedometer driven gear sleeve and driven gear.

(9) Install speedometer cable.

(10) Install rear propeller shaft. Tighten clamp strap bolts to 16 foot-pounds (21 N•m) torque.

DISASSEMBLY

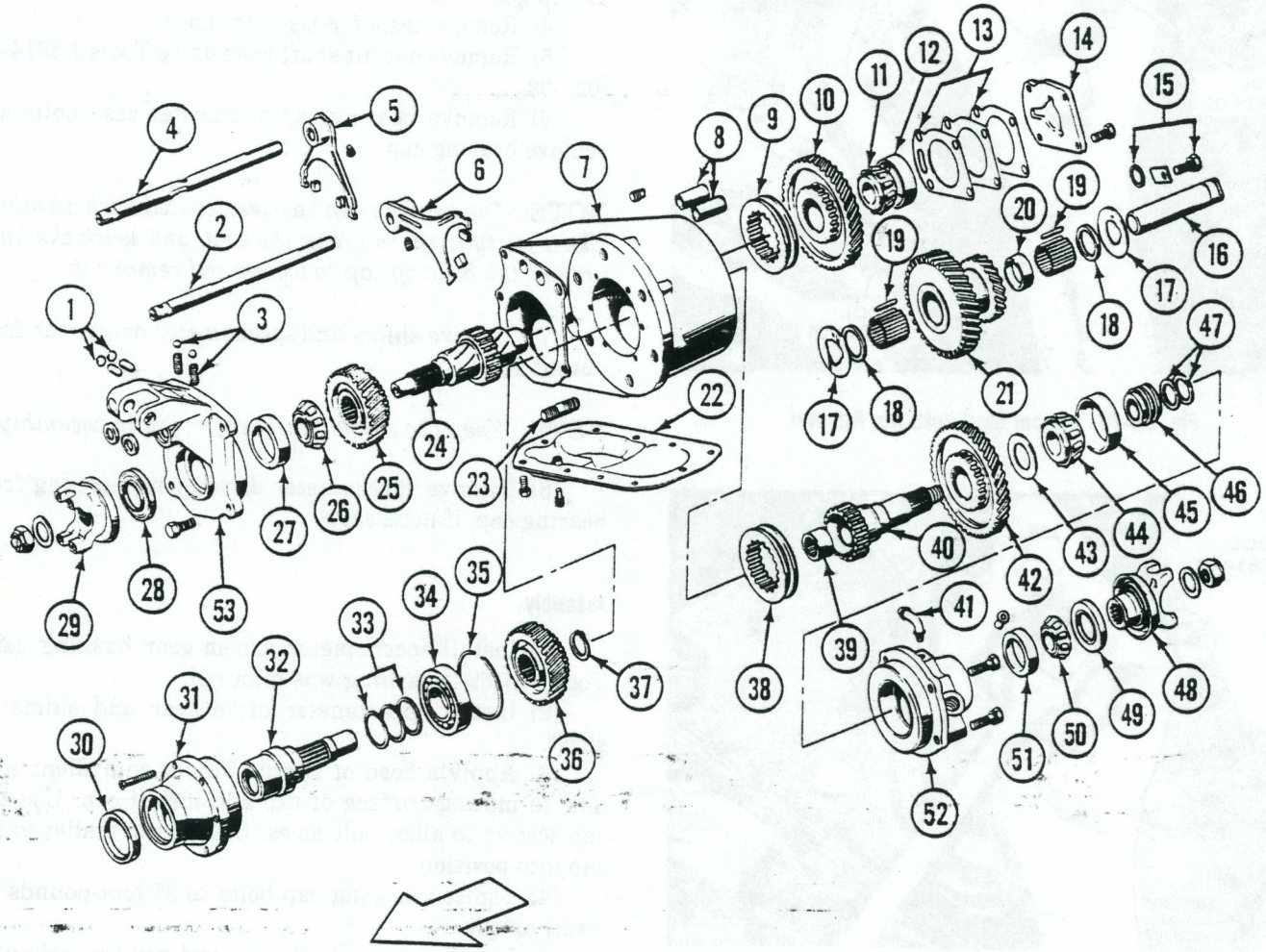
(1) Remove shift lever assembly.

(2) Remove bottom cover (fig. 2D-76).

NOTE: *The bottom cover has been coated with a sealant. Use a putty knife to break the seal, and work the knife around the bottom cover to loosen and remove it. Do not wedge the cover off.*

(3) Remove front and rear yokes using Tool J-8614-01 (fig. 2D-74). Discard yoke locknuts.

(4) Remove socket head screws attaching input shaft support to case and remove support, rear output shaft gear and input shaft as assembly (fig. 2D-77).



1. INTERLOCK PLUGS AND INTERLOCKS
2. SHIFT ROD – REAR OUTPUT SHAFT FORK
3. POPPET BALLS AND SPRINGS
4. SHIFT ROD – FRONT OUTPUT SHAFT FORK
5. FRONT OUTPUT SHAFT SHIFT FORK
6. REAR OUTPUT SHAFT SHIFT FORK
7. TRANSFER CASE
8. THIMBLE COVERS
9. CLUTCH SLEEVE – FRONT OUTPUT SHAFT
10. CLUTCH GEAR – FRONT OUTPUT SHAFT
11. BEARING – FRONT OUTPUT SHAFT REAR
12. RACE – FRONT OUTPUT SHAFT BEARING
13. END PLAY SHIMS – FRONT OUTPUT SHAFT
14. COVER PLATE
15. LOCK PLATE, BOLT AND WASHER
16. INTERMEDIATE GEAR SHAFT
17. THRUST WASHER
18. BEARING SPACER (THIN)
19. INTERMEDIATE GEAR SHAFT NEEDLE BEARINGS
20. BEARING SPACER (THICK)
21. INTERMEDIATE GEAR
22. BOTTOM COVER
23. STUD (CASE-TO-TRANS.)
24. FRONT OUTPUT SHAFT
25. FRONT OUTPUT SHAFT GEAR
26. FRONT OUTPUT SHAFT BEARING (FRONT)
27. FRONT OUTPUT SHAFT BEARING RACE
28. OIL SEAL
29. FRONT YOKE
30. SEAL
31. SUPPORT – INPUT SHAFT
32. INPUT SHAFT
33. SHIMS
34. INPUT SHAFT BEARING
35. INPUT SHAFT BEARING SNAP RING
36. REAR OUTPUT SHAFT GEAR
37. SNAP RING
38. CLUTCH SLEEVE – REAR OUTPUT SHAFT
39. INPUT SHAFT REAR BEARING (NEEDLE) (OR PILOT BEARING)
40. REAR OUTPUT SHAFT
41. VENT
42. CLUTCH GEAR – REAR OUTPUT SHAFT
43. THRUST WASHER
44. BEARING – REAR OUTPUT SHAFT FRONT
45. RACE – REAR OUTPUT SHAFT BEARING
46. SPEEDOMETER DRIVE GEAR
47. END PLAY SHIMS
48. REAR YOKE
49. REAR OUTPUT SHAFT OIL SEAL
50. BEARING – REAR OUTPUT SHAFT REAR
51. BEARING RACE
52. REAR BEARING CAP
53. FRONT BEARING CAP

Fig. 2D-76 Model 300 Transfer Case

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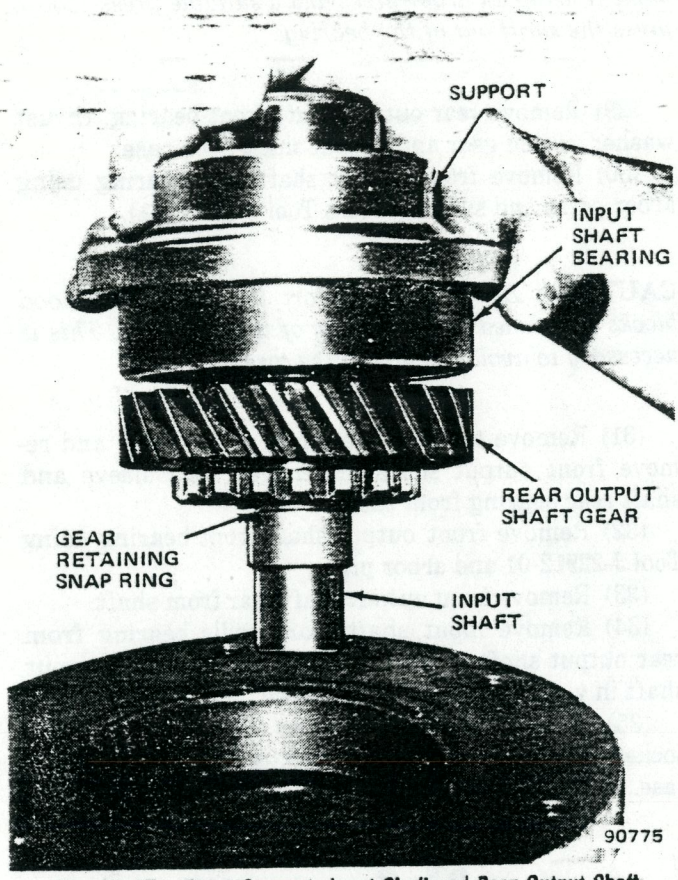


Fig. 2D-77 Front Support, Input Shaft and Rear Output Shaft Gear Removal/Installation

NOTE: *The support has been coated with a sealant. Use a putty knife to break the seal, and work the knife around the support to loosen and remove it.*

(5) Remove rear output shaft clutch sleeve from case.

(6) Remove and discard snap ring retaining rear output shaft gear on input shaft and remove gear.

(7) Remove and discard input shaft bearing snap ring.

(8) Remove input shaft and bearing from support. Tap end of input shaft with plastic mallet to aid removal.

(9) Remove input shaft bearing and end play shims from shaft using arbor press.

(10) Remove input shaft oil seal from support. Discard seal.

(11) Remove intermediate shaft lockplate bolt and lockplate (fig. 2D-76).

(12) Remove intermediate shaft. Tap shaft out of case using brass punch and plastic mallet.

(13) Remove and discard intermediate shaft O-ring seal.

(14) Remove intermediate gear assembly and thrust washers.

NOTE: *Thrust washers have locating tabs which must fit in notches in the case at assembly.*

(15) Remove needle bearings and bearing spacers from intermediate gear.

NOTE: *There are 48 needle bearings and three bearing spacers in the intermediate gear.*

(16) Remove rear bearing cap attaching bolts and remove cap. Use plastic mallet to tap on output shaft to aid cap removal.

NOTE: *The rear bearing cap has been coated with a sealant. Use a putty knife to break the seal, and work the knife around the cap to loosen and remove it.*

(17) Remove end play shims and speedometer drive gear from rear output shaft (fig. 2D-76).

(18) Remove and discard rear output shaft oil seal. Remove bearings and bearing races from rear bearing cap.

(19) Remove setscrews retaining front and rear output shaft shift forks on shift rods (fig. 2D-78).

(20) Remove shift rods. Insert punch through clevis pin holes in rods and rotate rods while pulling them out of case.

NOTE: *When the shift rods are free of the front cap take care to avoid losing the shift rod poppet balls and springs.*

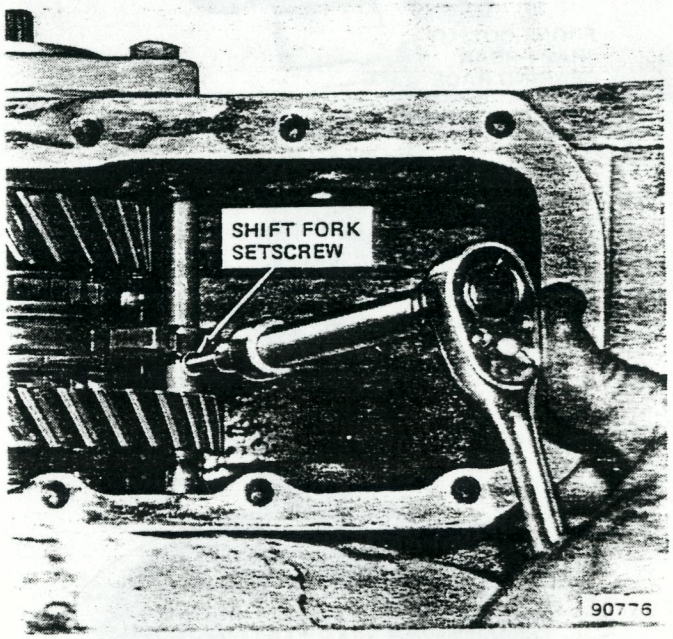


Fig. 2D-78 Shift Fork Setscrew Removal/Installation

(21) Remove shift forks from case.

(22) Remove bolts attaching front cap-to-case and remove front cap.

NOTE: *The front cap has been coated with a sealant. Use a putty knife to break the seal, and work the knife around the cap to loosen and remove it.*

(23) Remove front output shaft and shift rod oil seals from front cap (fig. 2D-76). Discard seals.

(24) Remove front bearing race from front bearing cap using Tool J-29168.

(25) Remove cover plate bolts and remove plate and end play shims from case (fig. 2D-79). Keep shims together for assembly.

(26) Move front output shaft toward front of case.

(27) Remove front output shaft rear bearing race from case (fig. 2D-79).

(28) Remove rear output shaft front bearing. Position case on wood blocks. Seat clutch gear on case interior surface and tap shaft out of bearing using rawhide mallet (fig. 2D-80).

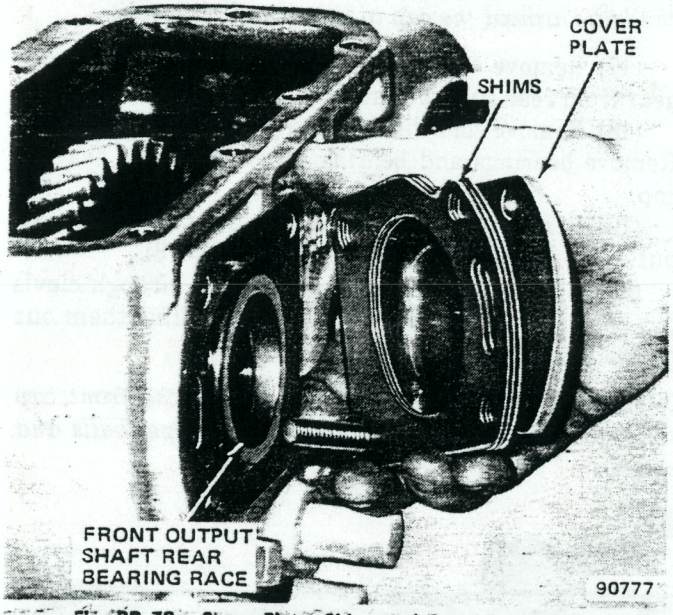


Fig. 2D-79 Cover Plate, Shims and Front Output Shaft Rear Bearing Race

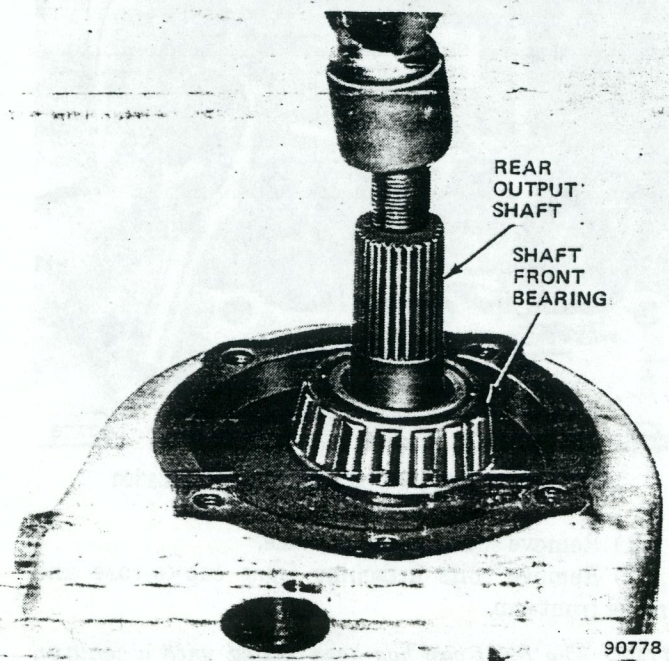


Fig. 2D-80 Rear Output Shaft Front Bearing Removal

NOTE: *If the bearing proves difficult to remove, remove it using an arbor press and a suitable press tool to press the shaft out of the bearing.*

(29) Remove rear output shaft front bearing, thrust washer, clutch gear and output shaft from case.

(30) Remove front output shaft rear bearing using arbor press and suitable press Tool (fig. 2D-81).

CAUTION: *Be sure to support the case with wood blocks positioned at either side of the case bore. This is necessary to avoid damaging the case.*

(31) Remove transfer case from arbor press and remove front output shaft, clutch gear and sleeve and shaft rear bearing from case.

(32) Remove front output shaft front bearing using Tool J-22912-01 and arbor press.

(33) Remove front output shaft gear from shaft.

(34) Remove input shaft rear needle bearing from rear output shaft using Tool J-29369-1. Support output shaft in vise during bearing removal.

(35) Remove shift rod thimbles. Use 3/8 drive, 7/16 socket and extension to tap shift rod thimbles out of case.

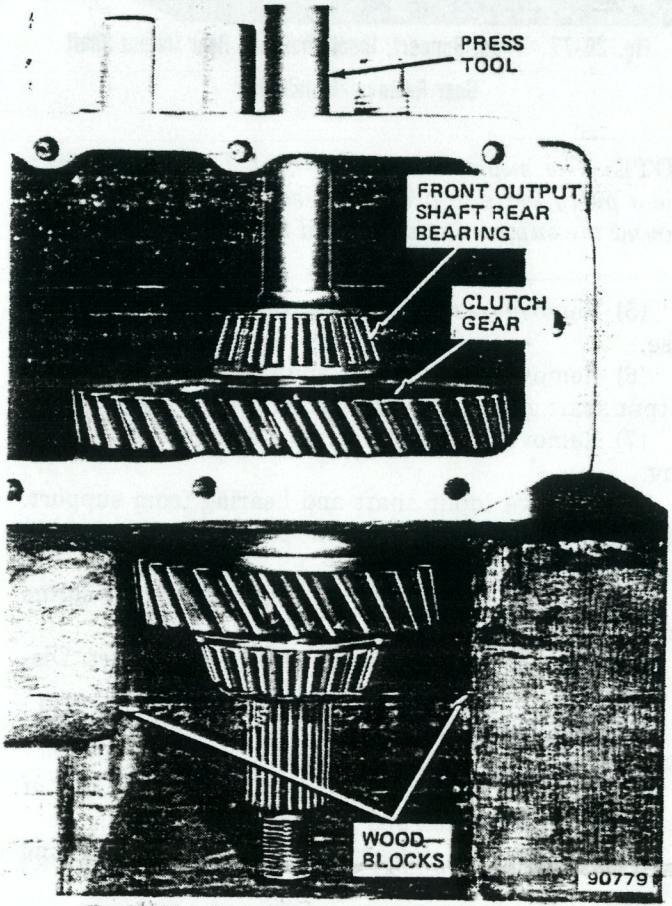


Fig. 2D-81 Front Output Shaft Rear Bearing Removal

CLEANING AND INSPECTION

Clean the case and all components in solvent. Remove all old sealing material from the case and bearing cap mating surfaces. Dry all components except the bearings, using compressed air. Use caution when cleaning the case mating surfaces. Do not scratch or mar these surfaces in any way. However, minor surface irregularities can be removed with sandpaper. Do not dry any bearings with compressed air. Use clean shop towels only.

Inspect all parts for signs of excessive wear or damage. Replace gears that are cracked, chipped broken or excessively worn. Replace any bearings that are worn, pitted, scored, flat-spotted, or brinelled. Replace any shaft that has damaged splines, threads or bearing surfaces. Check the shift rods and rod bores in the case for wear or damage. Minor scratches or nicks on the rods may be cleaned up using crocus cloth.

ASSEMBLY

(1) Install shift rod thimbles. Apply Loctite 220 or equivalent sealant to thimbles before installation.

(2) Install front output shaft gear on front output shaft. Be sure clutch teeth on gear face shaft gear teeth.

(3) Install front bearing on front output shaft using arbor press and suitable press tool. Be sure bearing is seated against gear.

(4) Install front output shaft in case and install clutch sleeve and clutch gear on shaft.

(5) Install front output shaft rear bearing using arbor press and suitable press tool (fig. 2D-82).

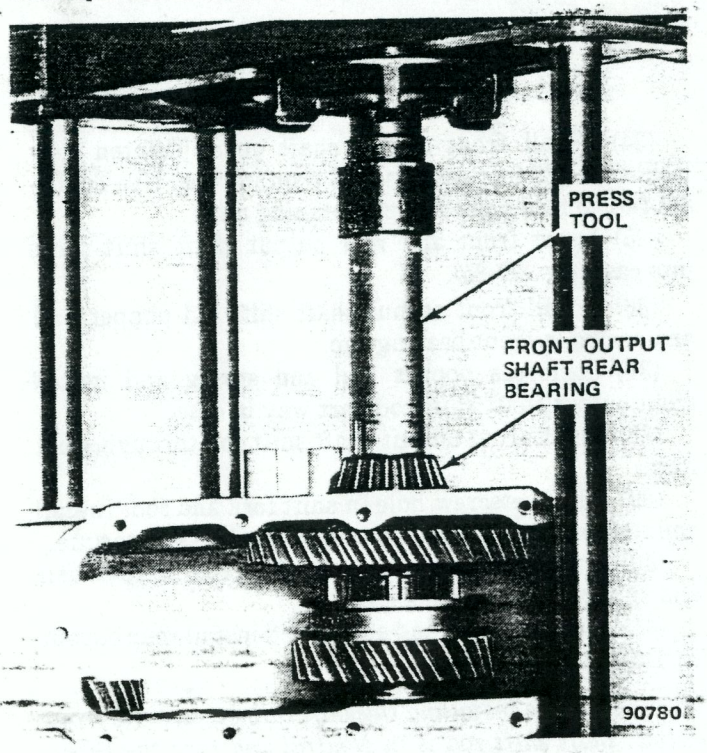


Fig. 2D-82 Front Output Shaft Rear Bearing Installation

NOTE: *Install an old yoke nut on the shaft to avoid damaging the threads.*

(6) Install input shaft rear needle bearing in rear output shaft using Tool J-29179.

(7) Position rear output shaft clutch gear in case and insert rear output shaft into gear.

(8) Install thrust washer and front bearing on rear output shaft using arbor press and suitable press tool.

(9) Install shims and bearing on input shaft using arbor press and suitable press tool.

(10) Install new input shaft oil seal in input shaft support using Tool J-29184.

(11) Install input shaft and bearing in support and install new bearing snap ring.

(12) Install rear output shaft gear on input gear and install new gear retaining snap ring (fig. 2D-77).

(13) Measure clearance between input gear and gear retaining snap ring using feeler gauge. Clearance should not exceed 0.003 inches (0.076 mm). If clearance is over tolerance, disassemble input shaft and add shims between input shaft and shaft bearing (fig. 2D-76).

(14) Install clutch sleeve on rear output shaft.

(15) Apply Loctite 515, or equivalent sealant, to mating surface of input shaft support and install assembled support, shaft and gear in case. Use two support bolts to align support on case and tap support into position using plastic mallet.

(16) Install and tighten socket head screws in support to 10 foot-pounds (14 N•m) torque.

(17) Install rear bearing cap front bearing race using Tool J-9276-3.

(18) Install rear bearing cap rear bearing race using Tool J-29182.

(19) Position rear output shaft rear bearing in rear bearing cap.

(20) Install rear output shaft yoke oil seal using Tool J-25160.

(21) Install speedometer gear and end play shims on rear output shaft.

(22) Install rear bearing cap. Apply Loctite 515, or equivalent sealant, to mating surface of cap. Use two cap bolts to align bolt holes and tap rear cap into place using plastic mallet.

(23) Install and tighten rear bearing cap bolts to 35 foot-pounds (47 N•m) torque.

(24) Install rear output shaft yoke. Tighten new locknut to 120 foot-pounds (163 N•m) torque. Use Tool J-8614-01 to hold yoke while tightening nut.

(25) Check rear output shaft end play as follows:

(a) Clamp Dial Indicator J-8001 onto bearing cap. Position indicator stylus so it contacts end of shaft (fig. 2D-83).

(b) Pry output shaft back and forth to check end play. End play should be 0.001 to 0.005 inches (0.025 to 0.127 mm).

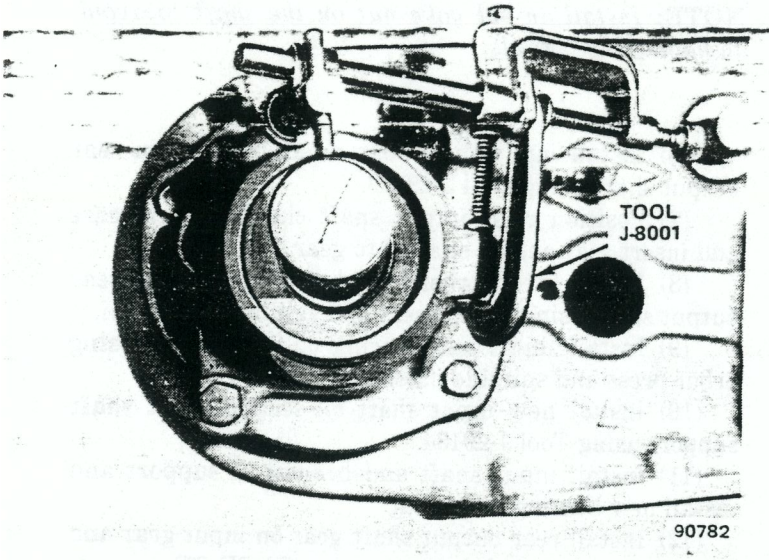


Fig. 2D-83 Checking Rear Output Shaft End Play

(c) If end play is not correct, remove or add shims between speedometer drive gear and output shaft rear bearing (fig. 2D-76).

(26) Install front output shaft rear bearing race (fig. 2D-79).

(27) Install front output shaft end, play shims and cover plate (fig. 2D-79). Tighten cover plate bolts to 35 foot-pounds (47 N•m) torque.

NOTE: *Apply Loctite 220, or equivalent sealant, to bolt threads before installation.*

(28) Install front output shaft front bearing race using Tools J-8092 and J-29181 (fig. 2D-84).

(29) Install front output shaft yoke oil seal using Tool J-25160.

(30) Install shift rod oil seals using Tool J-25167 (fig. 2D-72).

(31) Install front bearing cap. Apply Loctite 515, or equivalent sealant, to mating surface of cap before installation. Use two bolts to align cap and case bolt holes and tap cap into position on case using plastic mallet.

(32) Install and tighten bearing cap bolts to 35 foot-pounds (47 N•m) torque.

(33) Check front output shaft end play as follows:

(a) Seat rear bearing cup against cover plate by tapping end of front output shaft with plastic mallet.

(b) Mount dial indicator on front bearing cap and position indicator stylus against end of output shaft.

(c) Pry shaft back and forth to check end play. End play should be 0.001 to 0.005 inches (0.025 to .129 mm).

(d) If end play is not correct, remove or add shims between cover plate and case. If shims are added, seat rear bearing cup as outlined in step (a) before checking end play again.

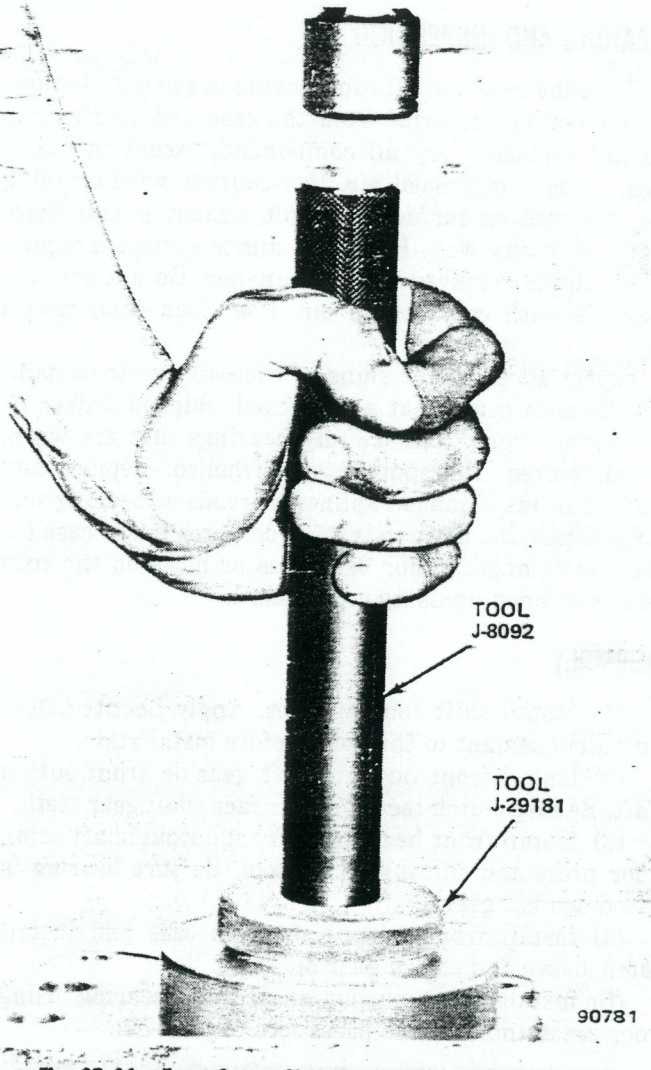


Fig. 2D-84 Front Output Shaft Front Bearing Race Installation

(34) Install front output shaft yoke. Tighten new locknut to 120 foot-pounds (163 N•m) torque. Use Tool J-8614-01 to hold yoke while tightening nut.

(35) Insert front and rear output shaft shift forks into case (fig. 2D-85).

(36) Install front output shaft shift rod poppet ball and spring in front bearing cap.

(37) Compress poppet ball and spring and install front output shaft shift rod part way in case.

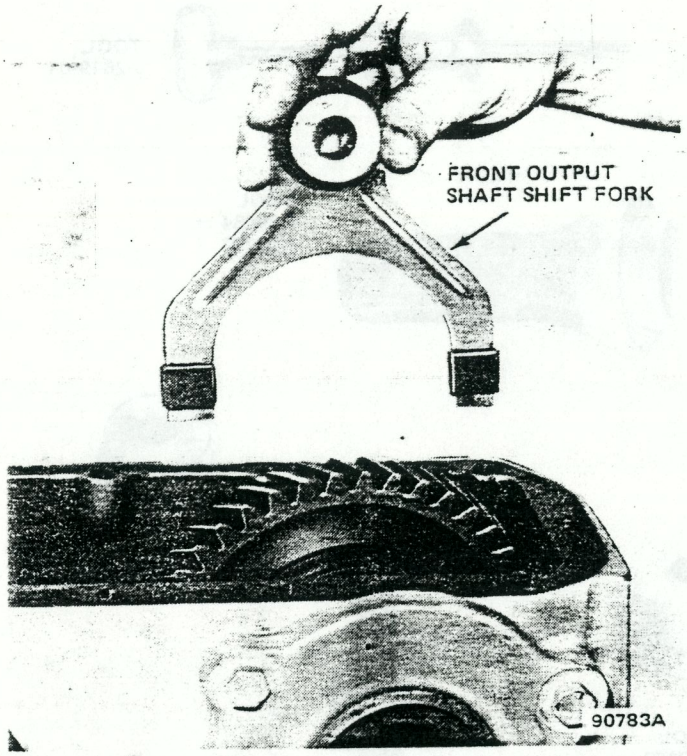
(38) Insert front output shaft shift rod through shift fork.

(39) Align setscrew hole in shift fork and rod. Install and tighten setscrew to 14 foot-pounds (19 N•m) torque.

(40) Install rear output shaft shift rod poppet ball and spring in front bearing cap.

(41) Compress ball and spring and install rear output shaft shift rail part way in case.

NOTE: *Before installing the shift rail, be sure the front output shaft shift rod is in Neutral and that the interlocks are seated in the front bearing cap bore.*



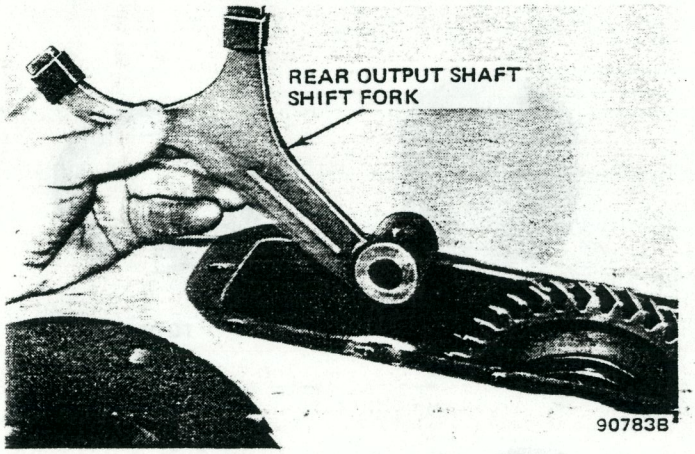


Fig. 2D-85 Shift Fork Installation

(42) Insert rear output shaft shift rod through shift fork.

(43) Align setscrew holes in fork and rod. Install and tighten setscrew to 14 foot-pounds (19 N•m) torque.

(44) Insert Tool J-25142 in intermediate gear and install needle bearings and spacers in gear.

(45) Install intermediate gear thrust washers in case. Be sure washer tangs are aligned with grooves in case.

NOTE: *The thrust washers can be held in place with petroleum jelly.*

(46) Install new O-ring seal on intermediate shaft.

(47) Position intermediate gear in case.

(48) Install intermediate shaft in case bore. Tap shaft into gear until shaft forces Tool J-25142 out of case. Use plastic mallet to tap shaft into place.

(49) Install intermediate shaft lockplate and bolt. Tighten bolt to 23 foot-pounds (31 N•m) torque.

(50) Install bottom cover and replacement gasket. Apply Loctite 515, or equivalent sealant, to mating surface of cover. Install and tighten cover bolts to 15 foot-pounds (20 N•m) torque.

SPECIFICATIONS

Specifications—Model 300 Transfer Case

Transfer Case Type	4 position, dual range part time 4 wheel drive unit with integral low range
Torque Transmittal Mode	Constant mesh gearbox with layshaft gear arrangement.
Low Range Reduction Ratio	2.6:1 gear reduction
Drive Positions and Shift Controls	2H, 4H, 4L and Neutral. Ranges selected via floor mounted shift lever. 4H and 4L ranges are undifferentiated
Case Configuration	One piece cast iron with aluminum front/rear bearing caps
Lubricant Capacity and Type	4 pints (1.9 liters) SAE 85W-90 gear lubricant API grade GL-5

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Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft-lbs)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Bottom Cover Bolts	15	10-20	20	14-27
Cover Plate Bolts	35	25-40	47	34-54
Front Bearing Cap Bolts	35	25-40	47	34-54
Front/Rear Yoke Locknuts	120	120-150	163	163-203
Input Shaft Support Screws	10	7-10	14	9-14
Lockplate Bolt	23	20-25	31	27-34
Shift Fork Setscrews	14	12-18	19	16-24

All torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

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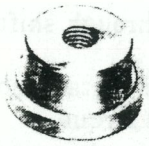
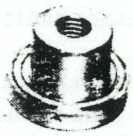
Tools

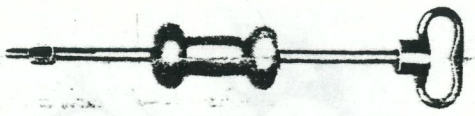


TOOL
J-29181

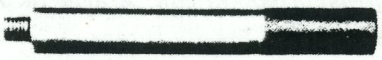


TOOL
J-29163

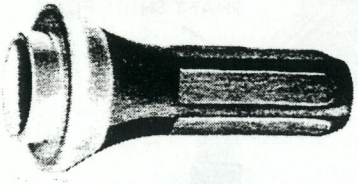
TOOL
J-29174



TOOL
J-2619-01



TOOL
J-8092



TOOL
J-29184 or
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TOOL
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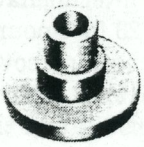
TOOL
J-9276-3



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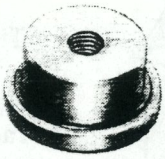

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TOOL
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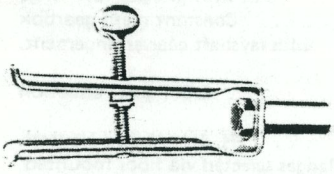

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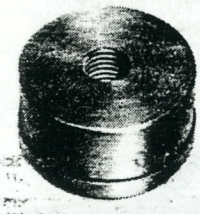
TOOL
J-25167



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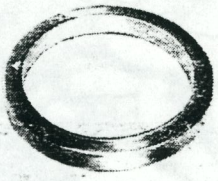

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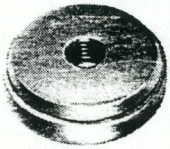
J-29185-2



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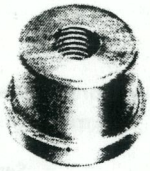

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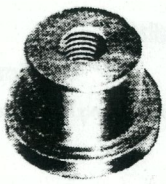

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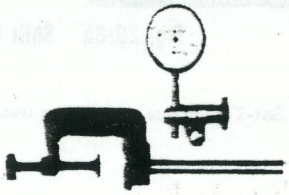

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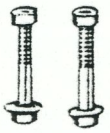
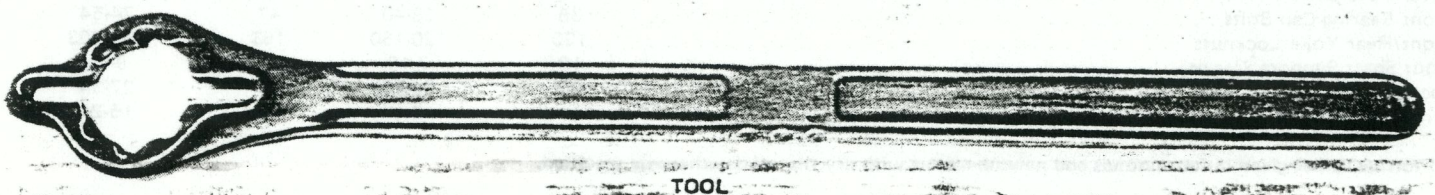
J-8001





TOOL
J-8614-01

PROPELLER SHAFT 2E

SECTION INDEX

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Lubrication	2E-8
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GENERAL

Jeep vehicles use tubular propeller shafts to transmit engine torque from the transfer case to the front and rear axles. Universal joints connect each shaft to the transfer case and axle yokes. A splined slip yoke is used at one end of each propeller shaft to compensate for variations in shaft length caused by suspension spring movement.

Because of the various driveline combinations available on Jeep vehicles, several different propeller shaft and universal joint designs are required.

Propeller Shaft Application

The front propeller shaft on Cherokee, Wagoneer and Truck models is connected to the axle yoke with a single cardan universal joint and to the transfer case yoke with a double cardan universal joint (fig. 2E-1).

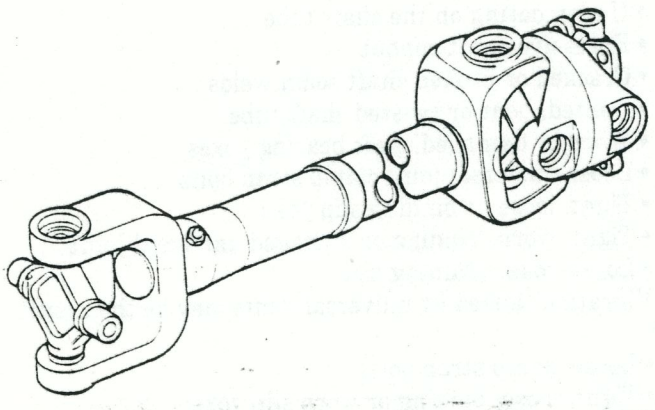

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Fig. 2E-1 Front Propeller Shaft Assembly—Cherokee, Wagoneer and Truck Models

The front propeller shaft on CJ models is connected to both the axle and transfer case yokes with single cardan universal joints. A slip yoke is used at the axle end of the shaft (fig. 2E-2).

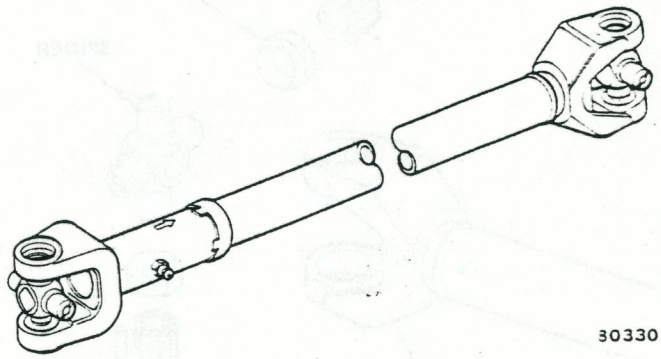

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Fig. 2E-2 Front Propeller Shaft Assembly—CJ

The rear propeller shaft on Cherokee, Wagoneer and Truck models is connected to both the axle and transfer case yokes with single cardan universal joints. A slip yoke is used at the transfer case end of the shaft (fig. 2E-3).

The rear propeller shaft on CJ models is similar to the front shaft in appearance and construction. Single cardan universal joints connect the shaft to both the axle and transfer case yokes and the slip yoke is located at the transfer case end of the shaft.

Universal Joint Application

Two different design universal joints are used for the various driveline combinations: a single cardan joint and a double cardan joint.

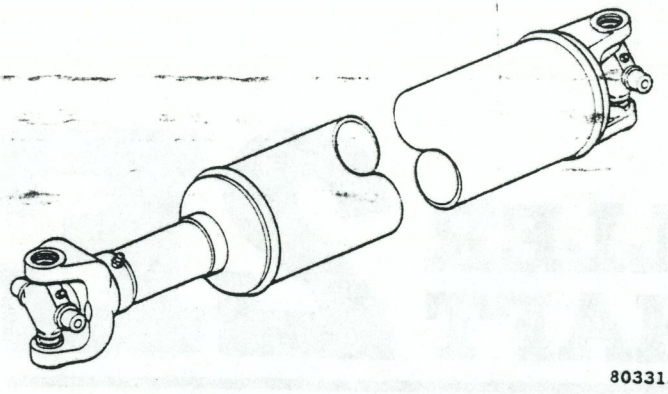


Fig. 2E-3 Rear Propeller Shaft Assembly—Cherokee, Wagoneer and Truck Models

The single cardan joint is used for most applications and consists of a single spider with four sets of needle bearings, and four bearing seals, bearing caps, and bearing cap retainers (fig. 2E-4). Clamp straps are used to attach the joint to the axle and transfer case yokes.

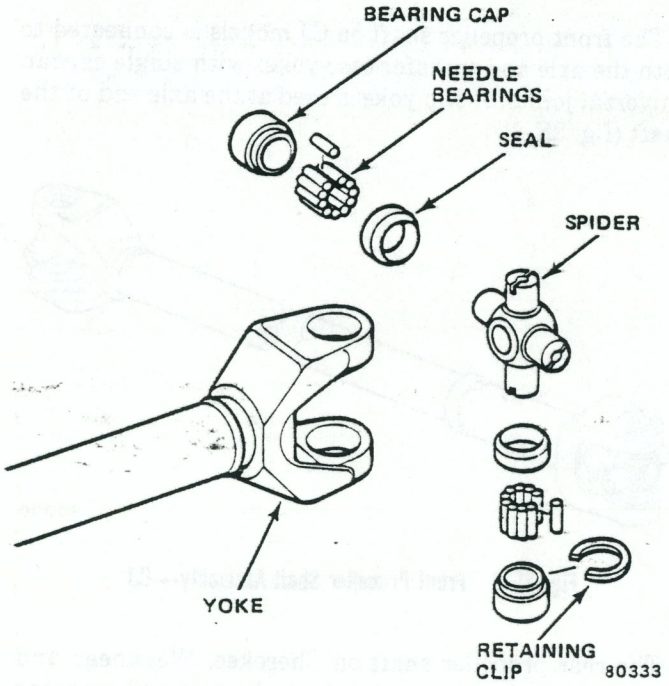


Fig. 2E-4 Single Cardan Universal Joint

The double cardan joint, also referred to as a constant velocity joint, consists of two spiders, a socket ball, a link yoke, a socket spring and dust seal, a socket yoke, and needle bearings, bearing seals, bearing caps and bearing retainers for each spider (fig. 2E-5). The double cardan joint is used for front propeller shaft-to-transfer case yoke applications on all Cherokee, Wagoneer and Truck models.

DRIVELINE VIBRATION

Driveline vibration can be divided into two categories: mechanical or audible. Mechanical vibrations produce

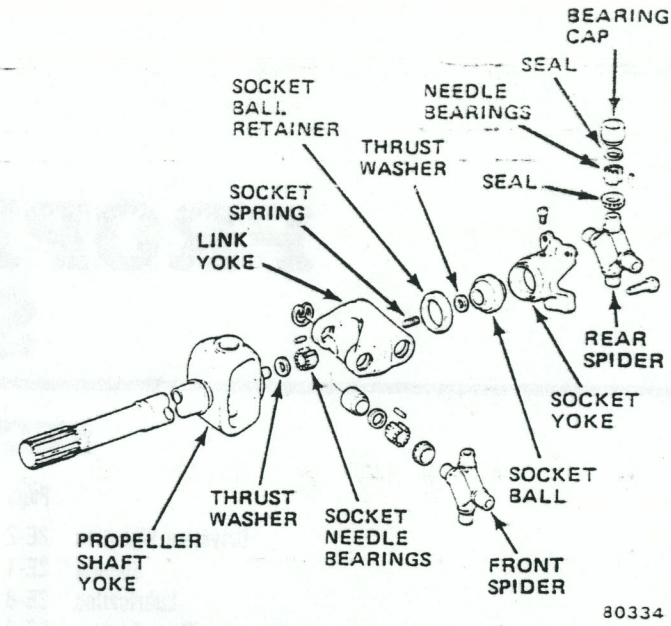


Fig. 2E-5 Double Cardan Universal Joint

visible motion in the fenders, rear view mirror, instrument panel or steering wheel, or can be felt through the seats, floorpan or steering wheel. Audible vibrations are heard or sensed above normal road and background noise and may be accompanied by mechanical vibration. In some cases, audible vibration occurs as a droning or drumming noise while in other cases, it produces a buffeting sensation that is felt or sensed by the driver rather than heard.

Driveline vibration may be caused by the front or rear propeller shafts, axle or transfer case yokes, universal joints, incorrect front or rear pinion angles, loose engine-transmission-transfer case mountings or engine driven accessories. Mechanical vibration is usually caused by a damaged or worn driveline component. Audible vibrations are usually caused by an incorrect universal joint angle or binding universal joints and are most noticeable in the 40-60 mph (64-97 km/h) speed range.

Vibration caused by a propeller shaft may be the result of:

- Undercoating on the shaft tube
- Excessive shaft runout
- Cracked or broken shaft seam welds
- Dented, bent or twisted shaft tube
- Worn or damaged shaft bearing yokes
- Loose universal joint clamp strap bolts
- Tight, loose or binding slip yoke
- Tight, worn, binding or damaged universal joint
- Loose yoke retaining nut

Vibration caused by universal joints may be the result of:

- Loose clamp strap bolts
- Tight, loose, binding or worn slip yoke
- Worn or damaged universal joint spider
- Worn or damaged needle bearings or bearing caps

Vibration caused by axle, transfer case, engine or suspension components may be the result of:

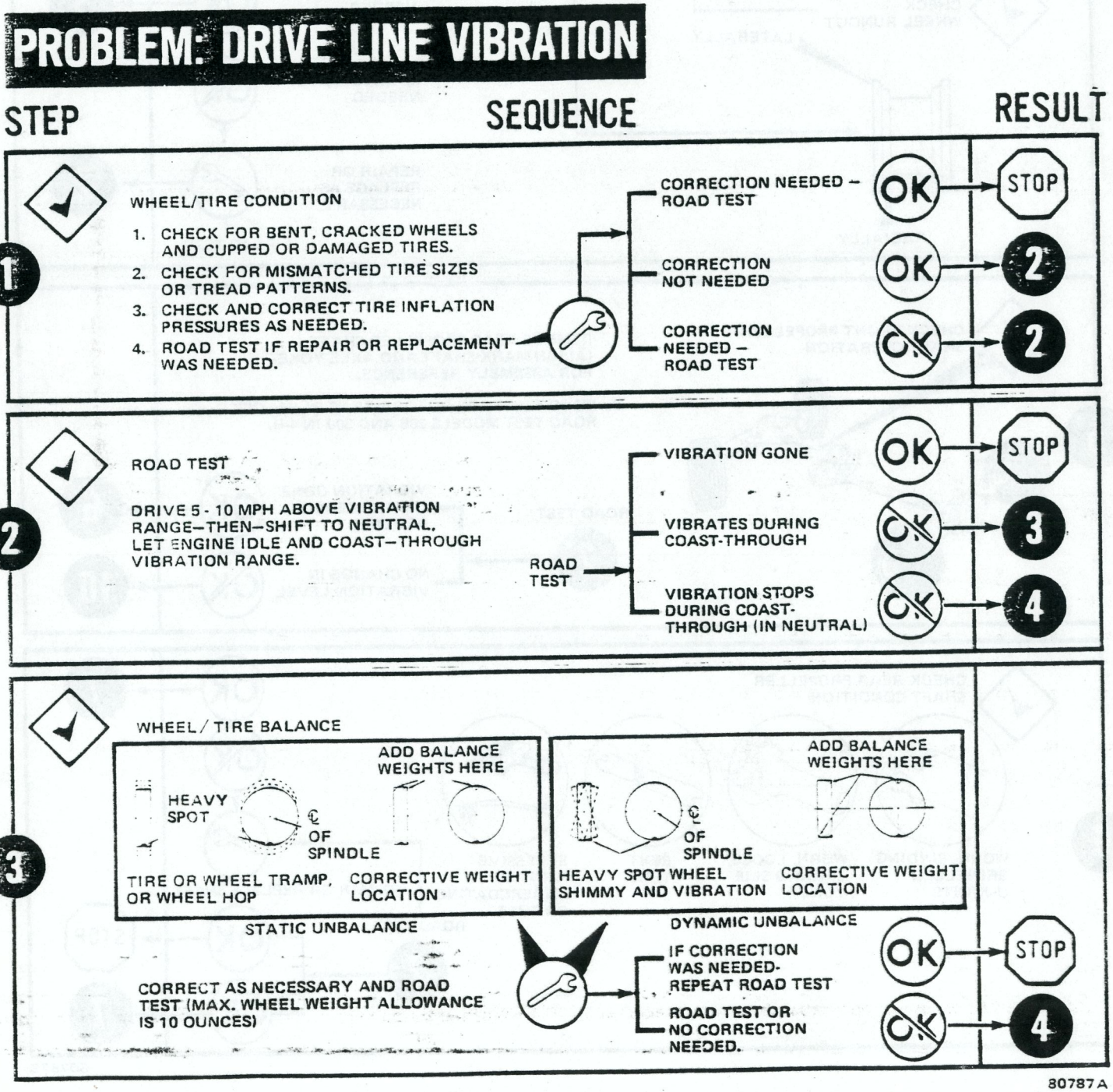
- Loose yoke retaining nut
- Excessive yoke runout
- Incorrect universal joint angle
- Bent, worn, broken, or loose torque reaction bracket or engine rear crossmember
- Damaged or loose suspension springs or suspension components
- Loose engine or transmission/transfer case support cushions or crossmembers, broken spring mounting pad (on axle), broken spring center bolt, or damaged engine driven accessories or drive belts.

Driveline Vibration Diagnosis

If a driveline vibration condition should develop, do not initiate corrective procedures until the vibration source has been determined. This is important in avoiding unnecessary or ineffective repairs. The following Diagnosis and Repair (DARS) Charts will help to isolate the most common causes of driveline vibration:

Driveline Vibration Diagnosis and Repair (DARS) Charts

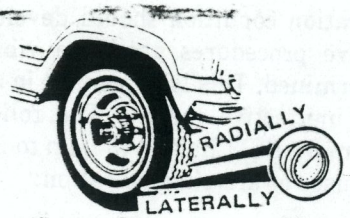
Note: Refer to Chapter A – General Information for details on how to use this DARS chart.



STEP | SEQUENCE | RESULT

4

CHECK TIRE RUNOUT

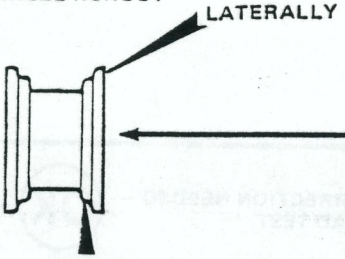


TIRE RADIAL RUNOUT:
RADIAL TIRES 0.080
CONVENTIONAL TIRES . . 0.105

TIRE LATERAL RUNOUT:
ALL TIRES 0.100

WHEEL RUNOUT:
LATERAL/RADIAL 0.045

CHECK WHEEL RUNOUT

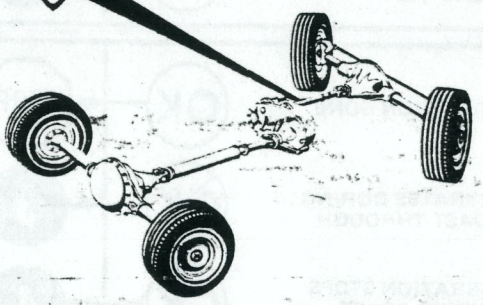


NO CORRECTION NEEDED → OK → 5

CORRECTION NEEDED → O.K → REPAIR OR REPLACE AS NECESSARY → 2 → ROAD TEST

5

CHECK FRONT PROPELLER SHAFT OPERATION

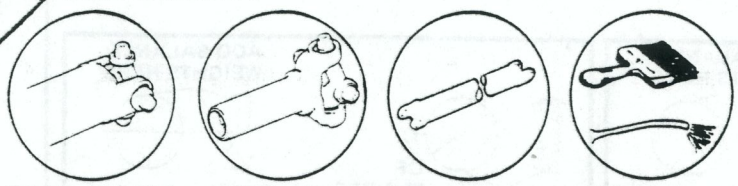


1. REMOVE REAR PROPELLER SHAFT (ALIGN MARK SHAFT AND AXLE YOKE FOR ASSEMBLY REFERENCE.
2. ROAD TEST WITH QUADRA-TRAC IN 4H-LOCK. ROAD TEST MODELS 208 AND 300 IN 4-H.

ROAD TEST → 2 →
- VIBRATION GONE OR NOTICEABLY REDUCED → OK → 6
- NO CHANGE IN VIBRATION LEVEL → O.K → 10

6

CHECK REAR PROPELLER SHAFT CONDITION



OK → 7

O.K → REPAIR OR REPLACE SHAFT

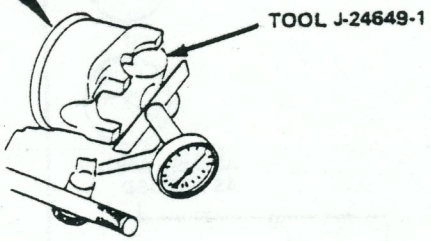
ROAD TEST → 2 →
- OK → STOP
- O.K → 7

80787B

STEP | SEQUENCE | RESULT

7

CHECK FRONT AXLE PINION AND TRANSFER CASE YOKE RUNOUT USING TOOL J-24649-1



MAXIMUM ALLOWABLE RUNOUT AT EITHER YOKE IS 0.006 (0.15 mm)

OK → 8

C.K

IF RUNOUT IS 0.007 OR MORE, REINDEX YOKE, AND RECHECK RUNOUT. REPLACE YOKE IF REINDEXING DOES NOT CORRECT RUNOUT.* REINSTALL PROP SHAFT.

ROAD TEST

2

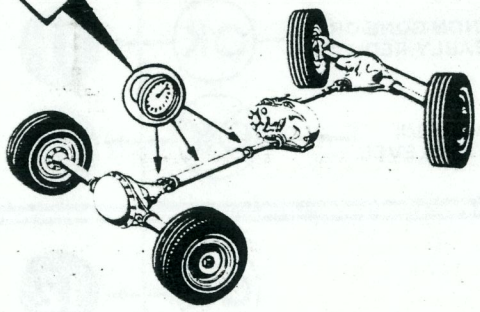
OK → STOP

C.K → 8

*REPLACEMENT YOKE RUNOUT SHOULD BE CHECKED ALSO.

8

CHECK REAR PROPELLER SHAFT RUNOUT USING DIAL INDICATOR.



MAXIMUM ALLOWABLE RUNOUT OF SHAFT IS .015 (INCHES) TOTAL INDICATOR RUNOUT AT ENDS AND CENTER OF SHAFT. AT SHAFT ENDS, MEASURE RUNOUT 3 INCHES FROM SHAFT WELD SEAMS.

OK → 9

C.K

REINDEX SHAFT 180° AND RECHECK RUNOUT.

OK

C.K

REPLACE SHAFT

ROAD TEST

2

OK → STOP

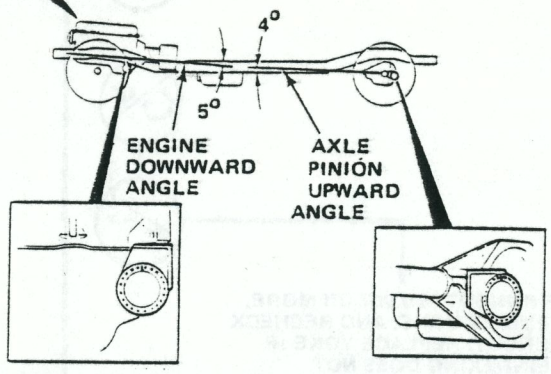
C.K → 9

80787C

STEP | SEQUENCE | RESULT

9

CHECK REAR AXLE PINION UPWARD ANGLE AND ENGINE DOWNWARD ANGLE



REAR AXLE PINION ANGLE MUST BE ½° TO 1½° (1° PREFERRED) BELOW ENGINE ANGLE. USE APPROPRIATE SHIMS TO CORRECT ANGLE

OK → 10

O.K

ADJUST ANGLES AS NEEDED

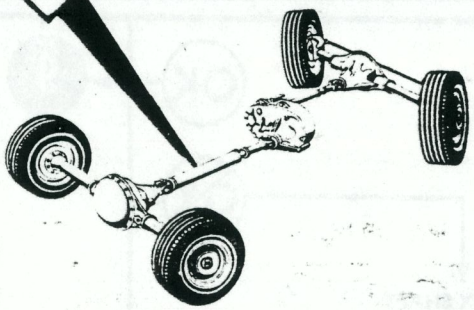
ROAD TEST 2

OK → STOP

O.K → 10

10

CHECK REAR PROPELLER SHAFT OPERATION



1. REMOVE FRONT PROPELLER SHAFT (ALIGN MARK SHAFT AND AXLE YOKES FOR ASSEMBLY REFERENCE).
2. ROAD TEST WITH QUADRA-TRAC IN 4H-LOCK AND MODELS 208 AND 300 IN 4H.

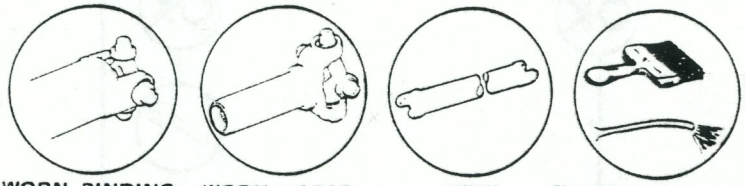
ROAD TEST 2

VIBRATION GONE OR NOTICEABLY REDUCED → OK → 11

NO CHANGE IN VIBRATION LEVEL → O.K → 12

11

CHECK FRONT PROPELLER SHAFT CONDITION



WORN, BINDING BRINELLED U-JOINT | WORN, LOOSE BINDING SLIP YOKE | BENT TUBE | EXCESSIVE PAINT OR UNDERCOATING ON TUBE

OK → 12

O.K

REPAIR OR REPLACE SHAFT

ROAD TEST 2

OK → STOP

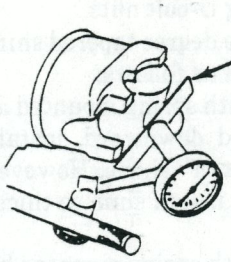
O.K → 13

80787D

STEP | SEQUENCE | RESULT

12

CHECK REAR AXLE PINION AND TRANSFER CASE YOKE RUNOUT USING TOOL J-24649-1



MAXIMUM ALLOWABLE RUNOUT AT EITHER YOKE IS 0.006 (0.15 mm)

IF RUNOUT IS 0.007 OR MORE, REINDEX YOKE AND RECHECK RUNOUT. REPLACE YOKE IF REINDEXING DOES NOT CORRECT RUNOUT. * REINSTALL PROP SHAFT.

OK → 13

O.K. → ROAD TEST → 2

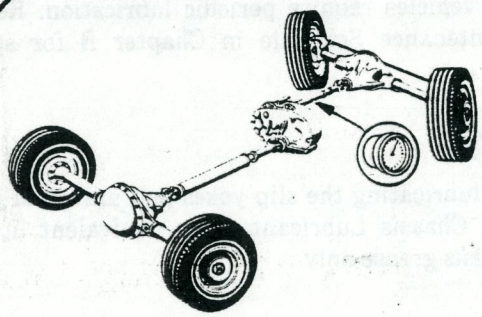
OK → STOP

O.K. → 13

*REPLACEMENT YOKE RUNOUT SHOULD BE CHECKED ALSO

13

CHECK FRONT PROPELLER SHAFT RUNOUT USING DIAL INDICATOR



MAXIMUM ALLOWABLE RUNOUT OF SHAFT IS .015 (INCHES) TOTAL INDICATOR RUNOUT AT ENDS AND CENTER OF SHAFT. AT SHAFT ENDS, MEASURE RUNOUT 3 INCHES FROM SHAFT WELD SEAMS.

OK → 14

O.K. → REINDEX SHAFT 180° AND RECHECK RUNOUT → O.K. → REPLACE SHAFT

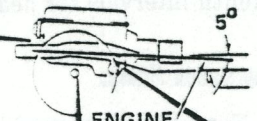
OK → ROAD TEST → 2

OK → STOP

O.K. → 14

14

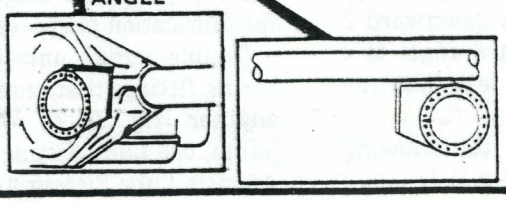
CHECK FRONT AXLE PINION AND FRONT PROPELLER SHAFT ANGLES



NOTE: Front axle pinion angle is measured using same procedure as rear axle pinion angle. Front propeller shaft angle is measured by placing protractor on front driveshaft. [Do not use engine downward angle as base for adjusting front axle pinion angle.] Record readings.

ENGINE DOWNWARD ANGLE

FRONT AXLE PINION ANGLE MUST BE ½° TO 1½° (1° PREFERRED) ABOVE FRONT PROPELLER SHAFT ANGLE. USE APPROPRIATE SHIMS TO OBTAIN CORRECT ANGLE



ROAD TEST → 2 → STOP

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UNIVERSAL JOINT ANGLE MEASUREMENT AND ADJUSTMENT

When torque is transmitted through single cardan universal joints operating at an angle, the rotating speeds of the driving and driven yoke will differ. In operation, the driving yoke rotates at a constant speed while the driven yoke speeds up and slows down twice every revolution.

This difference in driven yoke rotating speed is proportional to the operating angle of the universal joint. In effect, the greater the universal joint operating angle, the greater the speed fluctuation of the driven yoke.

If fluctuation is excessive, driveline vibration will occur. As a result, the universal joint operating angles must be controlled to minimize this effect.

On some Jeep models with Quadra-Trac, an incorrect rear propeller shaft universal joint angle will generate an audible-type vibration. The vibration occurs as a constant booming or drone-like sound most noticeable in the 40-60 mph (64-97 km/h) speed range.

If a vehicle exhibits this condition, the rear propeller shaft universal joint and engine angles must be checked. If the angles are not within specified limits, shims must be installed between the rear axle spring pads and rear spring to correct the angles. Shims are available in one, two and three degree increments for this purpose. The angle measurement and correction procedure is as follows:

(1) Place vehicle on level surface.

(2) Measure engine downward angle as follows:

(a) Position protractor on left side of engine block at transmission mounting ear. Place protractor in fore and aft direction. Use mirror to view protractor if necessary.

(b) Record engine downward angle, remove protractor and proceed to next step.

(3) Measure pinion upward angle as follows:

(a) Place protractor on left side of rear axle housing on flat machined surface of housing that is next to welded plug. Be sure this surface is free of weld flash.

(b) Record pinion upward angle, remove protractor and proceed to next step.

(4) If pinion upward angle is one degree less than engine downward angle, pinion angle is within specified limits. Check for other causes of vibration.

(5) If pinion upward angle is greater than engine downward angle by more than one degree, pinion angle must be adjusted as follows.

EXAMPLE: If the engine angle measures 5 degrees downward and the pinion angle measures 7 degrees upward, the pinion angle must by adjusted downward 3 degrees. This changes the pinion downward angle to 4 degrees which is the required one degree less than the engine downward angle.

(6) Adjust pinion angle as outlined in following steps.

(7) Raise rear of vehicle and place support stands under frame rails.

(8) Position hydraulic jack under axle housing and raise jack just enough to support weight of axle.

(9) Remove rear wheels.

(10) Loosen rear spring U-bolt nuts.

(11) Install appropriate degree tapered shim between spring and axle spring pad as follows:

(a) On vehicles with spring mounted above axle, if angle must be adjusted downward, install shim so thickest end is facing front of vehicle. However, if angle must be adjusted upward, install shim so thickest end is facing rear of vehicle.

(b) On vehicles with spring mounted below axle, if angle must be adjusted downward, install shims so thickest end is facing rear of vehicle. However, if angle must be adjusted upward, install shims so thickest end is facing front of vehicle.

(12) Tighten U-bolt nuts to 100 foot-pounds (135 N•m) torque.

(13) Install rear wheels.

(14) Remove support stands and lower vehicle.

LUBRICATION

The propeller shaft slip yoke and universal joints on all Jeep vehicles require periodic lubrication. Refer to the Maintenance Schedule in Chapter B for specific details.

Lubricant Type

When lubricating the slip yokes and universal joints, use Jeep Chassis Lubricant or an equivalent lithium-base chassis grease only.

Lubrication Intervals

On Cherokee, Wagoneer and Truck models, the slip yokes and universal joints must be lubricated at 10,000 mile (16 000 km) or 10 month intervals in normal service and at 5,000 mile (8 000 km) or 5 month intervals for heavy duty service.

On CJ models, the slip yoke and universal joints must be lubricated at 5,000 mile (8 000 km) or 5 month intervals in normal service and at 3,000 mile (4 800 km) or 3 month intervals for heavy duty service.

Lubrication Fittings

Externally mounted lubrication fittings are located in the slip yokes and single cardan universal joint spiders for lubrication purposes.

Double cardan universal joints have special ball and spring fittings that require a needle-type lube gun nozzle adapter (fig. 2E-7). When lubricating double cardan joints, use Lube Fitting Adapter J-25512-2 (fig. 2E-8) or Alemite Lube Fitting Adapter 6783 or equivalent.

CAUTION: *It is important that the recommended lubricant and lubrication schedule be adhered to. Failure to comply with lubrication requirements may result in premature wear of propeller shaft components.*

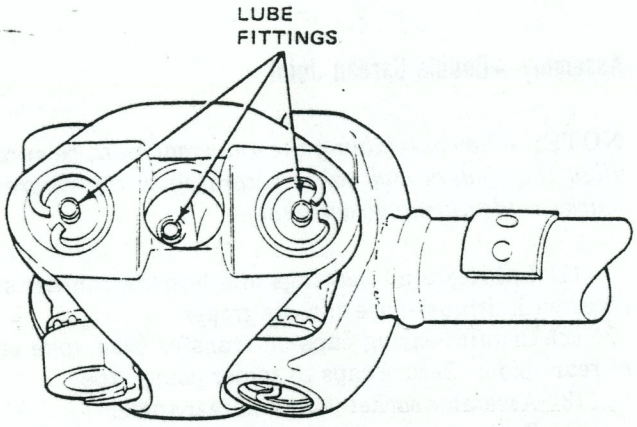

Fig. 2E-6 Double Cardan Joint Lube Fittings

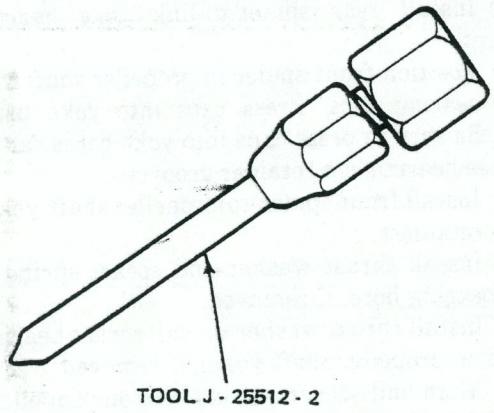

Fig. 2E-7 Double Cardan Lube Fitting Adapter

PROPELLER SHAFT SERVICE

Removal—Front Shaft

(1) Raise vehicle.

(2) Mark propeller shaft yokes, transfer case output shaft yoke, and axle yoke for assembly alignment reference.

(3) Disconnect propeller shaft at axle and transfer case yokes and remove shaft.

Installation—Front Shaft

(1) Align reference marks on propeller shaft and yokes and install propeller shaft.

(2) Tighten clamp strap bolts to 15 foot-pounds (20 N•m) torque.

(3) Lower vehicle.

Removal—Rear Shaft

(1) Raise vehicle.

(2) Mark propeller shaft, transfer case yoke or flange, and axle yoke for assembly alignment reference.

(3) Disconnect shaft at transfer case and axle yokes and remove shaft.

Installation—Rear Shaft

(1) Align reference marks on propeller shaft yokes and install shaft.

(2) Tighten clamp strap bolts to 15 foot-pounds (20 N•m) torque.

(3) Lower vehicle.

UNIVERSAL JOINT SERVICE

The single and double cardan universal joints are serviced as assemblies. Both universal joint types can be disassembled for inspection and replacement purposes.

Disassembly—Single Cardan Joint

(1) If slip yoke universal joint is to be replaced, paint alignment marks on slip yoke and propeller shaft for assembly reference and remove slip yoke from shaft.

(2) Remove loose bearing caps from spider and apply penetrating oil to bearing caps seated in shaft yoke.

(3) Mount propeller shaft or slip yoke in vise.

CAUTION: *Do not clamp the propeller shaft tube in the vise. Clamp the forged portion of the slip yoke or propeller shaft yoke in the vise only. Also, to avoid distorting either of the yokes, do not overtighten the vise.*

(4) Remove bearing cap retainers (fig. 2E-4). Tap ends of bearing caps with hammer to relieve pressure on retainers if necessary.

(5) Reposition shaft in vise so yoke is supported on vise jaws.

(6) Tap end of one bearing cap with hammer until opposite bearing cap is driven out of yoke.

(7) Reposition shaft yoke in vise and tap exposed end of spider to drive remaining bearing cap out of yoke.

(8) Remove spider from yoke.

Cleaning and Inspection

Clean the yoke bearing cap bores with solvent and a wire brush. Be sure to remove all rust, corrosion or dirt. Wash the bearing caps, bearings and spiders in solvent and wipe them dry with a shop cloth.

Inspect the bearing caps, needle bearings and bearing surfaces of the spider for evidence of brinneling, excessive wear, flat spots, scoring or cracks. Replace the complete assembly if any part exhibits these conditions.

Assembly—Single Cardan Joint

(1) Lubricate all needle bearings, bearing caps and bearing surfaces of spider with chassis grease. Also apply thin film of grease to exterior surface of bearing caps.

(2) Install bearing cap seals on spider.

(3) Install one bearing and needle bearing assembly part-way into shaft yoke.

(4) Position spider in shaft yoke and install opposite bearing cap and needle bearing assembly in yoke.

(5) Support yoke on vise jaws and seat both bearing caps in yoke using hammer.

(6) Install bearing cap retainers. Tap ends of bearing caps to seat caps fully if retainers are difficult to install.

(7) Install two remaining bearing cap and needle bearing assemblies on spider. Use rubber band or tape to retain these caps on spider until shaft is to be installed.

Disassembly—Double Cardan Joint

NOTE: *The socket yoke, ball, spring, needle bearings, retainer and thrust washers are serviced as an assembly only (fig. 2E-6). When servicing the double cardan joint, do not disassemble these components. If any one component is damaged, replace the assembly.*

(1) Remove all bearing cap retainers.

(2) Mark bearing caps, spiders, propeller shaft yoke, link yoke and socket yoke for assembly alignment reference.

(3) Remove bearing caps attaching front spider to propeller shaft yoke as follows (fig. 2E-5):

(a) Use 5/8 socket as bearing cap driver and 1-1/16 socket as bearing cap receiver.

(b) Place 5/8 socket on one bearing cap and 1-1/16 socket over opposite bearing cap.

(c) Mount assembly in vise so vise jaws bear directly against sockets positioned on bearing caps.

(d) Tighten vise to press first bearing cap out of link yoke.

(e) Loosen vise, reposition sockets and press opposite bearing cap out of link yoke.

(4) Disengage propeller shaft yoke from link yoke.

(5) Remove bearing caps attaching front spider to propeller shaft yoke as outlined in step (3).

(6) Remove front spider from yoke.

(7) Remove bearing caps attaching rear spider to link yoke as outlined in step (3) and remove rear spider and socket yoke from link yoke.

Cleaning and Inspection

Clean the yoke bearing cap bores with solvent and a wire brush. Be sure to remove all rust, dirt and corrosion from the bores. Wash the universal joint components in solvent and wipe them dry with a shop cloth.

Inspect all bearings and bearing surfaces for excessive wear, galling, brinneling, scoring, flat spots or cracks. Inspect the yokes for distortion, cracks or worn bearing cap bores. Replace the complete assembly if any component exhibits these conditions.

Assembly—Double Cardan Joint

NOTE: *When assembling the universal joint, be sure to align the spiders and yokes according to the reference marks made during disassembly.*

(1) Lubricate all bearings and bearing contact surfaces with lithium-base chassis grease.

(2) Install bearing caps on transfer case yoke ends of rear spider. Secure caps to spider using tape.

(3) Assemble socket yoke and rear spider.

(4) Position rear spider in link yoke and install bearing caps. Press caps into yoke using 5/8 socket. Be sure to press caps into yoke bores far enough to expose bearing cap retainer grooves.

(5) Install rear spider-to-link yoke bearing cap retainers.

(6) Position front spider in propeller shaft yoke and install bearing caps. Press caps into yoke using 5/8 socket. Be sure to press caps into yoke bores far enough to expose bearing cap retainer grooves.

(7) Install front spider-to-propeller shaft yoke bearing cap retainers.

(8) Install thrust washer and socket spring in ball socket bearing bore, if removed.

(9) Install thrust washer on ball socket bearing boss (located on propeller shaft yoke), if removed.

(10) Align ball socket bearing boss on propeller shaft yoke with ball socket bearing bore and insert boss into bore.

(11) Align front spider with link yoke bearing cap bores and install bearing caps. Press caps into yoke using 5/8 socket. Be sure to press caps into yoke bores far enough to expose bearing cap retainer grooves.

(12) Install front spider-to-link yoke bearing cap retainers.

SPECIFICATIONS

Universal Joint Angle Chart

	Front		Rear	
	OK Range	Set-To	OK Range	Set-To
Cherokee Wagoneer Truck	6°-8°	7°	4°-6°	5°
CJ	3°-5°	4°	4°-6°	5°

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Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft-lbs)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Pinion Yoke Nut:				
Model 30-44 Axle	210	200-220	285	271-298
Model 60 Axle	260	250-270	352	339-366
AMC—Jeep Axle	Add 5 in-lbs. (0.56 N·m) torque measured at disassemble. Refer to Pinion Seal and Yoke Replacement, Chapter 2F- AMC—Jeep Axle.			
Universal Joint Clamp Strap Bolt	15	13-18	20	18-24

All Torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

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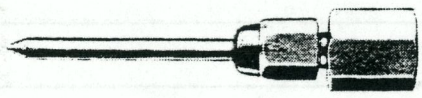
Tools



LUBE FITTING ADAPTER TOOL J-25512-2

J-24649-1 YOKE RUNOUT GAUGE

NOTES

AXLES — FRONT HUBS 2F

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AXLE TESTING AND DIAGNOSIS

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General	2F-1
Tire Noise Diagnosis	2F-1
Wheel Bearing Diagnosis	2F-1

GENERAL

When diagnosing an axle or front drive hub noise condition, obtain a complete description of the noise and driving conditions when the noise occurred. A preliminary road test with the owner demonstrating the complaint condition is recommended.

The action of transmitting engine torque to the wheels will produce some noise in all axles. Slight axle noises confined to a brief speed range or specific period are considered normal.

Noises produced by the engine, transfer case, transmission, tires, wheel bearings, exhaust system, propeller shaft, or the action of wind on the body or grille may be incorrectly diagnosed as axle noise. It is important to test the vehicle thoroughly in order to isolate the problem component and avoid unnecessary repair.

During the road test, stop the vehicle, shift the transmission into neutral, and operate the engine at various speeds. If the noise is heard during this test, the noise is being produced by the engine, exhaust system, clutch, transmission, transfer case, or by engine driven accessory equipment.

Before road testing, check and correct the tire inflation pressures and axle lubricant levels.

TIRE NOISE DIAGNOSIS

Because certain types of tire tread wear or tread patterns may produce objectionable noises, drive the vehicle on various types of road surfaces and listen for a change in the noise. If the noise varies with the type of road surface, the tires may be causing the noise.

WHEEL BEARING DIAGNOSIS

Worn, loose, or damaged wheel bearings can be confused with axle noises. Wheel bearing noise is usually more noticeable when coasting at lower vehicle speeds. Applying the brakes gently while the vehicle is moving will usually change wheel bearing noise. Another test involves turning the vehicle alternately left and right while moving straight ahead at relatively low speed. This manuever side-loads the bearings and should cause the problem bearing to become noisier.

AXLE TEST AND DIAGNOSIS

Before testing the axle, drive the vehicle a distance sufficient to warm the axles and axle lubricant. During the test, operate the transmission and transfer case in every gear combination.

Axle noises are usually related to vehicle speed rather than engine rpm or transmission gear range.

Axle noises may be classified into two types: gear noise and bearing noise.

Gear noise is often described as a whine or high-pitched resonating sound. It is usually more pronounced at certain vehicle speeds and within a narrow speed range under a drive (accelerating load), coast (decelerating load), or float (constant speed) condition.

Axle bearing noise is usually constant and the pitch is related to vehicle speed.

Since the pinion gear rotates faster than the ring gear, the pinion bearings produce a higher pitch sound than the differential bearings. The pinion bearings are usually heard at lower vehicle speeds of 20 to 30 mph (32 to 48 km/h).

Differential bearings produce a lower pitch sound because they are rotating at the same speed as the wheels. Differential bearing noise will not vary when the vehicle is turned alternately left and right or when the brakes are gently applied.

Axle Noisy On Pull and Coast

- Excessive ring and pinion backlash.
- Excessive pinion end play.
- Worn pinion bearings.
- Incorrect pinion depth adjustment.
- Incorrect lubricant (Trac-Lok differential).

Axle Noisy On Pull

- Incorrect ring and pinion backlash or depth adjustment.
- Damaged or worn pinion bearings.
- Incorrect pinion bearing preload.

AXLE NOISY ON COAST

- Excessive ring and pinion backlash.
- Excessive pinion end play.
- Worn or damaged pinion or differential bearings.
- Excessive differential bearing preload.

Backlash

Excessive driveline backlash may be the result of backlash in the transmission, transfer case, propeller shaft yokes or slip joint splines, universal joints, ring and pinion gears, differential gears, front axle shaft splines or universal joints, or rear axle shaft splines.

Chatter—Trac-Lok Differential

Trac-Lok chatter is usually caused by using non-recommended lubricants. If chatter occurs, drain and refill the axle with Jeep Axle lubricant or equivalent only.

Other Axle Conditions

A knocking noise heard at low speed or when coasting may be caused by loose fitting differential side gears. If this condition is encountered, operate the vehicle at the speed where noise is loudest and apply the brakes lightly. If loose fitting gears are causing the problem, the noise level will usually decrease when the brakes are applied.

Differential gear noise is considered normal when spinning a wheel with an on-the-vehicle wheel balancer, or when the wheels are spinning on icy or other types of low traction surface.

Whenever axle noise is caused by worn or damaged bearings, do not replace the gears unless they are also worn or damaged. Similarily, if axle gears are causing noise, do not replace the bearings unless they are worn or damaged.

FRONT AXLE

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GENERAL

A drive-type front axle with steering knuckles and hypoid differential gears is used on all Jeep models.

Engine torque is transmitted to the wheels through full-floating, two-piece axle shafts which have connecting universal joints (fig. 2F-1). The axle shafts revolve within and are supported by the steering knuckles. Open

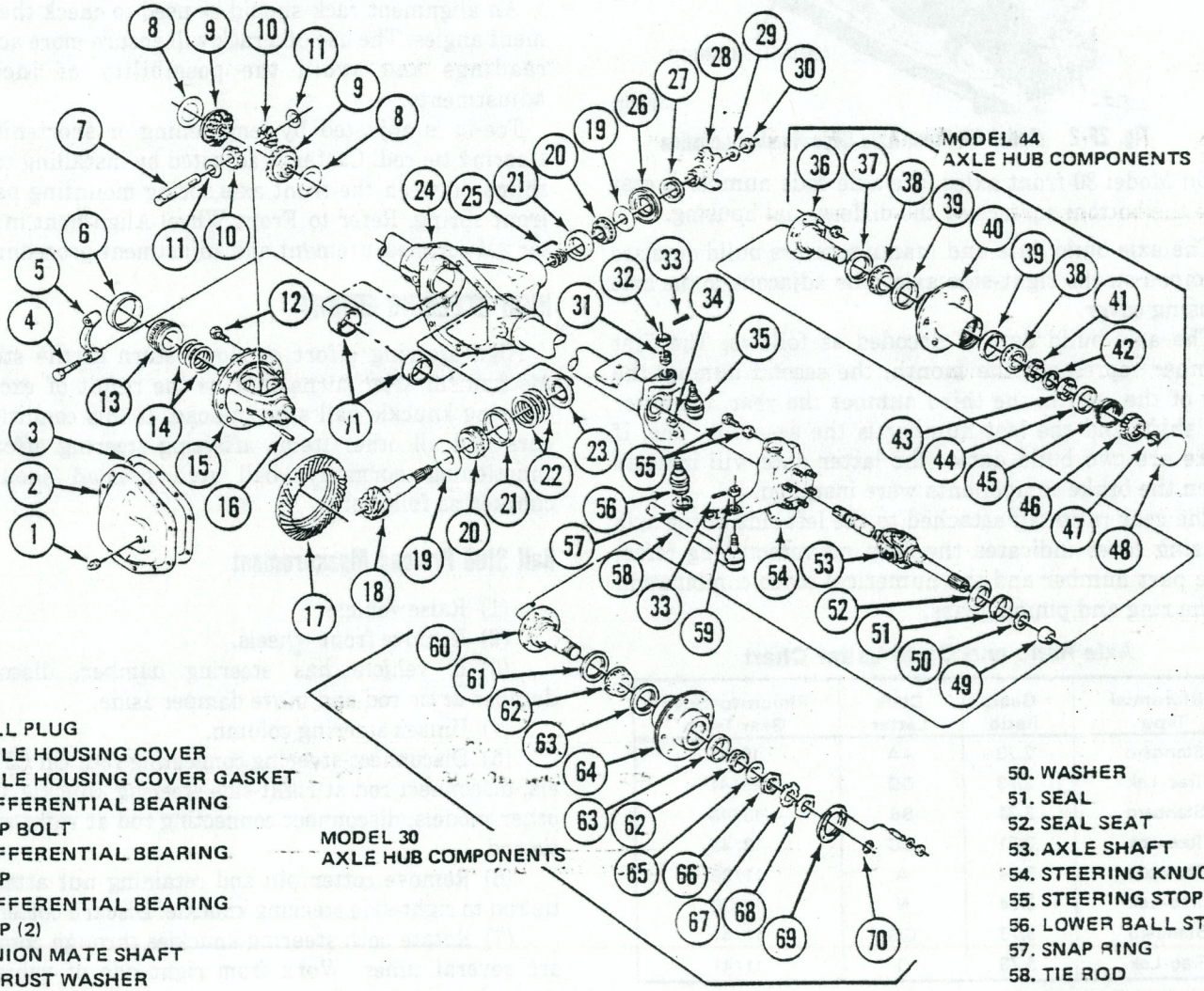
end steering knuckles which pivot on ball studs are used on all Jeep front axles.

The Model 30 front axle is used on all CJ models. The Model 44 front axle is used on all Cherokee, Wagoneer and Truck models. Service procedures for the two axle models are the same.

On all front axles, toe-in and caster are the only adjustable alignment angles. Camber is built into the axle and cannot be adjusted. Refer to Front End Alignment for adjustment methods.

AXLE IDENTIFICATION

On Model 44 front axles, the axle code number is cast into the upper surface of the reinforcing rib at the left side of the axle housing (fig. 2F-2).



1. FILL PLUG
2. AXLE HOUSING COVER
3. AXLE HOUSING COVER GASKET
4. DIFFERENTIAL BEARING CAP BOLT
5. DIFFERENTIAL BEARING CAP
6. DIFFERENTIAL BEARING CUP (2)
7. PINION MATE SHAFT
8. THRUST WASHER
9. DIFFERENTIAL SIDE GEAR
10. DIFFERENTIAL PINION GEAR
11. THRUST WASHER
12. RING GEAR MOUNTING BOLTS
13. DIFFERENTIAL BEARING (2)
14. DIFFERENTIAL BEARING PRELOAD SHIMS
15. DIFFERENTIAL CASE
16. PINION MATE SHAFT PIN
17. RING GEAR
18. PINION GEAR
19. SLINGER
20. PINION BEARING
21. PINION BEARING CUP
22. PINION DEPTH SHIMS
23. BAFFLE
24. AXLE HOUSING
25. PINION PRELOAD SHIMS
26. OIL SEAL
27. DUST CAP
28. YOKE
29. WASHER
30. PINION NUT
31. UPPER BALL STUD SPLIT RING SEAT
32. UPPER BALL STUD NUT
33. COTTER PIN
34. LOWER BALL STUD JAMNUT
35. UPPER BALL STUD
36. SPINDLE
37. SEAL
38. BEARING
39. BEARING CUP
40. HUB
41. INNER LOCKNUT
42. WASHER
43. OUTER LOCKNUT
44. SPRING CUP*
45. PRESSURE SPRING*
46. DRIVE GEAR*
47. SNAP RING
48. HUB CAP*
49. SPINDLE BEARING
50. WASHER
51. SEAL
52. SEAL SEAT
53. AXLE SHAFT
54. STEERING KNUCKLE
55. STEERING STOP BOLT
56. LOWER BALL STUD
57. SNAP RING
58. TIE ROD
59. TIE ROD END NUT
60. SPINDLE
61. SEAL
62. BEARING
63. BEARING CUP
64. HUB
65. TABBED WASHER
66. INNER LOCKNUT
67. LOCK WASHER
68. OUTER LOCKNUT
69. GASKET
70. SNAP RING
71. INNER OIL SEAL

* NOT USED WITH FRONT DRIVE HUBS

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Fig. 2F-1 Front Axle Assembly

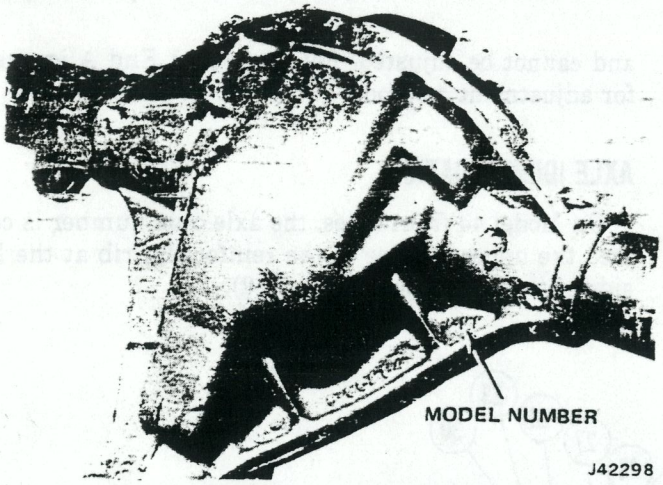

Fig. 2F-2 Model 44 Front Axle Code Number Location

On Model 30 front axles, the axle code number is cast into the bottom surface of the differential housing.

The axle build date and manufacturers build date are stamped on the right-side axle tube adjacent to the axle housing cover.

The axle build date is decoded as follows: The first number represents the month, the second number the day of the month, the third number the year, the letter the shift, and the last number is the assembly line. If there are two build dates, the latter date will indicate when the brake components were installed.

The gear ratio tag attached to the left side of the axle housing cover indicates the Jeep manufacturing reference part number and the numerical tooth combination of the ring and pinion gears.

Axle Ratio and Code Letter Chart

Differential Type	Gear Ratio	Code Letter	Pinion-to-Drive Gear Teeth
Standard	2.73	AA	15/41
Trac-Lok	2.73	DD	15/41
Standard	3.31	BB	13/43
Trac-Lok	3.31	CC	13/43
Standard	3.54	A	11/39
Trac-Lok	3.54	N	11/39
Standard	3.73	GG	11/41
Trac-Lok	3.73	Q	11/41

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AXLE HOUSING SERVICE

The front axle housing should be inspected periodically for weld cracks or other damage that could cause loss of lubricant, affect driving characteristics, or result in front end misalignment.

NOTE: *If the vehicle is driven through water that is deep enough to cover the front hubs, steering knuckles and brake components should be disassembled and inspected for water-dirt contamination and water damage. All components should be cleaned thoroughly, examined carefully, and lubricated as necessary before assembly. During the inspection, pay particular attention to the axle bearings, spindle bearings and brake components. Damaged or contaminated parts should be replaced.*

FRONT WHEEL ALIGNMENT

Toe-in and caster are the only adjustable front alignment angles. Camber is built into the axle during manufacture and cannot be adjusted.

An alignment rack should be used to check the alignment angles. The use of a rack will ensure more accurate readings and avoid the possibility of incorrect adjustments.

Toe-in is adjusted by lengthening or shortening the steering tie rod. Caster is adjusted by installing tapered shims between the front axle spring mounting pad and front spring. Refer to Front Wheel Alignment in Chapter 2M for measurement and adjustment procedures.

HIGH STEERING EFFORT

High steering effort or slow return of the steering mechanism after turns may be the result of excessive steering knuckle ball stud preload. If this condition occurs and all other items affecting steering effort are functioning normally, ball stud preload should be checked as follows:

Ball Stud Preload Measurement

(1) Raise vehicle.

(2) Remove front wheels.

(3) If vehicle has steering damper, disconnect damper at tie rod and move damper aside.

(4) Unlock steering column.

(5) Disconnect steering connecting rod. On CJ models, disconnect rod at right-side steering knuckle. On all other models, disconnect connecting rod at right-side of tie rod.

(6) Remove cotter pin and retaining nut attaching tie rod to right-side steering knuckle. Discard cotter pin.

(7) Rotate both steering knuckles through complete arc several times. Work from right-side of vehicle to rotate knuckles.

(8) Assemble socket and 0-50 foot-pound (68 N•m) capacity torque wrench and install wrench on tie rod retaining nut.

NOTE: *The torque wrench must be positioned at a 90 degree angle to the steering knuckle arm to obtain an accurate reading.*

(9) Rotate knuckles slowly and steadily through a complete arc and measure torque required to rotate knuckles.

(a) If reading is less than 25 foot-pounds (34 N•m), turning effort is within specifications and fault is

not in steering knuckle. Check steering gear, pump, and column.

(b) If reading is more than 25 foot-pounds (34 N•m), turning effort is excessive. Proceed to next step.

(10) Disconnect tie rod from both steering knuckles.

(11) Install 1/2 x 1 inch bolt, flat washer, and nut in tie rod stud mounting hole in one steering knuckle. Tighten bolt and nut securely.

(12) Assemble and install socket and 0-50 foot-pound (68 N•m) capacity torque wrench on bolt previously installed in steering knuckle.

NOTE: *The torque wrench must be positioned at a 90 degree angle to the steering knuckle arm.*

(13) Rotate steering knuckle slowly and steadily through complete arc and measure torque required to turn knuckle.

(14) Install bolt, flat washer, nut, torque wrench and socket on opposite steering knuckle and measure torque required to rotate knuckle.

(a) If reading is less than 10 foot-pounds (14 N•m), steering effort is within specifications and fault is not in knuckle ball studs. Check for tight or damaged tie rod ends, lubricate or replace as necessary, and proceed to next step.

(b) If torque reading is more than 10 foot-pounds (14 N•m), turning effort is excessive. Proceed to Ball Stud Preload Correction procedure.

(15) Install tie rod. Tighten tie retaining nuts to 35 foot-pounds (47 N•m) torque and install replacement cotter pins.

(16) Install connecting rod. Tighten connecting rod retaining nuts to 60 foot-pounds (81 N•m) torque on CJ models and 75 foot-pounds (102 N•m) torque on all other models. Install replacement cotter pins.

(17) Install front wheels.

(18) Lower vehicle.

Ball Stud Preload Correction

(1) Remove front axle shafts as outlined in this chapter.

(2) Loosen lower ball stud jamnut.

(3) Remove cotter pin and slotted nut from upper ball stud.

(4) Unseat upper and lower ball studs by striking studs with lead hammer.

(5) Remove upper ball stud split ring seat using Tool J-23447. Discard seat after removal.

(6) Remove lower ball stud jamnut and remove steering knuckle. Discard jamnut after removal.

(7) Clean upper ball stud split ring seat threads, lower ball stud taper in steering knuckle, threads and tapered surfaces of ball studs, and upper ball stud retaining nut threads.

(8) Position steering knuckle on axle and install replacement lower ball stud jamnut finger tight (only).

(9) Install and tighten upper ball stud slotted nut to 10-20 foot-pounds (13-27 N•m) torque to draw lower ball stud into tapered hole in axle yoke. Do not install upper ball stud split ring seat at this time.

(10) Tighten replacement lower ball stud jamnut to 80 foot-pounds (108 N•m) torque.

(11) Remove upper ball stud slotted nut and install replacement split ring seat using Tool J-23447. Tighten seat to 50 foot-pounds (68 N•m) torque.

(12) Install slotted nut on upper ball stud. Tighten nut to 100 foot-pounds (136 N•m) torque. Align and install cotter pin without loosening slotted nut.

NOTE: *If the cotter pin holes in the nut and stud are not aligned, tighten the nut (only) to align the holes. Never loosen the nut to align the holes.*

(13) Install front axle shafts and steering spindles loosely and measure turning effort of each steering knuckle as described in Ball Stud Preload Measurement.

(a) If turning effort is less than 10 foot-pounds (14 N•m) torque, proceed to next step.

(b) If turning effort is more than 10 foot-pounds (14 N•m) torque, replace upper and lower ball studs and repeat Ball Stud Preload Correction procedure.

NOTE: *If the Ball Stud Preload Correction Procedure is repeated, tighten split ring seat to 50 foot-pounds (68 N•m) torque. Also, tighten the slotted nut on the upper ball stud to 80 foot-pounds (108 N•m) torque.*

(14) Install front axle shafts.

(15) Connect tie rod to steering knuckle arms. Tighten tie rod end retaining nuts to 45 foot-pounds (61 N•m) torque and install replacement cotter pins.

(16) Attach connecting rod to tie rod. Tighten connecting rod end retaining nut to 60 foot-pounds (81 N•m) torque on CJ models and 75 foot-pounds (102 N•m) torque on all other models.

(17) Connect steering damper to tie rod, if equipped.

(18) Install front wheels. Tighten wheel retaining nuts to 80 foot-pounds (108 N•m) torque.

(19) Lower vehicle.

PINION SEAL AND YOKE

Removal

(1) Raise vehicle.

(2) Mark propeller shaft and yoke for assembly alignment reference and disconnect propeller shaft from yoke.

(3) Remove pinion nut and washer using socket, breaker bar, and Tool J-8614-01 (fig. 2F-3).

(4) Remove yoke using Tools J-8614-01, -02, -03 (fig. 2F-4).

(5) Remove pinion seal using Tool J-25180.

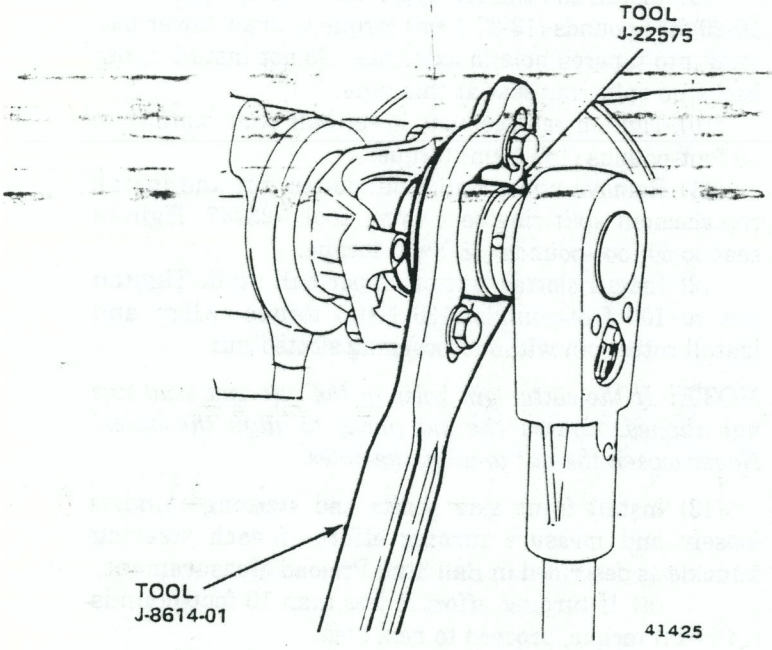

Fig. 2F-3 Pinion Nut Removal

Installation

(1) Install replacement seal using Tool J-25104.

(2) Install yoke.

(3) Install pinion washer and nut. Tighten nut to 210 foot-pounds torque.

(4) Align reference marks on propeller shaft and yoke and connect shaft to yoke. Tighten shaft-to-yoke attaching bolts or nuts to 16 foot-pounds (22 N•m) torque.

(5) Lower vehicle.

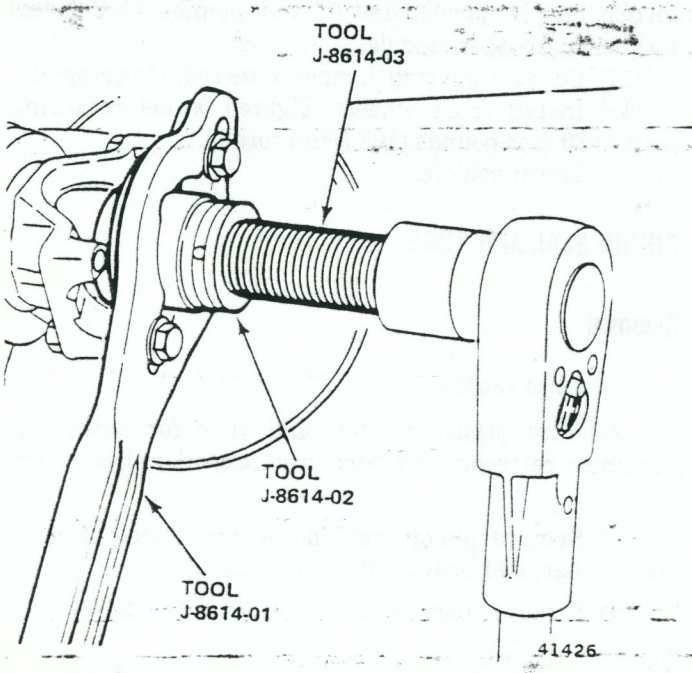

Fig. 2F-4 Pinion Yoke Removal

AXLE SHAFT

Removal—CJ Models

(1) Raise vehicle.

(2) Remove disc brake caliper. Refer to Chapter 2G.

(3) Remove bolts attaching front hub to axle and remove hub body and gasket.

(4) Remove retaining ring from axle shaft.

(5) Remove hub clutch and bearing assembly from axle.

(6) Straighten lip of lock washer.

(7) Remove outer locknut, lock washer, inner locknut, and tabbed washer. Use Tool J-25103 to remove locknuts.

(8) Remove outer bearing and remove disc brake rotor.

(9) Remove disc brake caliper adapter and splash shield.

(10) Remove axle spindle.

(11) Remove axle shaft and universal joint assembly.

Installation—CJ Models

(1) Clean all parts thoroughly.

(2) Install axle shaft and universal joint assembly. Insert splined end of axle shaft into differential side gear and push shaft into place.

(3) Install axle spindle.

(4) Install splash shield and disc brake caliper adapter.

(5) Lubricate and install outer bearing in disc brake rotor.

(6) Install disc brake rotor on spindle.

(7) Install tabbed washer and inner locknut. Tighten locknut to 50 foot-pounds (68 N•m) torque; then back off locknut 1/6 turn (45°-65°). Rotate wheel while tightening inner locknut to seat bearings evenly. Use Tool J-25103 to tighten locknut.

(8) Install lock washer and outer locknut. Tighten locknut to 50 foot-pounds (68 N•m) torque and bend lip of lock washer over nut.

(9) Install hub clutch and bearing assembly on axle shaft.

(10) Install retaining ring on axle shaft.

(11) Install gasket and hub body on axle and install hub attaching bolts. Tighten bolts to 30 foot-pounds (41 N•m) torque. Tighten bolts alternately and evenly.

(12) Install disc brake caliper. Refer to Chapter 2G.

(13) Lower vehicle.

Removal—Cherokee-Wagoneer-Truck

(1) Raise vehicle.

(2) Remove disc brake caliper. Refer to Chapter 2G.

(3) On models without front hubs:

(a) Remove rotor hub cap.

(b) Remove axle shaft snap ring, drive gear, pressure spring, and spring retainer.

(4) On models with front hubs:

(a) Remove socket head screws from hub body and remove body and large retaining ring.

(b) Remove small retaining ring from axle shaft.

(c) Remove hub clutch assembly from axle.

(5) Remove outer locknut, washer, and inner locknut using Tool J-6893.

(6) Remove rotor. Spring retainer and outer bearing are removed with rotor.

(7) Remove nuts and bolts attaching spindle and support shield and remove spindle and shield. If necessary, tap spindle with rawhide mallet to remove it from knuckle (fig. 2F-5).

(8) Remove axle shaft.

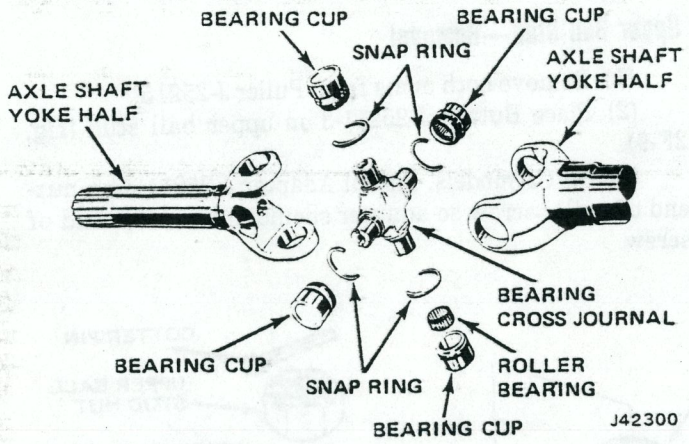

Fig. 2F-5 Axle Shaft Universal Joint

Installation—Cherokee-Wagoneer-Truck

(1) Install axle shaft. Insert splined end of axle shaft in differential side gear and push shaft into place.

(2) Install spindle.

(3) Install support shield and rotor.

(4) Install inner wheel bearing locknut (nut has peg on one side). Tighten locknut just enough to remove end play.

(5) Install wheel and tire but do not tighten wheel nuts completely.

(6) Tighten inner locknut to 50 foot-pounds (68 N•m) torque; then back off locknut 1/6-turn (45°-65°). Rotate wheel while tightening locknut to seat bearings evenly.

(7) Install washer so inner tab is aligned with spindle keyway. Also be sure peg on inner locknut engages in nearest hole in washer.

(8) Install and tighten outer locknut to minimum of 50 foot-pounds (68 N•m) torque.

(9) Remove wheel and tire.

(10) On models without front hubs:

(a) Install spring retainer, pressure spring, and drive gear.

CAUTION: *Install the spring retainer with the cupped side of the retainer facing toward the center of the vehicle.*

(b) Push drive gear inward to provide clearance for axle shaft snap ring and install snap ring.

(c) Coat rotor hub cap rim with Permatex Adhesive-Sealant number 3, or equivalent, and install hub cap in rotor.

(11) On models with front hubs:

(a) Install hub clutch assembly in axle.

(b) Install small retaining ring on axle shaft. Install large retaining ring in axle hubs.

(c) Install replacement O-ring on hub body if necessary.

(d) Install hub body. Install and tighten socket head screws to 30 inch-pounds (3 N•m) torque.

(12) Install disc brake caliper. Refer to Chapter 2G.

(13) Install wheel and tire.

(14) Lower vehicle.

AXLE SHAFT UNIVERSAL JOINT

Replacement

(1) Remove axle shaft.

(2) Remove snap rings from universal joint bearing cups (fig. 2F-5).

(3) Press on end of one bearing cup to press opposite bearing from yoke half.

(4) Turn yoke over and press remaining bearing cup out of yoke by pressing on exposed end of bearing cross journal.

CAUTION: *To avoid damaging the bearing, remove the bearing using a brass drift having a flat face that is approximately 1/32-inch smaller in diameter than the hole in the axle shaft yoke.*

(5) Repeat above step to remove remaining bearing cups. Remove bearing cross journal by sliding it to one side and lifting out.

(6) Clean parts in solvent. Inspect parts after cleaning. Replace any part that exhibits excessive wear or damage.

(7) Pack bearing cups 1/3 full of bearing lubricant and install bearing rollers.

(8) Install bearing cross journal. Hold bearing cups in vertical position to prevent bearings from dropping out.

(9) Install bearing cups in axle shaft yoke halves and seat them firmly against bearing shoulders.

(10) Press bearing cups on journal from opposite side until firmly seated.

(11) Repeat previous steps to install opposite bearing cups on cross journal.

(12) Install snap rings on bearing cups.

NOTE: *If the universal joint binds when assembled, tap the yoke lightly to relieve any pressure on the bearings at each end of the journal.*

(13) Install axle shaft.

STEERING KNUCKLE REMOVAL

NOTE: *The open-end steering knuckle pivots on ball studs. Ball stud replacement requires removal of the axle shaft and steering knuckle (fig. 2F-6).*

(1) Remove axle shaft.

(2) Disconnect tie-rod end at steering knuckle arm.

(3) Remove and discard lower ball stud jamnut (fig. 2F-7).

(4) Remove cotter pin from upper ball stud and loosen stud nut until top edge of nut is flush with top of stud.

(5) Unseat upper and lower ball studs using lead hammer.

(6) Remove upper ball stud nut and steering knuckle.

(7) Remove upper ball stud split ring seat using Tool J-25158.

STEERING KNUCKLE BALL STUDS

Lower Ball Stud Removal

(1) Remove lower ball stud snap ring.

(2) Clamp knuckle assembly securely in vise with upper ball stud pointing downward (fig. 2F-8).

(3) Attach Plate J-25211-1 to spindle mating surface of knuckle assembly (fig. 2F-8).

(4) Position Button J-25211-3 on lower ball stud (fig. 2F-8).

(5) Assemble and install Puller J-25215 on steering knuckle (fig. 2F-8). Hook one puller arm in Plate J-25211-1 and hook opposite arm in knuckle.

(6) Tighten puller screw to press lower stud out of knuckle.

(7) Remove tools used to press stud from knuckle.

Upper Ball Stud—Removal

(1) Remove both arms from Puller J-25215.

(2) Place Button J-25211-3 on upper ball stud (fig. 2F-9).

(3) On CJ models, install Adapter J-25211-4 on nut-end of puller screw so adapter shoulder faces nut-end of screw.

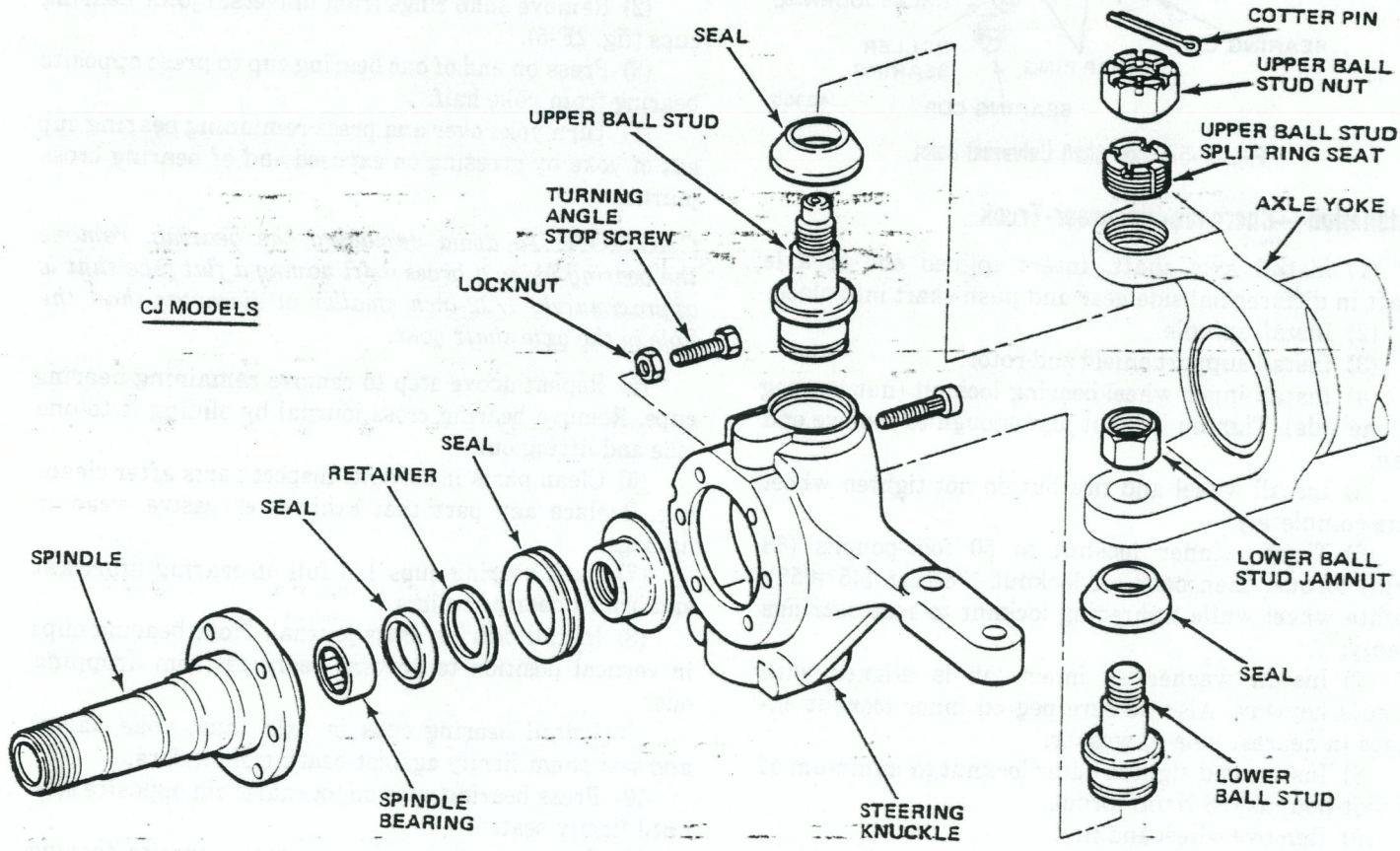

Fig. 2F-6 Steering Knuckle Components

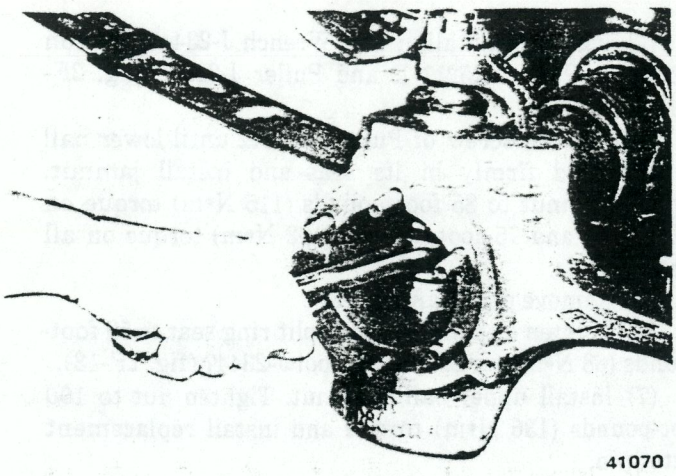

Fig. 2F-7 Lower Ball Stud Jamnut Removal

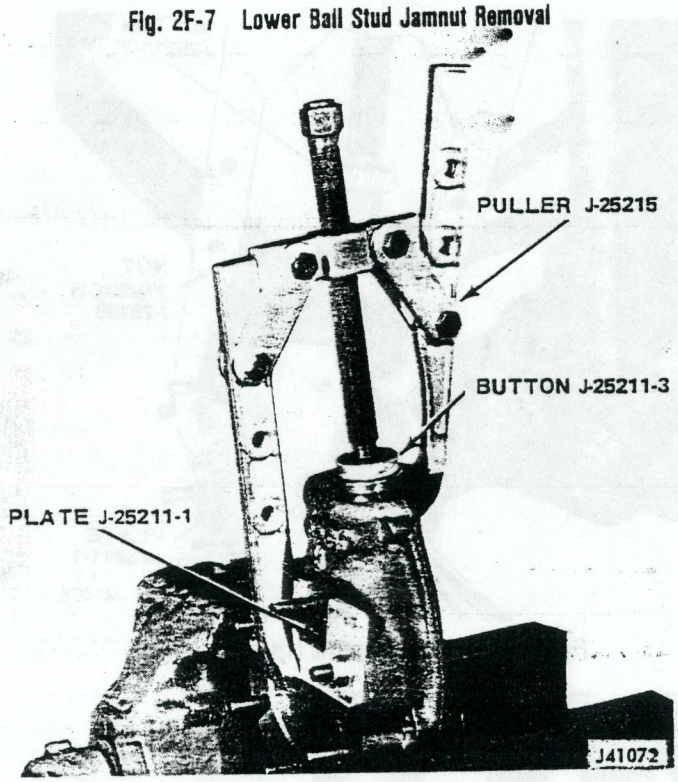

Fig. 2F-8 Lower Ball Stud Removal

(4) On all models, thread puller frame halfway onto puller screw. Insert nut-end of screw through lower ball stud hole in steering knuckle. Position puller frame against knuckle and puller screw against Button J-25211-3 (fig. 2F-9). On CJ models, be sure Adapter J-25211-4 is positioned between puller frame and steering knuckle.

(5) Tighten puller screw to press upper ball stud out of knuckle.

(6) Remove tools used to press upper ball stud from knuckle. Do not disassemble screw and frame of Puller J-25215 at this time. Tools will be used, as assembled, to install lower ball stud.

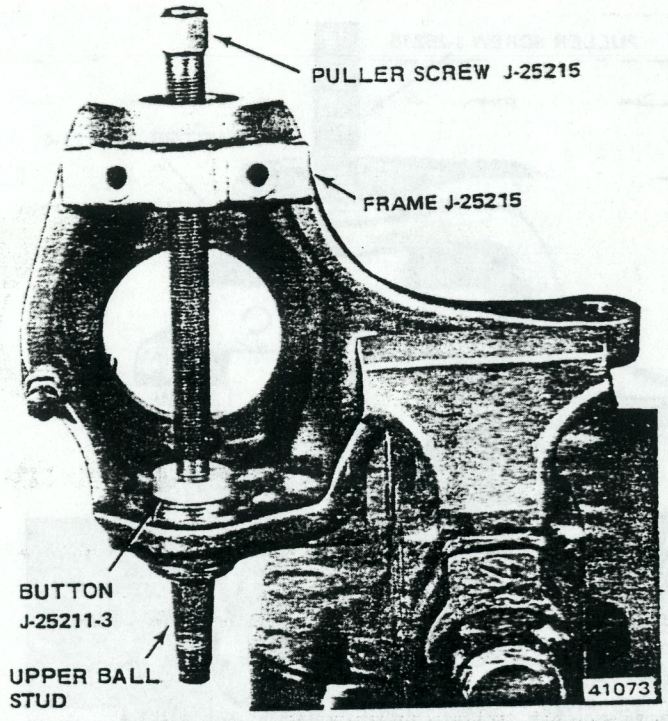

Fig. 2F-9 Upper Ball Stud Removal

Lower Ball Stud—Installation

(1) Invert steering knuckle in vise.

(2) Position replacement lower ball stud in steering knuckle.

(3) Place Adapter J-25211-4 over nut-end of puller screw and against puller frame (fig. 2F-10).

(4) Insert nut-end of puller screw through upper ball stud hole in knuckle and hold adapter and frame against knuckle (fig. 2F-10).

(5) Place Installer Cup J-25211-2 on ball stud (fig. 2F-10).

(6) Tighten puller screw to press lower ball stud into steering knuckle (fig. 2F-10).

(7) Install replacement lower ball stud retaining snap ring.

(8) Remove tools used to install lower ball stud.

Upper Ball Stud Installation

(1) Install both arms on Puller J-25215 (fig. 2F-11).

(2) Position replacement upper ball stud in steering knuckle.

(3) Install Plate J-25211-1 on spindle mounting studs (fig. 2F-11).

(4) Position Installer Cup J-25211-2 on upper ball stud (fig. 2F-11).

(5) Install assembled Puller J-25215 on steering knuckle. Hook one puller arm in plate and hook opposite arm in knuckle (fig. 2F-11). Be sure puller screw is centered on installer cup.

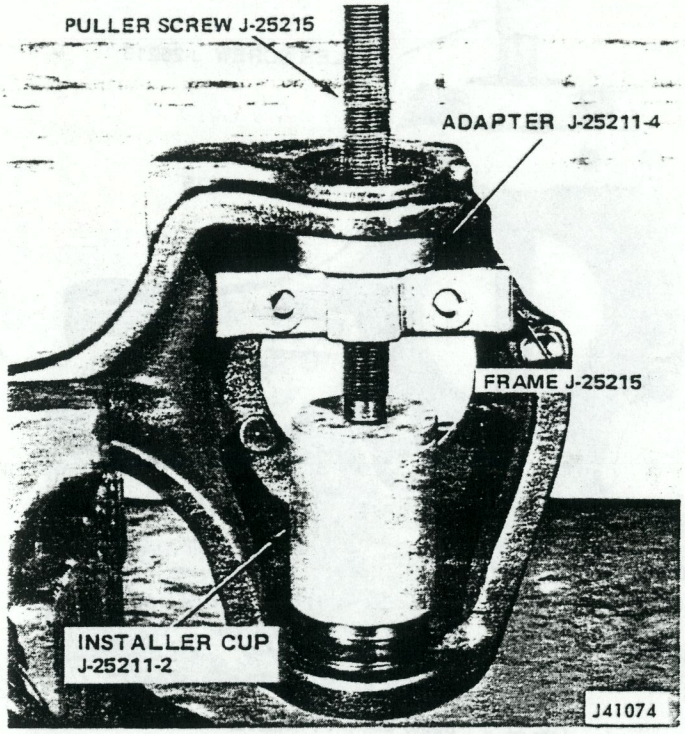

Fig. 2F-10 Lower Ball Stud Installation

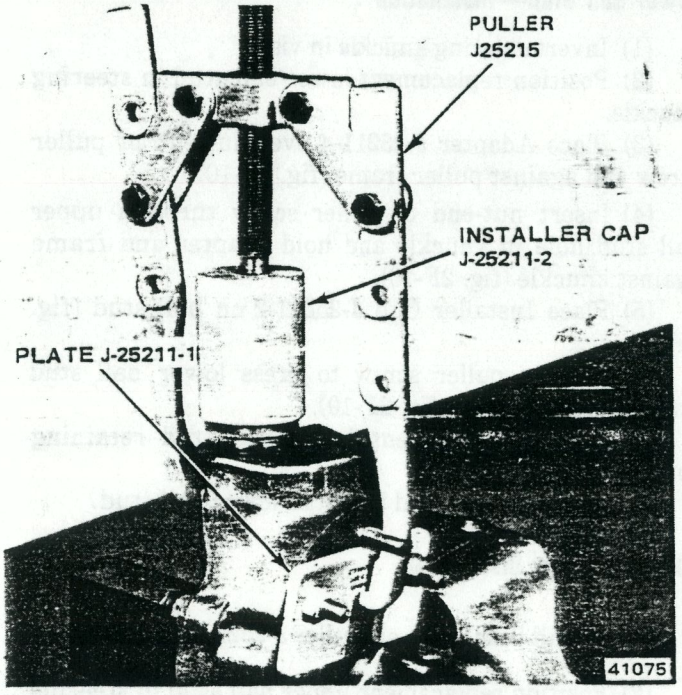

Fig. 2F-11 Upper Ball Stud Installation

(6) Tighten puller screw to press ball stud into steering knuckle (fig. 2F-11).

(7) Remove upper ball stud installation tools.

STEERING KNUCKLE INSTALLATION

(1) Install upper ball stud split ring seat in axle yoke. Top of seat should be flush with top of yoke.

(2) Install steering knuckle on axle yoke and install lower ball stud stud jamnut finger-tight only.

(3) Position and align Nut Wrench J-23447, Button J-25211-3, Plate J-25211-1, and Puller J-25212 (fig. 2F-12).

(4) Tighten screw of Puller J-25212 until lower ball stud is held firmly in its seat and install jamnut. Tighten jamnut to 85 foot-pounds (115 N•m) torque on CJ models and 75 foot-pounds (102 N•m) torque on all other models.

(5) Remove puller and plate.

(6) Tighten upper ball stud split ring seat to 50 foot-pounds (68 N•m) torque using Tool J-23447 (fig. 2F-13).

(7) Install upper ball stud nut. Tighten nut to 100 foot-pounds (136 N•m) torque and install replacement cotter pin.

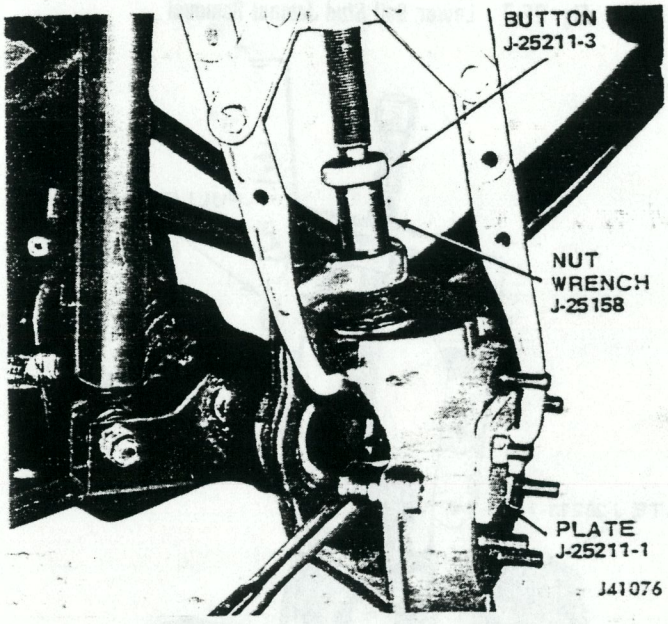

Fig. 2F-12 Steering Knuckle Installation

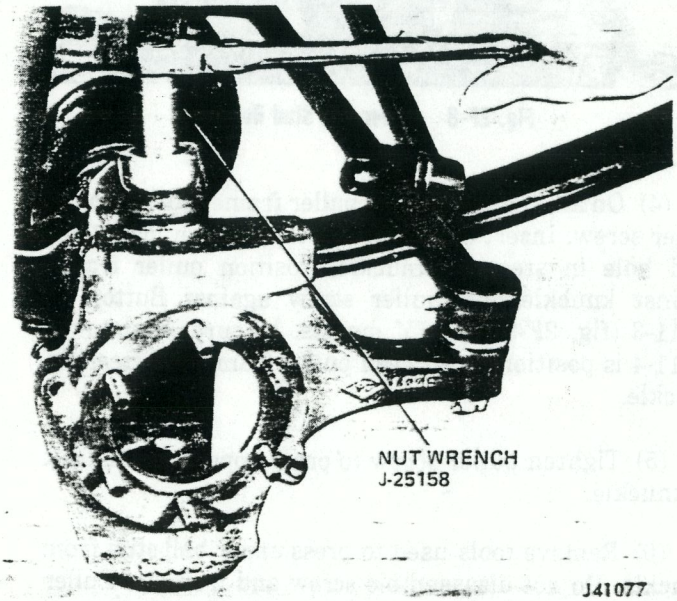

Fig. 2F-13 Tightening Upper Ball Stud Seat

NOTE: *If the cotter pin holes do not align, tighten the nut until the holes are aligned. Never loosen the nut to align the holes.*

(8) Connect steering tie rod. Tighten tie rod endnuts to 50 foot-pounds (68 N•m) torque and install replacement cotter pins.

(9) Check and correct front axle turning angle as necessary. Refer to Turning Angle Adjustment.

AXLE SHAFT SEAL

Replacement

(1) Remove axle shaft. Refer to Axle Shaft-Removal procedure.

(2) Remove seal from axle shaft (fig. 2F-14).

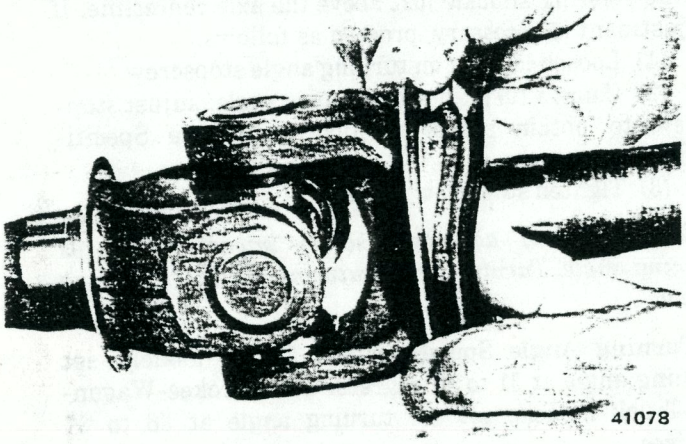

Fig. 2F-14 Axle Shaft Seal Installation

(3) Remove bronze thrust washer. If washer is worn, replace it.

(4) Clean dirt and foreign matter from seal area.

(5) Install bronze washer with chamfered side toward axle shaft seal.

(6) Install replacement seal with seal lip facing spindle (fig. 2F-14).

(7) Pack wheel bearing lubricant around thrust face of shaft and seal and fill seal area of spindle with wheel bearing lubricant also.

(8) Install axle shaft. Refer to Axle Shaft-Installation procedure.

SPINDLE BEARING

Replacement

NOTE: *Front axle spindles are equipped with a needle roller bearing that is located in the spindle flange bore (fig. 2F-15).*

(1) Wrap machined surfaces of spindle with tape and mount spindle in vise. Do not clamp spindle in vise until protective tape is applied to spindle surfaces.

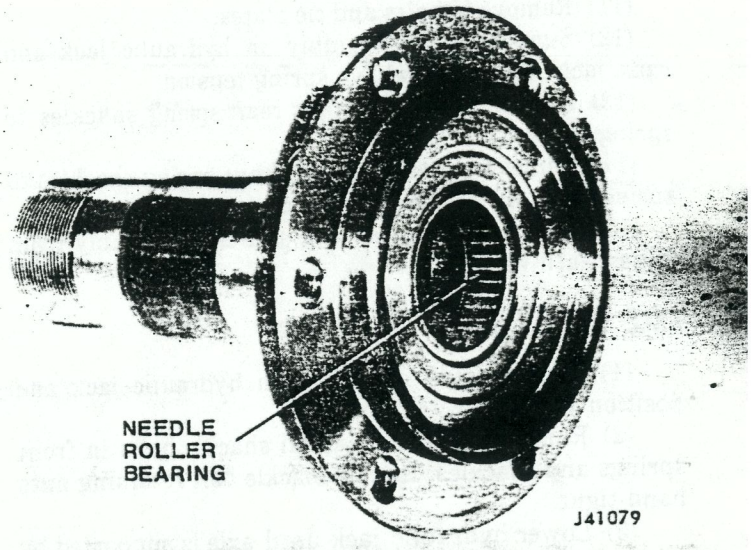

Fig. 2F-15 Spindle Bearing Location

(2) Remove needle bearing using internal-type puller.

(3) Clean dirt and foreign matter from spindle bearing surface.

(4) Install replacement bearing using bearing driver.

(5) Pack needle bearing with wheel bearing lubricant.

AXLE HOUSING INNER OIL SEAL

Model 30 and 44 front axles have inner oil seals that are located inside the housing. The seals are installed in counterbores machined into the shaft bores in the housing center section.

The axle housing inner seals are serviceable items but require differential removal in order to replace them. Refer to Differential Overhaul—Model 30-44-60 Axle in the Standard Differential section for removal/installation procedures.

AXLE REMOVAL

(1) Raise and support front end. Position frame stands under frame rails at rear of front springs.

(2) Remove wheels.

(3) Mark propeller shaft and axle yoke for assembly alignment reference.

(4) Disconnect propeller shaft at axle yoke. Secure shaft to frame rail using wire.

(5) Disconnect connecting rod at steering knuckles.

(6) Disconnect shock absorbers at axle housing.

(7) On vehicles equipped with stabilizer bar, remove nuts attaching stabilizer bar connecting links to spring tie plates.

(8) Disconnect breather tube at axle housing.

(9) Disconnect stabilizer bar link bolts at spring clips.

(10) Remove disc brake calipers, rotors, and brake shields. Refer to Chapter 2G.

(11) Remove U-bolts and tie plates.

(12) Support axle assembly on hydraulic jack and raise jack slightly to relieve spring tension.

(13) Loosen nuts attaching rear spring shackles to springs.

(14) Remove bolts attaching front spring shackles to springs and lower springs to floor.

(15) Remove hydraulic jack and axle assembly from underneath vehicle.

AXLE INSTALLATION

(1) Support axle assembly on hydraulic jack and position axle under vehicle.

(2) Raise springs and install shackle bolts in front springs and shackles. Install shackle bolt retaining nuts hand-tight.

(3) Lower hydraulic jack until axle is supported by front springs and rotate axle into position on springs.

(4) Install spring U-bolts and tie plates.

(5) On vehicles equipped with sway bar, mount sway bar connecting links on tie plates.

(6) Tighten spring shackle bolts to 24 foot-pounds (33 N•m) torque on CJ models and 100 foot-pounds (136 N•m) torque on all other models.

(7) On vehicles equipped with stabilizer bar, install nuts attaching stabilizer bar connecting links to tie plates.

(8) Tighten spring pivot bolts to 100 foot-pounds (136 N•m) torque on all models.

(9) Install brake shields, rotors, and brake calipers. Refer to Chapter 2G.

(10) Connect breather tube.

(11) Connect shock absorbers.

(12) Connect steering connecting rod at steering knuckles. Use replacement cotter pins to secure nuts.

(13) Connect propeller shaft to yoke. Align shaft and yoke using alignment marks made during removal.

(14) Install wheels.

(15) Remove support stands and lower vehicle.

(16) Tighten wheel retaining nuts and install wheel covers.

(17) Check front wheel alignment.

(18) Check turning angle.

TURNING ANGLE ADJUSTMENT

The turning angle stopscrews are located at the rear of the steering knuckle just above the axle centerline. If adjustment is necessary, proceed as follows.

(1) Loosen locknut on turning angle stopscrew.

(2) Using a turntable to measure angle, adjust stopscrew to obtain proper turning angle (see Specifications).

(3) Tighten stopscrew locknut.

NOTE: *Turning adjusting screw inward increases turning angle. Turning screw outward decreases turning angle.*

Turning Angle Specifications: On CJ models, set turning angle at 31 to 32 degrees. On Cherokee-Wagoneer-Truck models, set the turning angle at 36 to 37 degrees.

SPECIFICATIONS

Front Axle Specifications

Axle Type:	
Model 30/44	Drive-type, full-floating axle with open end steering knuckles mounted on ball studs.
Axle Application:	
Model 30 Front Axle	CJ-5, CJ-7
Model 44 Front Axle	Cherokee, Wagoneer, Truck
Axle Ring Gear Diameter:	
Model 30	7.125-inches (18.09 cm)
Model 44	8.500-inches (21.59 cm)
Front Axle Lubricants:	Jeep Axle Lubricant or equivalent of SAE 85W-90, A.P.I. Grade GL-5 quality, Grade MIL-L-2105C.
Lubricant Capacity:	
Model 30	2.5 Pints (1.18 liters)
Model 44	3.0 Pints (1.41 liters)
Turning Angle:	
CJ-5, CJ-7	31-32 degrees
Cherokee, Wagoneer, Truck	36-37 degrees

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Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft-lbs)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Axle Housing Cover Bolts	20	15-25	27	20-34
Connecting Rod-End Nut:				
CJ	40 min.	–	54 min.	–
Cherokee-Wagoneer-Truck	70 min.	–	95 min.	–
Lower Ball Stud Jam Nut:				
CJ	85	–	115 min.	–
Cherokee-Wagoneer-Truck	75	–	102 min.	–
Tie Rod-End Nut:				
CJ	40 min.	–	54 min.	–
Cherokee-Wagoneer-Truck	60 min.	–	81 min.	–
Shock Absorber Lower Mounting Stud Nut	45	35-50	61	48-68
Spring Pivot Bolts	100	80-120	136	109-163
Spring Shackle Bolts/Nuts:				
CJ	24	18-30	33	24-41
Cherokee-Wagoneer-Truck	100	80-120	136	109-163
Spring Clip U-Bolt Nuts:				
9/16-18	100	85-105	163	115-142
1/2-20	55	45-65	75	61-81
Upper Ball Stud Split Ring Seat	50	–	68	–
Upper Ball Stud Retaining Nut	100	–	136	–
Universal Joint Strap Bolt	16	15-19	22	20-26
Wheel Retaining Nuts	80	65-90	109	88-122

All torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

Refer to the Standard Torque Specifications and Capscrew Markings Chart in Section A of this manual for any torque specifications not listed above.

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REAR AXLE

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Axle Shaft and Bearing—CJ	2F-15	Pinion Seal and Yoke—Model 44 and 60 Axle	2F-19
Axle Shaft and Bearing—Cherokee-Wagoneer-J-10 Truck	2F-17	Rear Axle Installation	2F-19
Axle Shaft and Bearing—J-20 Truck	2F-18	Rear Axle Removal	2F-19
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GENERAL

CJ models are equipped with the AMC/Jeep semi-floating rear axle with tapered axle shafts. This axle has an 8-7/8 inch (23 cm) diameter ring gear.

Cherokee, Wagoneer, and J-10 Truck models use an AMC/Jeep semi-floating rear axle which has flanged axle shafts. This axle has an 8-7/8 (23 cm) diameter ring gear. J-20 Truck models use the Model 60 full-floating rear axle.

IDENTIFICATION

On AMC/Jeep rear axles, the axle code letters are stamped on the right-side axle housing tube boss (fig. 2F-16). On Dana model 60 rear axles, the axle ratio is stamped on an I.D. tag attached to the axle housing cover. In addition to the ratios listed in the ratio and letter code chart, J-20 Truck models are also available with 3.73 ratio axles. The ring and pinion tooth combination for this ratio is 11/41.

J-20 Truck Axle

On the Model 60 rear axle, the model number is cast into a boss on the lower right side of the housing, adjacent to the housing cover.

The axle build date and manufacturer's part numbers are stamped on the right-hand axle tube, adjacent to the cover (fig. 2F-17). The build date of the axle is as follows. First number is the month, second number is the day of the month, third number is the year, the alpha-letter is the shift and the last number is the assembly line. If

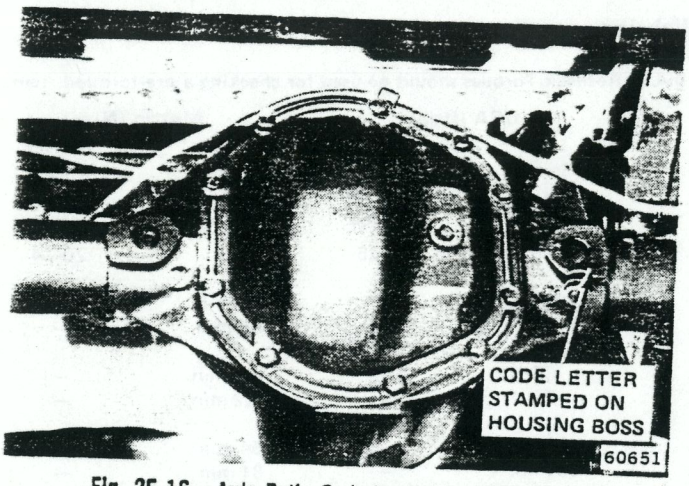

Fig. 2F-16 Axle Ratio Code Location—AMC/Jeep Axle

Axle Ratio and Code Letter Chart

Differential Type	Gear Ratio	Code Letter	Pinion-to-Drive Gear Teeth
Standard	2.73	AA	15/41
Trac-Lok	2.73	DD	15/41
Standard	3.31	BB	13/43
Trac-Lok	3.31	CC	13/43
Standard	3.54	A	11/39
Trac-Lok	3.54	N	11/39
Standard	3.73	GG	11/41
Trac-Lok	3.73	Q	11/41

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there are two build dates, the latter will be the date in which the brake components were installed.

AXLE HOUSING

The rear axle housing should be checked periodically for weld cracks and other damage that may cause loss of lubricant or affect driving characteristics.

If the vehicle is driven through water deep enough to cover the hubs, the wheel ends should be disassembled and inspected for water damage or contamination.

Examine, clean, and replace damaged parts before lubricating and assembling the wheel end components. Pay particular attention to the axle bearings, front spindle bearings and brake components.

AXLE HUB—CJ MODELS

Removal

(1) Remove axle shaft dust cap.
(2) Remove axle shaft nut and washer.
(3) Raise and support vehicle.
(4) Remove wheel and tire.
(5) Remove screws attaching brake drum to rear hub and remove drum.
(6) Install Puller Tool J-25109-01 on axle hub and remove hub (fig. 2F-18).

CAUTION: *Do not use a knockout or slide hammer-type puller to remove the hub. This type of puller may damage axle bearings, axle shaft, or differential thrust block.*

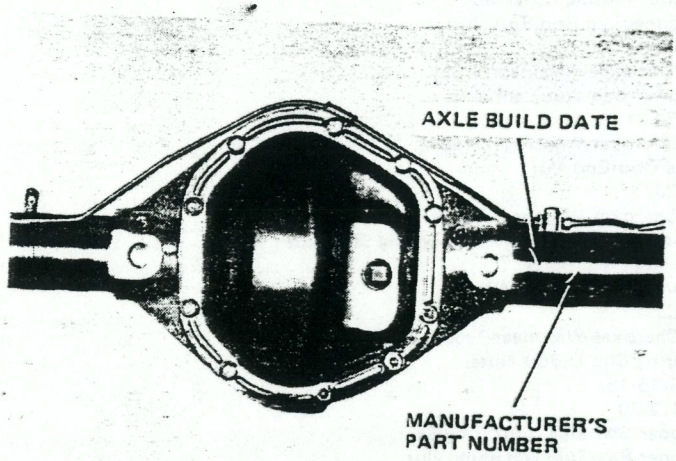

Fig. 2F-17 Axle Part Number and Build Date Code Location—Model 60 Axle

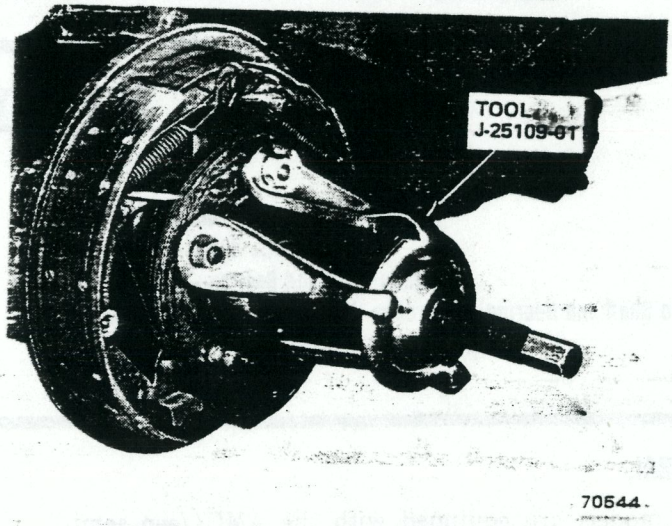

Fig. 2F-18 Axle Hub Removal—CJ Axle

Inspection

Inspect the hub for loose or distorted wheel lug studs. Inspect the keyway and tapered center bore for wear, damaged serrations, or cracks. Replace the hub if worn or damaged.

Installation

NOTE: *The procedures for installing an original hub and for installing a replacement hub are different. The installation procedures for both hub-types are as follows:*

Original Hub Installation

(1) Align keyway in hub with axle shaft key.
(2) Slide hub onto axle shaft as far as possible.
(3) Install axle shaft nut and washer.
(4) Install drum, drum retaining screws, and road wheel.
(5) Lower vehicle onto wheels.
(6) Tighten axle shaft nut to 250 foot-pounds (339 N•m) torque. If cotter pin hole is not aligned, tighten nut to the next castellation and install cotter pin. Do not loosen nut to align cotter pin hole.

NOTE: *When a replacement axle shaft is installed, a replacement hub must also be installed. However, a replacement hub may be installed on an original axle shaft if the serrations on the shaft are not worn or damaged.*

Replacement Hub Installation

(1) Align keyway in hub with axle shaft key.
(2) Lubricate two thrust washers with liberal amount of chassis lubricant and install washers on axle shaft.
(3) Install axle shaft nut.
(4) Install brake drum, drum retaining screws, and wheel.
(5) Lower vehicle onto wheels. Tighten axle shaft nut until distance from hub outer face to axle shaft outer end is 1-5/16 inches (33 mm) (fig. 2F-19).

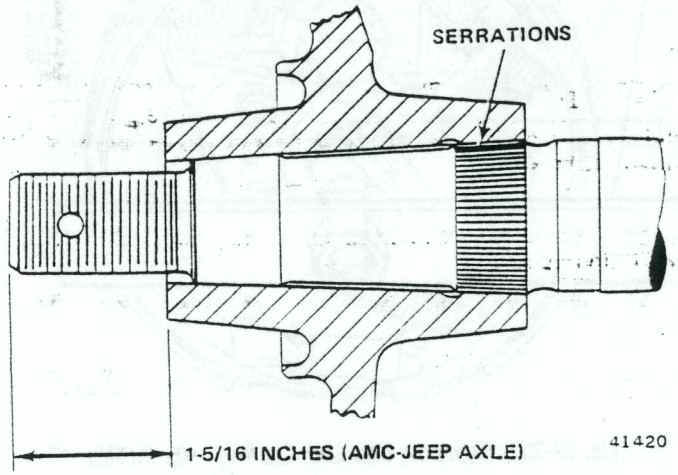

Fig. 2F-19 Replacement Hub Installation Measurement—CJ Axle

NOTE: *The hub must be pressed onto the axle shaft to the specified dimension in order to form the hub serrations properly.*

(6) Remove axle shaft nut and one thrust washer.

(7) Install axle shaft nut and tighten to 250 foot-pounds (339 N•m) torque. If cotter pin hole is not aligned, tighten nut to next castellation and install cotter pin. Do not loosen nut to align cotter pin hole.

AXLE SHAFT AND BEARING—CJ AXLE

Removal

(1) Remove rear wheel, drum, and hub as outlined under Axle Hub—CJ Models.
(2) Disconnect parking brake cable at equalizer.
(3) Disconnect brake line at wheel cylinder and remove brake support plate assembly, oil seal, and shims from axle shaft.

NOTE: *If both axle shafts are removed, keep the shims separated. Axle shaft end play is adjusted on the left side only.*

(4) Remove axle shaft and bearing using Tool J-2498 (fig. 2F-20).

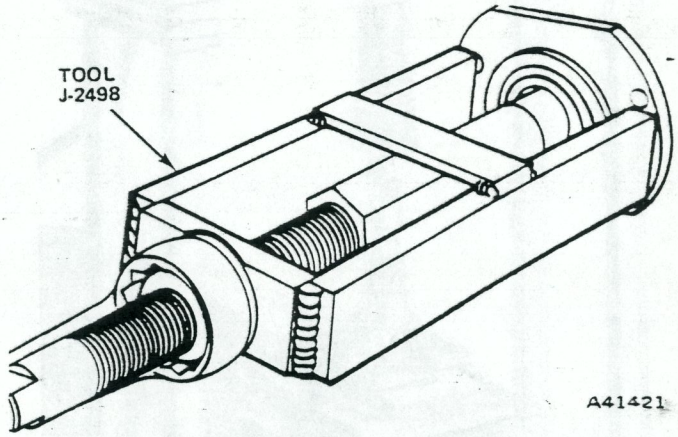

Fig. 2F-20 Axle Shaft Removal—CJ Models

CAUTION: *On models equipped with a Trac-Lok differential, do not rotate the differential gears unless both axle shafts are in place. If one shaft is removed and remaining shaft is rotated, the side gear splines will become misaligned and prevent installation of the replacement shaft.*

(5) Remove and discard axle shaft inner oil seal.
(6) Remove axle shaft bearing if bearing is worn or damaged.

NOTE: *The bearing is a press-fit on the axle shaft and must be removed using an arbor press only (fig. 2F-21). Do not attempt to remove the bearing by any other method.*

Installation

NOTE: *Tapered shaft axle bearings do not have any provision for lubrication after assembly and must be packed with a high quality wheel bearing lubricant before installation.*

(1) If axle shaft bearing is to be replaced, pack bearing with generous amount of wheel bearing lubricant

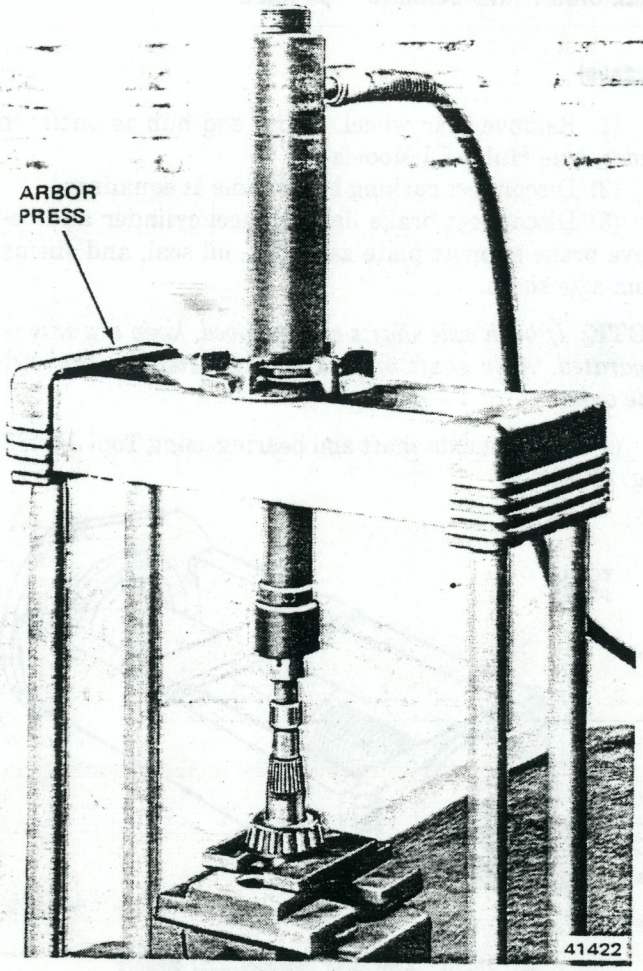

Fig. 2F-21 Axle Shaft Bearing Removal—CJ Models

and press bearing onto shaft. Small diameter of bearing must face toward outer tapered end of shaft.

(2) Coat inner seal with oil.

(3) Coat outer surface of seal metal retainer with nonhardening sealer.

(4) Install inner oil seal using Seal Installer J-21788 (fig. 2F-22).

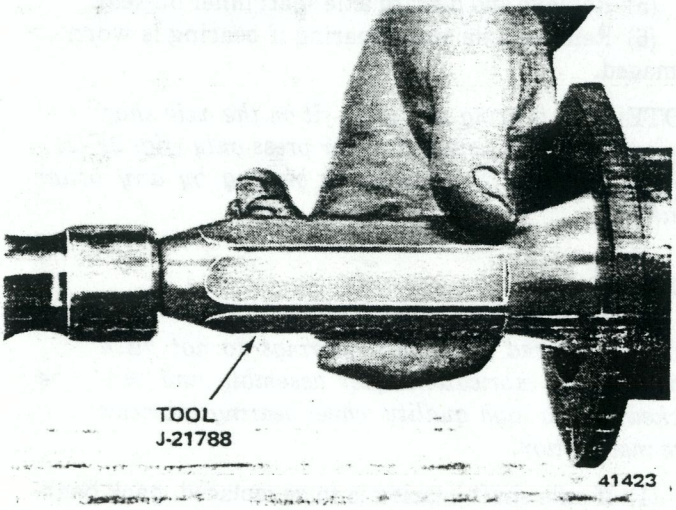

Fig. 2F-22 Inner Oil Seal Installation—CJ Models

(5) Install axle shaft. Align shaft splines with differential side gear splines and insert shaft into gear.

(6) Install outer bearing cup.

(7) Inspect brake support plate for elongated bolt holes. Replace support plate if necessary.

NOTE: *During assembly, apply a silicone-type sealer to the axle tube flange and brake support plate mounting area to prevent entry of dust and water.*

(8) Install original axle end play shims, oil seal assembly, and brake support plate. Tighten attaching bolts to 35 foot-pounds (47 N•m) torque.

NOTE: *The oil seal and retainer are located on the outside of the brake support plate.*

End Play Adjustment—CJ Axle Shaft

Axle shaft end play is adjusted at the left side axle shaft only.

(1) Strike end of each axle shaft with lead hammer to seat bearing cups against support plate.

(2) Attach Axle Shaft End Play Tool J-2092 to end of left side axle shaft. Mount dial indicator on support plate or tool, and check end play while pushing and pulling on axle shaft (fig. 2F-23).

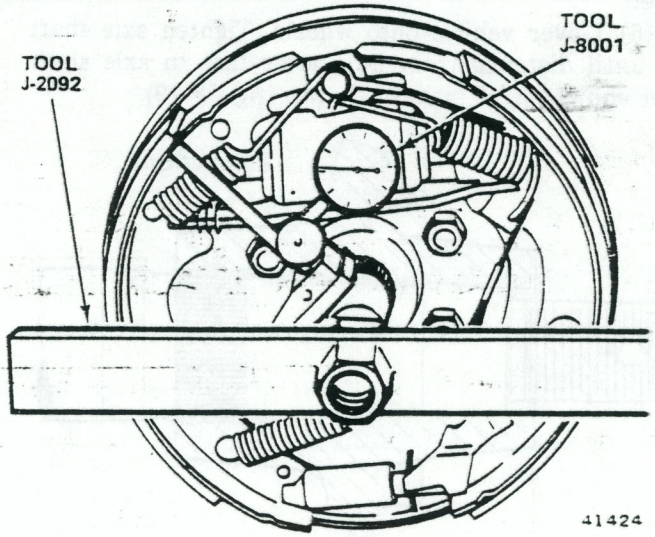

Fig. 2F-23 Measuring Axle Shaft End Play—CJ Models

(3) End play should be 0.004 to 0.008 inch (0.10 to 0.20 mm), 0.006 inch (0.15 mm) is desired.

(4) Add shims to increase end play, or remove shims to decrease end play.

(5) Install axle hub and brakedrum as outlined under Rear Axle Hub—Installation.

(6) After axle shaft end play is checked and corrected, adjust brakes. Refer to Chapter 2G.

AXLE SHAFT AND BEARING—CHEROKEE-WAGONEER-TRUCK AXLES

Removal—Cherokee-Wagoneer-J-10 Truck

(1) Raise and support vehicle and remove wheels.

(2) Remove brakedrum.

(3) Remove nuts attaching support plate and retainer to axle tube flange using access hole in axle shaft flange.

(4) Assemble Adapter Tool J-21579 and Slide Hammer J-2619-01, install tools on axle shaft flange, and remove axle shaft (fig. 2F-24).

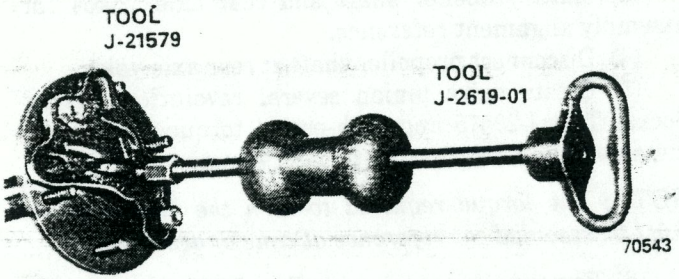

Fig. 2F-24 Axle Shaft Removal—Cherokee-Wagoneer-J-10 Truck

(5) If cup portion of wheel bearing assembly remains in axle housing after axle shaft is removed, remove bearing cups using Tools J-2619-01 and J-26941.

(6) Remove axle shaft oil seal from axle housing tube.

Axle Shaft Bearing Replacement

CAUTION: *Under no circumstances should the axle shaft retaining ring or bearing be removed using a torch. Heat will transfer into the axle shaft bearing journal and weaken it.*

(1) Mount axle shaft in vise. Use protective jaws on vise to prevent scratching or damaging shaft.

(2) Drill 1/4 inch (6 mm) diameter hole in retaining ring. Hole depth should be approximately 3/4 of ring thickness.

CAUTION: *Do not allow drill to contact axle shaft.*

(3) Position chisel over drilled hole in retaining ring. Cut deep groove in retaining ring using chisel. This will enlarge ring, or split it, allowing ring to be removed from axle shaft (fig. 2F-25).

(4) Slide retaining plate and oil seal toward axle shaft. This provides room for bearing removal tool between seal and bearing.

(5) Remove axle shaft bearing using arbor press and Tool J-22912-01 or J-23674 (fig. 2F-26).

(6) Inspect axle shaft bearing and seal surfaces for scratches. Remove scratches using crocus cloth.

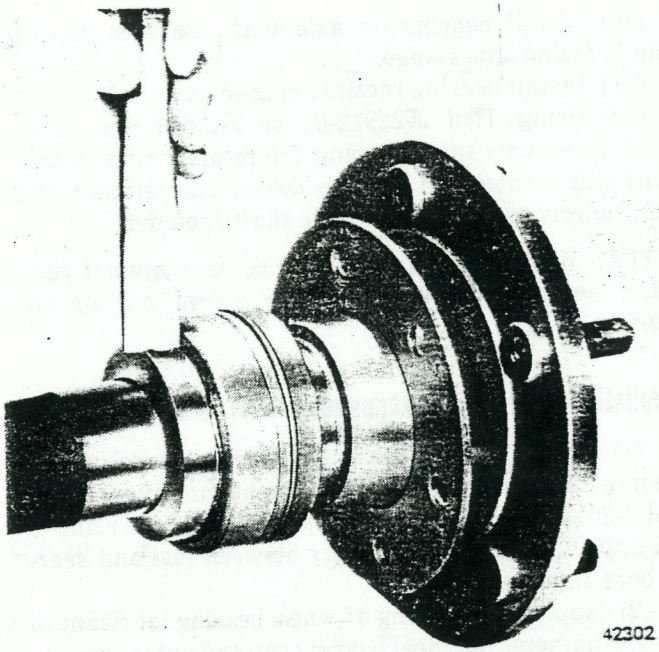

Fig. 2F-25 Notching Bearing Retaining Ring—Cherokee-Wagoneer-J-10 Truck Axle

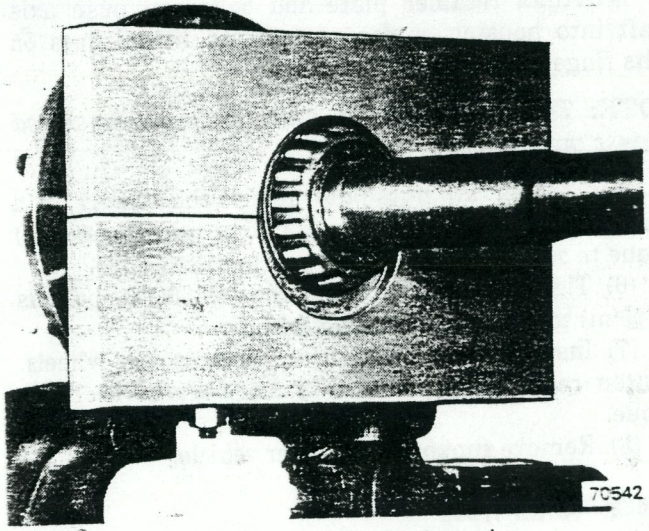

Fig. 2F-26 Axle Shaft Bearing Removal—Cherokee-Wagoneer-J-10 Truck Axle

(7) Install retainer plate on axle shaft.

(8) Pack wheel bearing lubricant in oil seal cavity and between seal lips and install seal on axle shaft seal seat. Outer face of seal must face axle flange.

NOTE: *Prevent damage to the seal by lubricating seal lips before installation. The seal lips, when seal is installed, must contact the machined portion of the axle shaft only.*

(9) Pack replacement bearing with wheel bearing lubricant. Force lubricant through cup rib ring end until it appears at opposite end, around bearing.

(10) Install bearing on axle shaft. Be sure cup rib ring is facing axle flange.

(11) Install bearing retainer ring on axle shaft.

(12) Using Tool J-22912-01 or J-23674 and arbor press, press axle shaft bearing and retainer ring on axle shaft simultaneously. Be sure bearing and retainer ring are properly seated against axle shaft shoulder.

NOTE: *When the seal and bearing seat against each other, some lubricant should be forced out of the bearing.*

Installation—Cherokee-Wagoneer-J-10 Truck

(1) Clean inner oil seal and bearing bores in axle housing tube and install replacement inner seal using Tool J-25135-01. Next, apply wheel bearing lubricant to seal and to bottom 1/3 of cavity between seal and bearing bore shoulder.

(2) Apply thin coating of wheel bearing lubricant to outside diameter of wheel bearing cup and outer oil seal.

CAUTION: *Take care to avoid damaging the oil seal when installing the shaft.*

(3) Insert splined end of shaft into differential side gears and start cup rib rings and seals into axle tube.

(4) Align retainer plate and bolts and push axle shaft into housing as far as possible. Install nuts on bolts finger tight only.

NOTE: *The outer oil seal must be squarely seated against the bearing.*

(5) Tighten all nuts alternately and evenly in a cross pattern to approximately 15 foot-pounds (20 Nm) torque to seal the cup rib ring evenly in axle tube.

(6) Tighten nuts to final torque of 50 foot-pounds (68 N•m) torque in a cross pattern.

(7) Install rear brake drum, locknuts and wheels. Tighten rear wheel nuts to 72 foot-pounds (98 N•m) torque.

(8) Remove supports and lower vehicle.

Removal—J-20 Truck

NOTE: *It is not necessary to raise the wheels in order to remove the axle shafts on Model 60 full-floating rear axles.*

(1) Remove axle flange nuts, lockwashers, and split washers retaining axle shaft flange.

(2) Remove axle shaft from housing.

Installation—J-20 Truck

(1) Be sure axle flange mating area on hub and axle are clean and free of old gasket material.

(2) Install replacement flange gasket on hub studs.

(3) Insert axle shaft into housing.

NOTE: *It will be necessary to rotate the axle shaft to simultaneously align the shaft splines with the differential gear splines and the flange attaching holes with the hub studs.*

(4) Install split washers, lockwashers, and flange bolts. Tighten bolts.

PINION SEAL AND YOKE—CJ-CHEROKEE-WAGONEER-J-10 TRUCK

Removal

(1) Raise and support vehicle.

(2) Remove rear wheels and brake drums.

(3) Mark propeller shaft and rear axle yokes for assembly alignment reference.

(4) Disconnect propeller shaft at rear axle yoke.

(5) Rotate drive pinion several revolutions using Socket Tool J-22575 and inch-pound torque wrench to measure torque required to turn drive pinion.

NOTE: *The torque required to turn the drive pinion must be recorded for reference at time of assembly.*

(6) Remove pinion nut using Tool J-8614-01 (fig. 2F-3). Discard pinion nut.

(7) Mark yoke and pinion for alignment reference at time of assembly.

(8) Remove yoke using Tools J-8614-01, -02, -03 (fig. 2F-4).

(9) Inspect seal surface of yoke. If surface is damaged or grooved, replace yoke.

(10) Remove pinion seal using Tool J-9233 (fig. 2F-27).

(11) Before installing replacement seal, coat seal lip with rear axle lubricant.

(12) Install seal using Tool J-22661 (fig. 2F-28).

(13) Install yoke on pinion. Note alignment marks.

(14) Install replacement pinion nut. Tighten nut using Tools J-8614-01 and J-22575 to remove pinion bearing end play only. **Do not overtighten nut.**

(15) Check torque required to turn pinion gear. Pinion gear must be turned several revolutions to obtain accurate torque reading. Refer to torque reading recorded during disassembly and add 5 inch-pounds (0.56 N•m) more torque to this amount for correct preload torque.

(16) If preload torque is less than desired amount, which should equal disassembly torque reading plus 5 inch-pounds (0.56 N•m), tighten pinion nut slightly and recheck torque.

(17) Repeat gradual tightening procedure until desired torque is attained. **Do not loosen and retighten nut.**

CAUTION: *Do not overtighten the pinion nut. If the desired torque is exceeded, a replacement collapsible pinion spacer sleeve must be installed and the pinion gear preload reset. Refer to Differential Overhaul.*

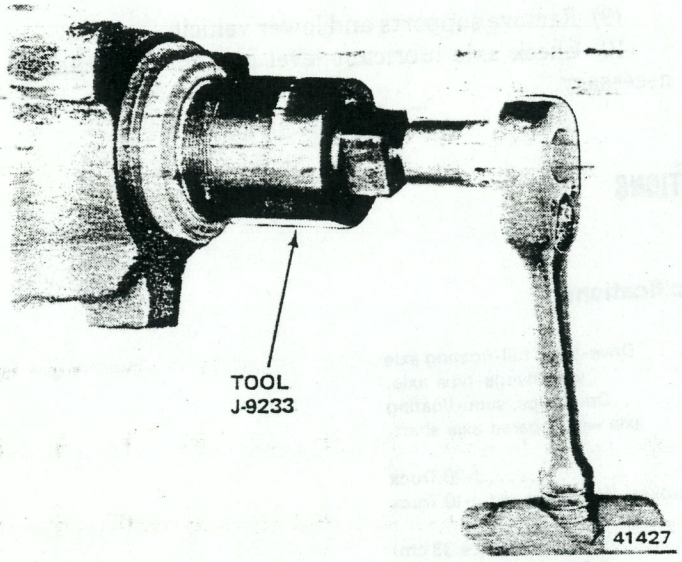

Fig. 2F-27 Pinion Seal Removal

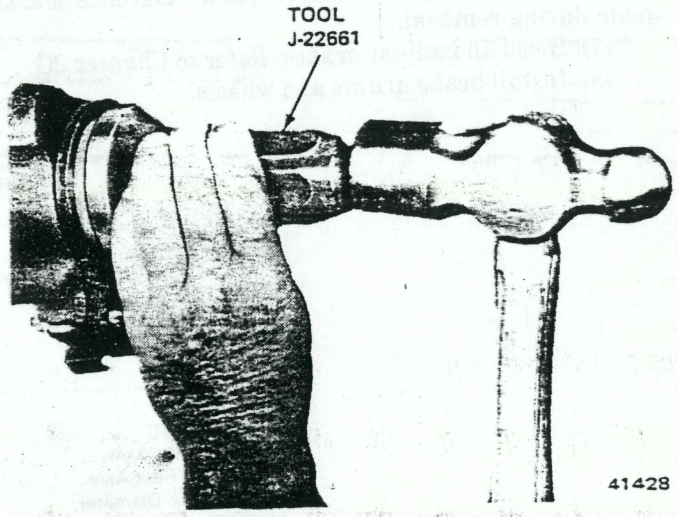

Fig. 2F-28 Pinion Seal Installation

(18) Install propeller shaft. Align index marks made at disassembly

(19) Install rear brake drums and wheels.

(20) Remove supports and lower vehicle.

PINION SEAL AND YOKE—MODEL 44 AND 60 AXLE

Removal

(1) Raise and support vehicle.

(2) Index propeller shaft to front yoke for assembly reference and disconnect shaft at yoke.

(3) Remove pinion nut and washer using Tool J-8614-01 (fig. 2F-3).

(4) Remove yoke using Tools J-8614-01, -02, -03 (fig. 2F-4).

(5) Remove pinion seal using Tool J-25180 on Model 44 axle or Tool J-25144 on Model 60 axle.

Installation

(1) Install replacement pinion seal using Tool J-25104.

(2) Install yoke on pinion.

(3) Install pinion washer and nut. Tighten nut to 210 foot-pounds (285 N•m) torque on Model 44 axle and 260 foot-pounds (352 N•m) torque on Model 60 axle.

(4) Align index marks on propeller shaft and yoke and install shaft. Tighten strip clamp bolts to 16 foot-pounds (22 N•m) torque or tighten flange bolts to 35 foot-pounds (47 N•m) torque.

(5) Remove supports and lower vehicle.

REAR AXLE REMOVAL

(1) Raise vehicle and position support stands under frame rails just forward of rear springs.

(2) Remove wheels.

(3) Mark propeller shaft and axle for assembly alignment reference.

(4) Disconnect propeller shaft at rear axle yoke.

(5) Disconnect shock absorbers at axle tubes.

(6) Disconnect brake hydraulic hose at rear axle tee fitting. Tape ends of hose and fitting to prevent dirt entry.

(7) Disconnect parking brake cable at equalizer.

(8) Support axle using hydraulic jack.

(9) Remove U-bolts. On vehicle with spring-mounted above axle, disconnect spring at rear shackle.

(10) Slide axle from under vehicle.

REAR AXLE INSTALLATION

NOTE: *All service replacement axle assemblies are shipped from the factory without lubricant in the differential. Lubricant must be added to the differential before the axle is installed. Use Jeep Axle Lubricant, or equivalent, marked SAE 85W-90 gear lubricant, grade API GL-5.*

When adding differential lubricant, be sure the pinion bearings receive lubricant. Suspend the axle so the axle shafts are in a horizontal position and the yoke end of the pinion housing is facing downward. Then, turn the pinion gear several times so lubricant will reach the pinion bearings.

(1) Support axle assembly on hydraulic jack and position assembly under vehicle.

(2) Align springs with axle spring pads, and install U-bolts and nuts. On vehicles with spring mounted above axle, position spring on shackles and install bolts but do not tighten bolts completely.

(3) Attach brake line hose at tee fitting on top of housing.

(4) Connect parking brake cables.

(5) Connect shock absorbers to axle tubes.

(6) Install propeller shaft. Align reference marks made during removal.

(7) Bleed and adjust brakes. Refer to Chapter 2G.

(8) Install brake drums and wheels.

(9) Remove supports and lower vehicle.

(10) Check axle lubricant level and add lubricant as necessary.

SPECIFICATIONS

Rear Axle Specifications

Axle Type:	
Model 60	Drive-type, full-floating axle with flange-type axle.
AMC/Jeep	Drive-type, semi-floating axle with tapered axle shaft.
Axle Application:	
Model 60 Rear Axle	J-20 Truck
AMC/Jeep Rear Axle	CJ, Cherokee, Wagoneer and J-10 Truck
Axle Ring Gear Diameter:	
Model 60	9.750-inches (24.38 cm)
AMC/Jeep	8.875-inches (22.19 cm)
Rear Axle Lubricants:	Jeep Axle Lubricant or equivalent of SAE 85W-90 A.P.I. Grade GL-5 quality, or axle lubricant grade MIL-L-2105 C
Lubricant Capacity:	
Model 60	6.0 Pints (2.84 liters)
AMC/Jeep	4.75 Pints (2.25 liters)

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Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (in-lbs)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Axle Hub-To-Shaft Nut (AMC-Jeep Axle)-CJ	205 min.	—	339 min.	—
Axle Housing Cover Bolts	20	15-25	27	20-34
Brake Support Plate Bolts:				
AMC/Jeep-Cherokee, Wagoneer and J-10 Truck	30	25-35	41	34-47
Model 60	50	45-55	68	61-75
AMC/Jeep	32	25-40	43	34-47
Pinion Nut:				
Model 60	260	250-270	353	339-366
AMC/Jeep	17-25 in-lbs	—	2-3	—
Shock Absorber Lower Stud Nut	45	35-50	61	47-68
Spring Clip U-Bolt Nut:				
9/16-18	100	85-105	136	115-142
1/2-20	55	45-65	75	61-88
Spring Shackle Bolt/Nuts:				
CJ	24	18-30	33	24-41
Cherokee-Wagoneer-Truck	100	80-120	136	115-163
Spring Pivot Bolts/Nuts (All)	100	80-120	136	115-163
Styled Wheel Hub Cap	32 in-lbs	24-40 in-lbs	4	3-5
Universal Joint Clamp Strap Bolts	16	15-19	22	20-26
Universal Joint Flange Bolts/Nuts	35	25-45	47	34-61
Wheel Retaining Nuts:				
Model 60	120	110-150	163	149-203
AMC/Jeep	80	65-90	108	88-108

All Torque values given in inch-pounds and Newton-meters with dry fits unless otherwise specified.

80325

STANDARD DIFFERENTIAL

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Differential Operation	2F-21
Differential Overhaul—AMC/Jeep Axle	2F-21
Differential Overhaul—Axle Models 30-44-60	2F-30
General	2F-21

GENERAL

CJ models use the Model 30 front axle and an AMC/Jeep rear axle which has tapered axle shafts.

Cherokee, Wagoneer, and J-10 Truck models use the Model 44F front axle and an AMC/Jeep rear axle with flanged axle shafts. Truck models rated at 6800 GVWR (3084 kg) and up use the Model 44F front axle and the Model 60 rear axle with full-floating axle shafts.

The AMC/Jeep rear axles are semi-floating type axles. Only the Model 60 is a full-floating type unit.

DIFFERENTIAL OPERATION

The differential gear system divides the torque between the axle shafts and allows them to rotate at different speeds when turning corners.

Each differential side gear is splined to an axle shaft. The pinion gears are mounted on a pinion mate shaft and are free to rotate on the shaft. The pinion gear is fitted in a bore in the differential case and is positioned at a right angle to the axle shafts.

In operation, power flow occurs as follows: The pinion gear rotates the ring gear. The ring gear, which is bolted to the differential case, rotates the case. The differential pinion gears, which are mounted on the pinion mate shaft, which is fitted in the case, rotate the side gears. The side gears, which are splined to the axle shafts, rotate the shafts.

During straight-ahead driving, the differential pinion gears do not rotate on the pinion mate shaft. This occurs because input torque applied to the gears is divided and distributed equally between the two side gears. As a result, the pinion gears revolve with the pinion mate shaft but do not rotate around it (fig. 2F-29).

When turning corners, the outside wheel must travel a greater distance than the inside wheel in order to complete the turn. This difference must be compensated for in order to prevent the wheels from scuffing and sliding through the turn. To accomplish this, the differential becomes effective allowing the axle shafts to rotate at unequal speeds (fig. 2F-30). In this instance, the input torque applied to the pinion gears is not divided equally. The pinion gears now rotate around the pinion mate shaft in opposite directions. This allows the side gear and axle shaft attached to the outside wheel to rotate at a faster speed.

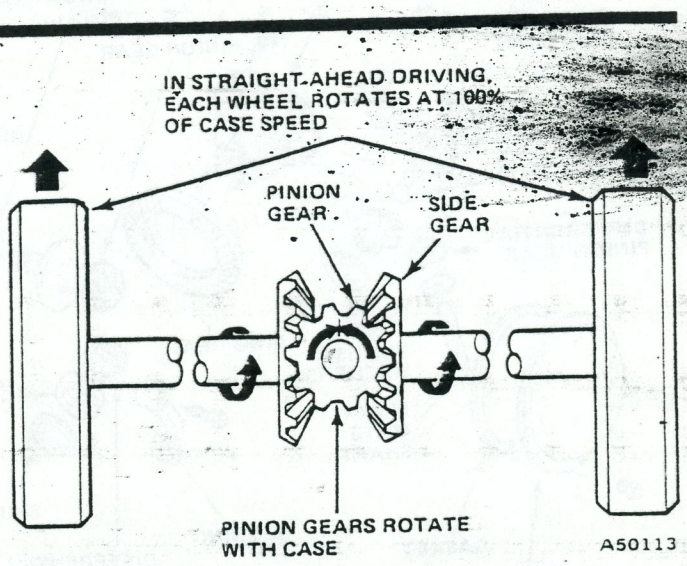

Fig. 2F-29 Differential Operation—Straight Ahead Driving

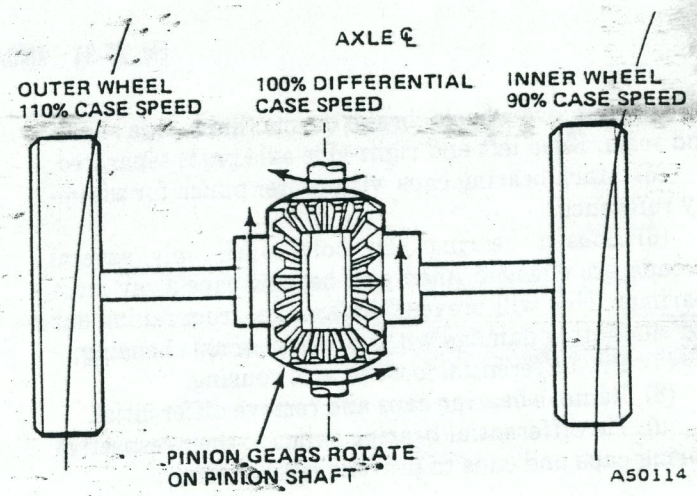

Fig. 2F-30 Differential Operation—On Turns

DIFFERENTIAL OVERHAUL—AMC/JEEP REAR AXLES

Differential Disassembly

NOTE: *It is not necessary to remove the rear axle assembly in order to overhaul the differential. Refer to figure 2F-31 for parts nomenclature during overhaul.*

(1) Remove axle shaft dust caps and retaining nuts.
(2) Raise and support vehicle.
(3) Remove axle housing cover and drain lubricant.

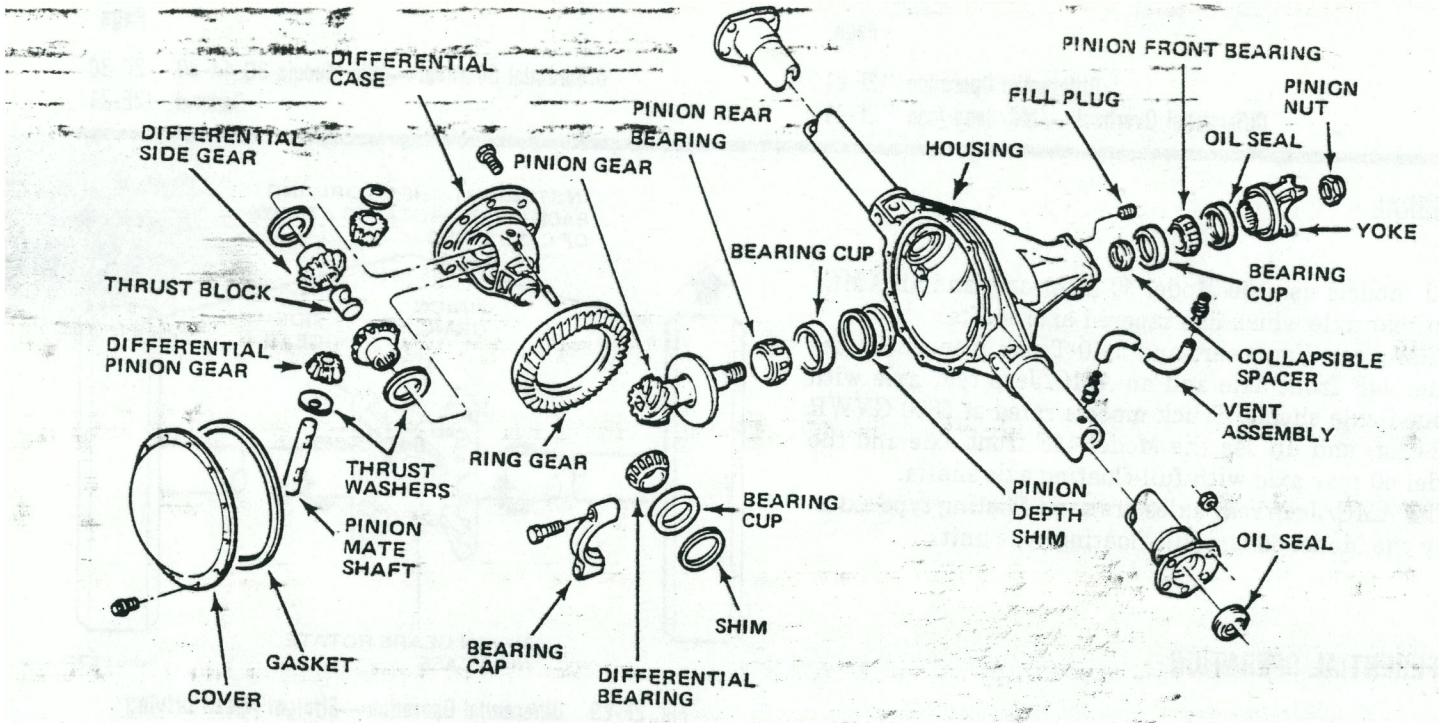

Fig. 2F-31 AMC/Jeep Rear Axle

(4) Remove wheels, brake drums, hubs, axle shafts, and seals. Keep left and right-side axle parts separated.

(5) Mark bearing caps with center punch for assembly reference.

(6) Loosen bearing cap bolts until only several threads are engaged, then pull bearing caps away from bearings. This will prevent differential from falling out and sustaining damage when pried from axle housing.

(7) Pry differential loose in axle housing.

(8) Remove bearing caps and remove differential.

(9) Tie differential bearing shims to their respective bearing caps and cups to prevent misplacement.

Differential Bearing Removal

Use Puller J-2497-01 to remove the differential bearings (fig. 2F-32). When using this tool, be sure the puller legs do not contact the bearing roller cage. If the puller legs contact the cage, the cage will be damaged.

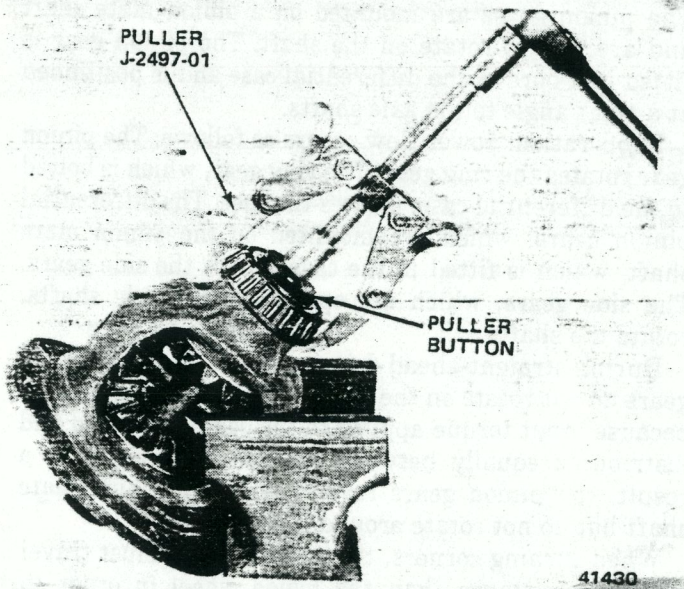

Fig. 2F-32 Differential Bearing Removal

Ring Gear Removal

(1) Remove ring gear-to-differential case bolts.

(2) Remove ring gear from case. Use brass drift and hammer to tap ring gear from case. Do not nick ring gear face of differential case or drop gear.

CAUTION: *Do not chisel or wedge the gear from the case.*

Pinion Mate Shaft Removal

(1) Remove pinion mate shaft lockpin using 3/16-inch (5 mm) diameter drift at least 3 inches (8 cm) long (fig. 2F-33).

(2) Remove pinion mate shaft and remove thrust block (fig. 2F-34).

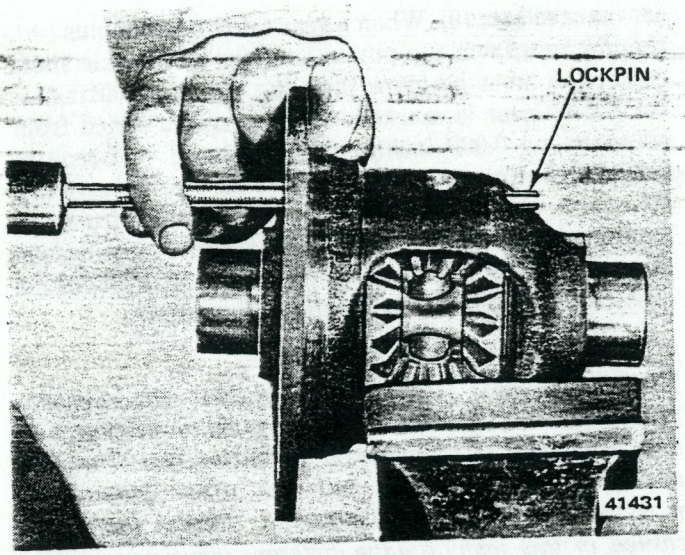

Fig. 2F-33 Pinion Mate Shaft Lockpin Removal

Fig. 2F-34 Pinion Mate Shaft and Thrust Block Removal

(3) Rotate pinion gears on side gears until pinion gears are aligned with case opening. Remove pinion gears and thrust washers and remove side gears and thrust washers.

Pinon Gear Removal

(1) Remove pinion nut using Tool J-8614-01 (fig. 2F-3).

(2) Remove yoke using Tools J-8614-01, -02, -03 (fig. 2F-4).

(3) Reinstall axle housing cover to prevent pinion gear from falling out when gear is driven out of bearings and housing. Loosely attach cover using two bolts.

(4) Remove pinion seal.

(5) Tap end of pinion gear with rawhide mallet to drive pinion gear out of front bearing. Remove front bearing and collapsible spacer. Discard spacer.

CAUTION: *The collapsible spacer is used to control pinion bearing preload. Discard this spacer after removal, it is not reusable.*

(6) Remove axle housing cover and remove pinion gear and rear bearing from housing.

Pinion Bearing Cup Removal

(1) Remove rear bearing cup using Tools J-8092 and J-21786.

NOTE: *The pinion gear depth adjustment shims are located under the rear bearing cup. Tag these shims for assembly reference.*

(2) Remove front bearing cup using Tools J-8092 and J-21787.

CAUTION: *Keep the bearing cup remover tool seated squarely on the cup to prevent damaging the cup bores during removal.*

Cleaning and Inspection

Clean all parts in solvent. Allow bearings to air dry. Dry other parts with compressed air.

Inspect the differential bearing cones, cups, and rollers for pitting, galling, flat spots, or cracks.

Inspect the differential case for an elongated or enlarged pinion mate shaft hole. The machined thrust washer surface areas and counterbores must be smooth and free of nicks, gouges, cracks, or burrs. Inspect the differential case for cracks or other visible damage which would necessitate replacement.

Inspect the pinion mate shaft for excessive wear in the contact area of the differential pinions. The shaft should be smooth and concentric and not scored or galled.

Inspect the differential side gears and pinions; they should have smooth teeth with a uniform contact pattern but not display excessive wear or broken surfaces. The side gear and pinion thrust washers should be smooth and free from any scoring or metal pickup.

Inspect the pinion mate shaft lockpin for damage or looseness in the case. Replace the pin or case as necessary.

Inspect the ring and pinion gears for worn or chipped teeth or damaged attaching bolt threads. If replacement is necessary, replace the ring gear and pinion as a matched set only.

Inspect the pinion bearing cones, cups, and rollers for pitting, galling, excessive wear, or other visible damage. Replace any part that exhibits any of these conditions.

Inspect the axle housing for cracks, porosity, bent or loose tubes, or other damage. In addition, if raised metal was created on the pinion bearing cup bore shoulders during cup removal, flatten it using a blunt punch.

Inspect the pinion gear for damaged bearing journals, damaged shim surfaces, or excessively worn splines. If pinion replacement is necessary, replace both the pinion gear and ring gear as a matched set only.

Inspect the pinion yoke for cracks, worn splines, and a pitted, rough, or corroded oil seal contact surface. Repair or replace the yoke as necessary.

Inspect the pinion gear depth adjustment shims for being broken, damaged, or distorted. Replace the shims as necessary before adjusting pinion gear depth.

Differential Assembly

Pinion Gear Installation and Depth Adjustment

Pinion gear depth is the distance (measured in inches) from the end (button) face of the pinion gear to the centerline of the axle shafts (fig. 2F-35). This dimension is controlled by shims installed between the pinion gear rear bearing cup and axle housing (fig. 2F-35).

Ring and pinion sets are factory tested to detect machining variances. Tests are started at a standard setting which is then varied to obtain the most desirable tooth contact pattern and quiet operation. When this setting is determined, the ring and pinion gear are etched with identifying numbers (fig. 2F-36).

The ring gear receives one number. The pinion gear receives two numbers which are separated by a plus (+) or minus (-) sign.

The second number on the pinion gear indicates pinion position, in relation to the centerline of the axle shafts, where tooth contact was best and gear operation was quietest. This number represents pinion depth variance and indicates the amount, in thousandths of an inch, that the gear set varied from the standard setting. The number on the ring gear and first number on the pinion gear identify the gears as a matched set. Do not attempt to use a ring and pinion set having differing numbers. This is not a matched set.

The standard setting for AMC/Jeep axles is 2.547 inches (6.46 cm). If the pinion is marked +2, the gear set varied from standard by +0.002 inches (0.05 mm) and will require 0.002 inch (0.05 mm) less shims than a gear set marked zero (0). When a gear set is marked plus (+), the distance from the pinion end face to the axle shaft centerline must be more than the standard setting. If the pinion gear is marked -3, the gear set varied from standard by 0.003 inches (0.07 mm) and will require 0.003 (0.07 mm) more shims than a set marked zero (0). When a set is marked minus (-), the distance from the pinion end face to the axle shaft centerline must be less than the standard setting. Refer to figure 2F-35 for an illustration of the standard setting dimension.

NOTE: *On some factory installed gear sets, an additional 0.010 or 0.020 inches (0.25 or 0.50 mm) may have been machined off the pinion gear button face. This does not affect gear operation but does affect pinion gear marking and depth measurement. Pinion gears machined in this fashion have different identifying numbers. For example, if the pinion is marked +23, the number 2 indicates that 0.020 (0.50 mm) was removed from the pinion button face and the number 3 indicates that variance from the standard setting is +0.003 (0.07 mm). If the pinion is marked +16, the number 1 indicates that 0.010 (0.25 mm) was removed from the pinion button face and the number 6 indicates that variance from the standard setting is +0.006 (0.15 mm). Gear sets with additional amounts machined off the pinion button face are factory installed items exclusively. All service replacement gear sets will be machined to standard settings only. In addition, replacement gear sets marked + or -0.009 (0.22 mm) or more, or sets with mismatched identifying numbers must be returned to the parts distribution center. Do not attempt to install these gear sets.*

Pinion Variance Chart

This chart will help to determine the approximate "starter shim" thickness needed for initial pinion depth measurement. However, the chart will not provide the exact shim thickness required for final adjustment and must not be used as a substitute for an actual pinion depth measurement.

To use the chart, proceed as follows:

(a) Measure thickness of original pinion depth shim.

(b) Note pinion depth variance numbers marked on old and new pinion gears.

(c) Refer to Old and New Pinion Marking columns in chart. Chart box where old and new pinion depth variances intersect will provide approximate amount of change required to achieve desired starter shim thickness.

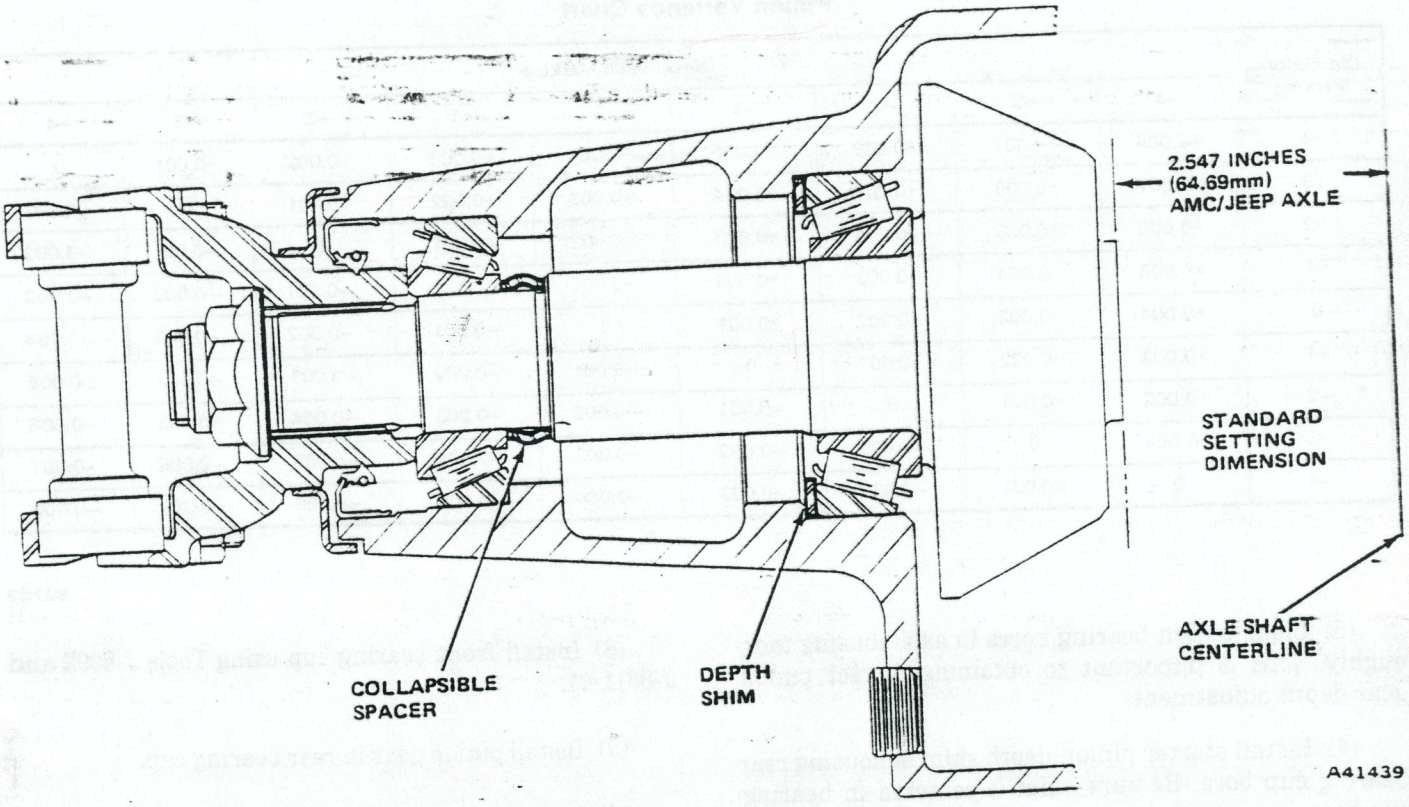

Fig. 2F-35 Standard Setting Dimension and Pinion Depth Shim Location—AMC/Jeep Axle

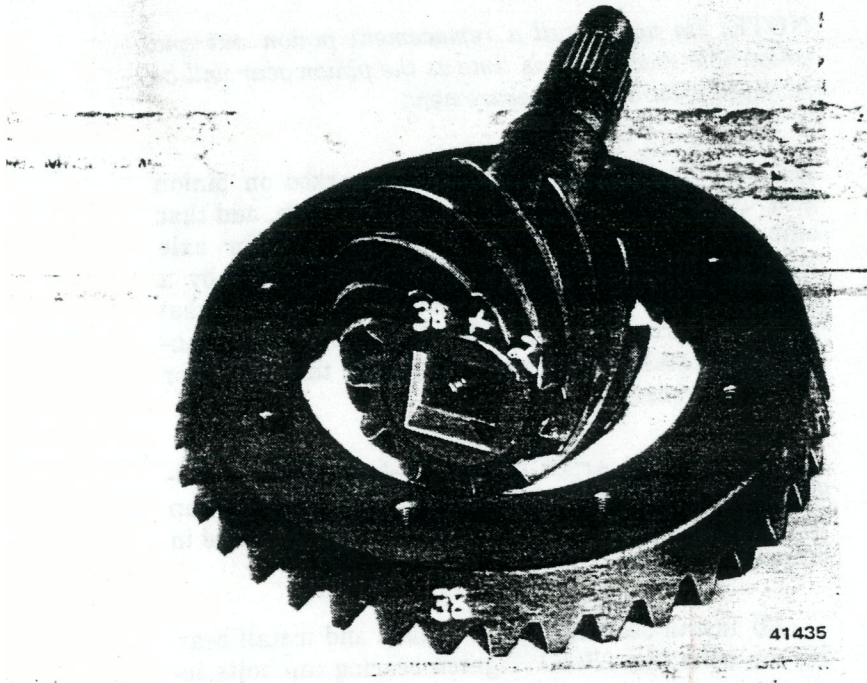

Fig. 2F-36 Ring and Pinion Gear Markings

For example, if the old pinion is marked -3 and the new pinion +2, chart procedure would be as follows: Refer to Old Pinion Marking column at left side of chart and locate -3 figure in this column. Then read to right, across chart, until under +2 figure in New Pinion Marking column. Box where two columns intersect is amount of shim thickness change required. In this case, the number in the intersecting box is -0.005 (0.12 mm) which represents the amount to be subtracted from the old shim thickness. If the box number had been a + figure, this amount would be added to the old shim thickness.

(1) Measure thickness of pinion depth shim removed during disassembly.

(2) Note pinion depth variance numbers marked on old and new pinion gears.

(3) Refer to Pinion Variance Chart and determine amount to be added or subtracted from original shim for desired starter shim thickness.

NOTE: *Do not use the starter shim thickness determined by the pinion variance chart as the final shim setting. The actual pinion depth measurement must be performed and final shim thickness adjusted as necessary.*

(4) Install rear bearing on pinion gear with large diameter of bearing cage facing gear end of pinion. Press bearing against rear face of gear.

Pinion Variance Chart

Old Pinion Marking	New Pinion Marking								
	−4	−3	−2	−1	0	+1	+2	+3	+4
+4	+0.008	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0
+3	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001
+2	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002
+1	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003
0	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004
−1	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005
−2	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006
−3	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006	−0.007
−4	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006	−0.007	−0.008

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(5) Clean pinion bearing bores in axle housing thoroughly. This is important to obtaining correct pinion gear depth adjustment.

(6) Install starter pinion depth shim in housing rear bearing cup bore. Be sure shim is centered in bearing cup bore.

NOTE: *If the shim is chamfered, be sure the chamfered side faces the bottom of the bearing cup bore.*

(7) Install rear bearing cup using Tools J-8092 and J-8608 (fig. 2F-37).

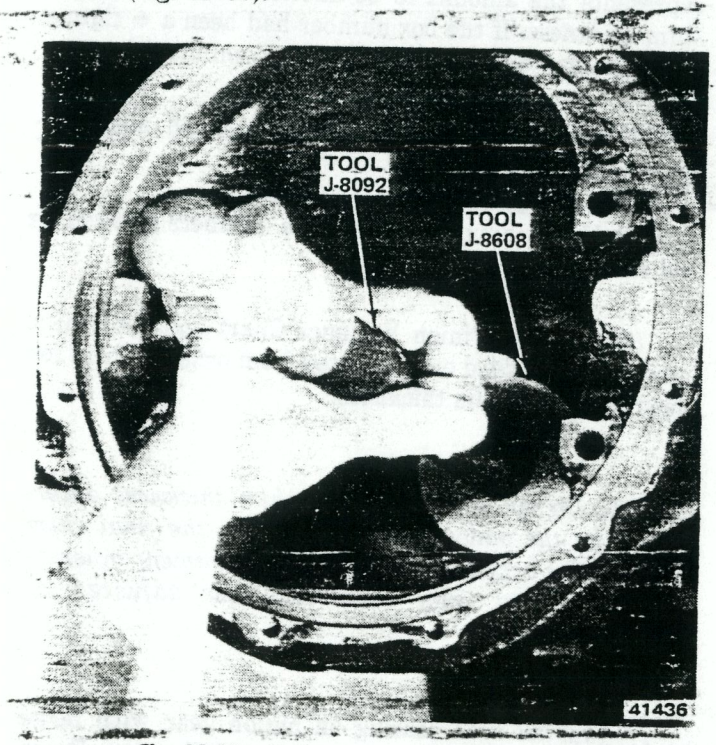

Fig. 2F-37 Pinion Rear Bearing Cup Installation

(8) Install front bearing cup using Tools J-8092 and J-8611-01.

(9) Install pinion gear in rear bearing cup.

(10) Install front bearing, rear universal joint yoke, and original pinion nut on pinion gear. **Tighten pinion nut only enough to remove bearing end play.**

NOTE: *Do not install a replacement pinion nut and collapsible spacer at this time as the pinion gear will be removed after depth measurement.*

(11) Note pinion depth variance marked on pinion gear. If number is preceded by a plus (+) sign, add that amount (in thousands) to standard setting for axle model being overhauled. If number is preceded by a minus (-) sign, subtract that amount (in thousandths) from standard setting. Result of this addition or subtraction is **desired pinion depth.** Record this figure for future reference.

(12) Assemble Arbor Tool J-5223-4 and Discs J-5223-23 and install assembled tools in differential bearing cup bores (fig. 2F-38). Be sure discs are completely seated in bearing cup bores.

(13) Install bearing caps over discs and install bearing cap bolts (fig. 2F-38). Tighten bearing cap bolts securely, but not to specified torque.

(14) Position Gauge Block J-5223-20 on end face of pinion gear with anvil end of gauge block seated on gear and gauge plunger underneath Arbor Tool J-5223-4 (fig. 2F-38).

(15) Assemble and mount Clamp J-5223-14 and Bolt J-5223-24 on axle housing (fig. 2F-38). Use axle housing cover bolt to attach clamp to housing.

(16) Extend clamp bolt until it presses against gauge block with enough force to prevent gauge block from moving.

(17) Loosen gauge block thumbscrew to release gauge block plunger. When plunger contacts arbor tool, tighten thumbscrew to lock plunger in position. Do not disturb plunger position.

(18) Remove clamp and bolt assembly from axle housing.

(19) Remove gauge block and measure distance from end of anvil to end of plunger using a 2 to 3 inch (5 to 8 cm) micrometer (fig. 2F-39). This dimension represents the **measured pinion depth.** Record this dimension for assembly reference.

(20) Remove bearing caps and remove arbor tool and discs from axle housing.

(21) Remove pinion gear, rear bearing cup, and pinion depth shim from axle housing.

(22) Measure thickness of depth shim used in step (10). Add this dimension to measured pinion depth obtained in step (8). From this total, subtract desired pinion depth. Result represents correct shim thickness required.

NOTE: *The desired pinion depth is the standard setting plus or minus the pinion depth variance.*

(23) Following examples will illustrate procedure for determining correct shim thickness.

Example I—Pinion Depth Variance is Plus (+)

Step 1—Determine desired pinion depth

Add pinion depth variance (marked on pinion gear) to standard setting. Result is desired pinion depth.

Standard Setting	2.547 (6.46 cm)
Pinion Depth Variance	+0.007 (0.17 mm)
Desired Pinion Depth =	2.554 (6.48 cm)

Step 2—Determine total measured pinion depth

Add measured pinion depth to measured shim thickness. Result is total measured pinion depth.

Measured Pinion Depth	2.550 (6.47 cm)
Starter Shim Thickness	+0.098 (2.48 mm)
Total Measured Pinion Depth =	2.648 (6.72 cm)

Step 3—Determine correct shim thickness

Subtract desired pinion depth from total measured pinion depth. Result is correct shim thickness.

Total Measured Pinion Depth	2.648 (6.72 cm)
Desired Pinion Depth	-2.554 (6.48 cm)
Correct Shim Thickness =	0.094 (2.38 mm)

Example II—Pinion Depth Variance is Minus (-)

Step 1—Obtain desired pinion depth

Subtract pinion depth variance (marked on pinion gear) from standard setting. Result is desired pinion depth.

Standard Setting	2.547 (6.46 cm)
Pinion Depth Variance	-0.003 (0.07 mm)
Desired Pinion Depth =	2.544 (6.46 cm)

Step 2—Determine total measured pinion depth

Add measured pinion depth to measured shim thickness. Result equals total measured pinion depth.

Measured Pinion Depth	2.542 (6.45 cm)
Starter Shim Thickness	+0.096 (2.43 mm)
Total Measured Pinion Depth =	2.638 (6.70 cm)

Step 3—Determine correct shim thickness

Subtract desired pinion depth from total measured pinion depth. Result is correct shim thickness.

Total Measured Pinion Depth	2.638 (6.70 cm)
Desired Pinion Depth	-2.544 (6.46 cm)
Correct Shim Thickness =	0.094 (2.38 mm)

Pinion Gear Bearing Preload Adjustment

(1) Install correct thickness pinion depth shim(s) in axle housing bearing cup bore.

(2) Install rear bearing cup and pinion gear.

(3) Install replacement collapsible spacer and front bearing on pinion gear.

CAUTION: *The collapsible spacer controls pinion bearing preload. Do not reuse the old spacer. Use a replacement spacer only.*

(4) Install pinion oil seal using tool J-22661 (fig. 2F-28).

(5) Install pinion yoke and replacement pinion nut. **Tighten pinion nut finger-tight only.**

(6) Tighten pinion nut **only enough to remove end play and seat pinion bearings.** Use tool J-22575 to tighten nut and use tool J-8614-01 to hold yoke while tightening nut. Rotate pinion while tightening nut to seat bearings evenly.

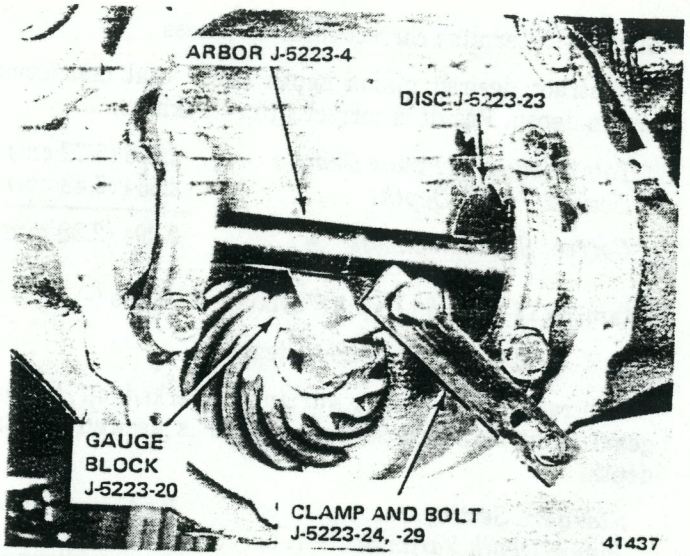

Fig. 2F-38 Installing Pinion Depth Gauge Tools

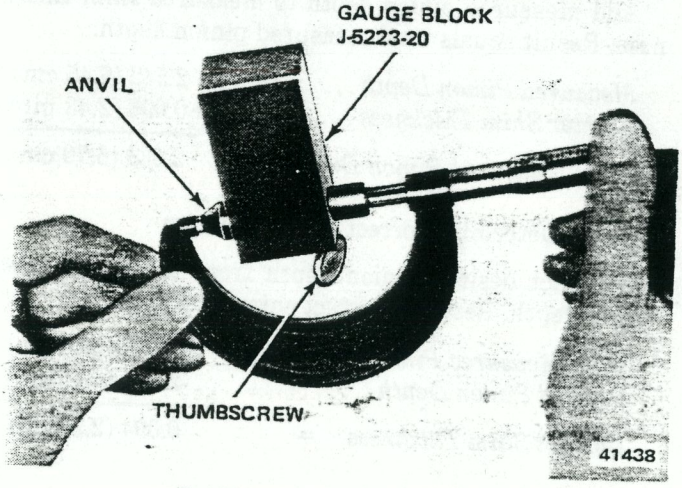

Fig. 2F-39 Measuring Gauge Block

(7) Remove Tools J-8614-01 and J-22575.

(8) Measure torque required to turn pinion gear using an inch-pound torque wrench and Tool J-22575. Correct pinion bearing preload torque is 17 to 25 inch-pounds (2 to 3 N•m) torque. Continue tightening pinion nut until required preload torque is obtained.

CAUTION: *Do not exceed the specified preload torque and do not loosen the nut to reduce preload torque if the specified torque is exceeded.*

(9) If pinion bearing preload torque is exceeded, remove pinion gear, replace collapsible spacer and pinion nut, and adjust preload again.

Differential Case Assembly

(1) Install differential bearings on case using Tools J-21784 and J-8092 (fig. 2F-40).

(2) Install thrust washers on differential side gears and install gears in differential case.

(3) Install differential pinion gears in case. Install thrust washers behind pinion gears and align pinion gear bores.

(4) Rotate differential side and pinion gears until pinion mate shaft bores in pinion gears are aligned with shaft bores in case.

(5) Install thrust block in case. Insert block through side gear bore. Align bore in block with pinion mate shaft bores in pinion gears and case.

(6) Install pinion mate shaft. Align lockpin bore in shaft with bore in case and install shaft lockpin.

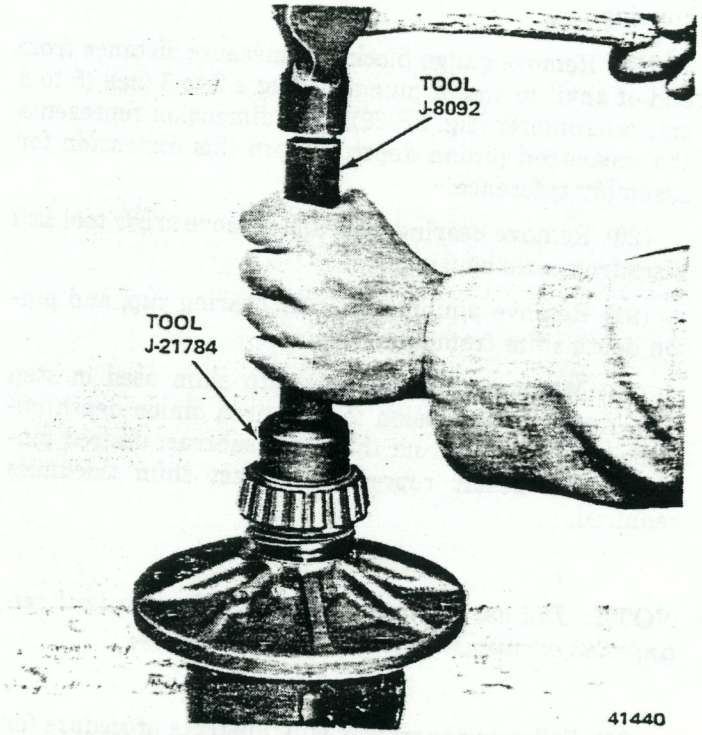

Fig. 2F-40 Differential Bearing Installation

Differential Bearing Adjustment

(1) Place bearing cup over each differential bearing and install differential case assembly in axle housing.

(2) Install shim on each side between bearing cup and housing. Use 0.080 inch (2 mm) shims as starting point (fig. 2F-41).

(3) Install bearing caps and tighten bolts finger-tight. Mount Dial Indicator J-8001 on housing (fig. 2F-42).

(4) Using two screwdrivers, pry between shims and housing. Pry assembly to one side and zero indicator then pry assembly to opposite side and read indicator.

NOTE: *Do not zero or read indicator while prying.*

(5) Amount read on indicator is shim thickness that should be added to arrive at zero preload and zero end play. Repeat procedure to ensure accuracy and adjust if necessary.

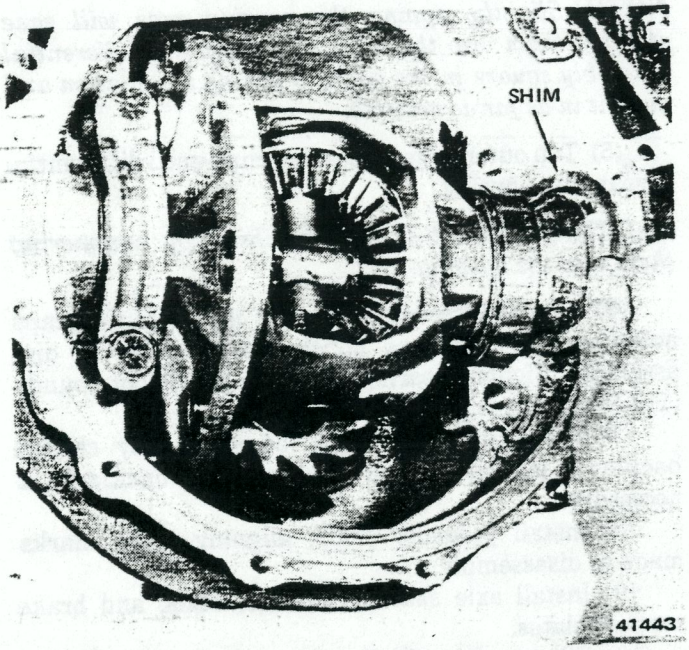

Fig. 2F-41 Adjusting Sideplay

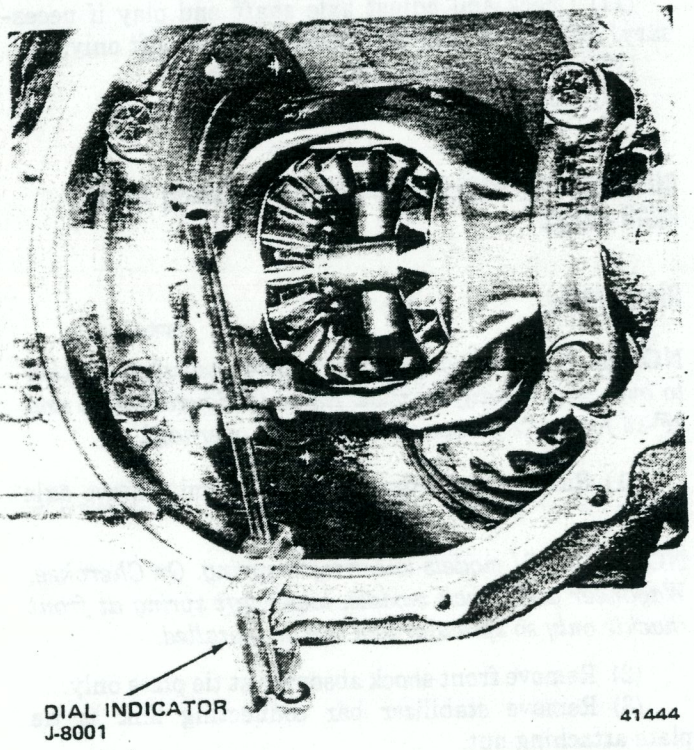

Fig. 2F-42 Checking Ring Gear Mounting Surface of Case for Runout

(6) Shims are available in thicknesses from 0.080 to 0.110 inch (0.25 mm) in 0.002 inch (0.05 mm) increments.

(7) When sideplay is eliminated, a slight bearing drag will be noticed. Install bearing caps and tighten bearing cap bolts to 87 foot-pounds (118 N•m) torque.

(8) Attach dial indicator to axle housing and check ring gear mounting face of differential case for runout (fig. 2F-42). Runout should not exceed 0.002 inch (0.05 mm).

(9) Remove case from housing. Retain shims used to adjust sideplay.

Ring Gear Installation

(1) Position ring gear on differential case.

(2) Install two ring gear bolts in opposite holes and tighten bolts to pull gear into position.

(3) Install remaining ring gear attaching bolts. Tighten bolts to 105 foot-pounds (142 N•m) torque.

Ring and Pinion Gear Backlash Adjustment

(1) Position shims previously selected to remove differential bearing sideplay on bearing cups and install differential assembly in axle housing.

(2) Install bearing cap bolts and tighten bolts to 87 foot-pounds (118 N•m) torque.

(3) Attach dial indicator to housing. Position indicator so indicator stylus contacts drive side of a ring gear tooth and at right angle to tooth (fig. 2F-43).

(4) Move ring gear back and forth and note movement registered on dial indicator. Ring gear backlash should be 0.005 to 0.009 inch (0.12 to 0.22 mm), with 0.008 inch (0.20 mm) desired.

(5) Adjust backlash as follows: to increase backlash, install thinner shim on ring gear side and thicker shim on opposite side. To decrease backlash, reverse procedure, however, do not change total thickness of shims. **Example:** Sideplay was removed using 0.090 inch (2.28 mm) shims on each side totaling 0.180 inch (4.57 mm).

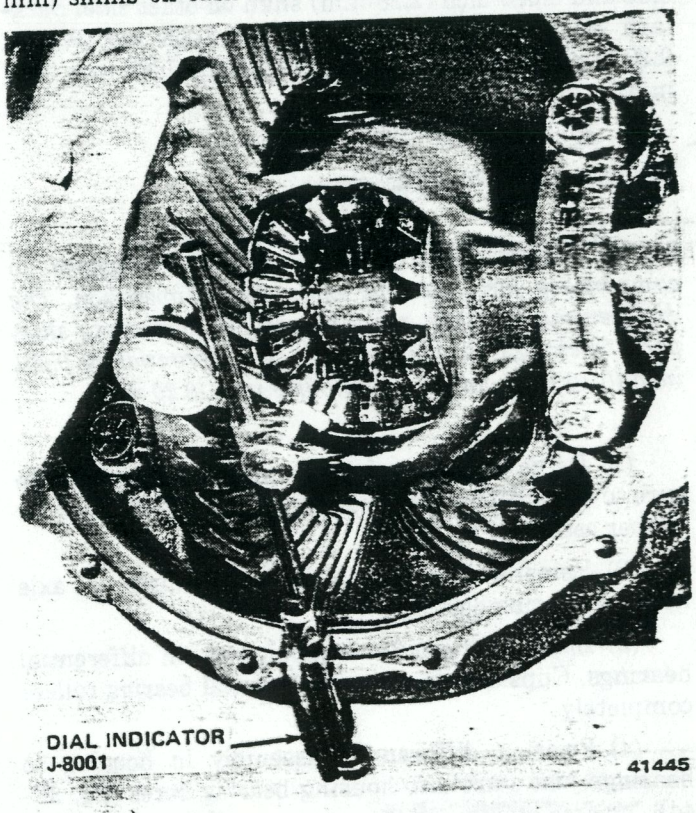

Fig. 2F-43 Checking Backlash

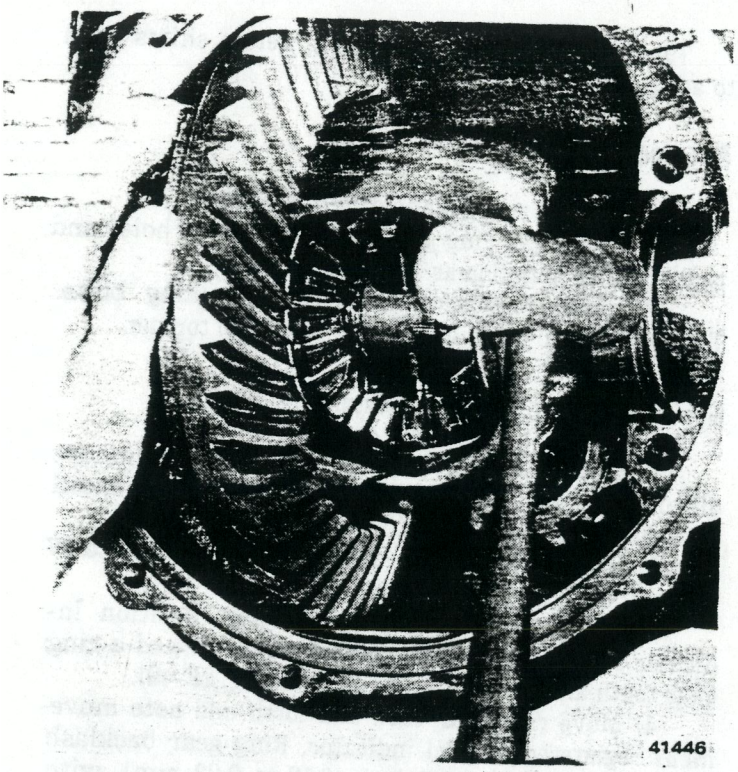

Fig. 2F-44 Differential Installation

Backlash is checked and found to be 0.011 inch (0.27 mm). To correct backlash, add 0.004 inch (0.10 mm) to shim on ring gear side and subtract 0.004 inch (0.10 mm) from shim on opposite side.

This will result in 0.094 inch (2.38 mm) shim on ring gear side and 0.086 inch (2.18 mm) shim on other side. Backlash will be approximately 0.007 to 0.008 inch (0.17 to 0.20 mm). Total shim thickness remains 0.180 inch (4.57 mm).

Differential Bearing Preload Adjustment

NOTE: *Differential bearings must be preloaded to compensate for heat and loads during operation. The differential bearings are preloaded by increasing shim pack thickness at each side of the differential by 0.004 inch (0.10 mm) for a total of 0.008 inch (0.20 mm).*

(1) Remove differential assembly from housing. Be sure to keep differential bearing shim packs together for proper assembly.

(2) Reinstall differential bearing shims in axle housing bearing bores.

(3) Install differential bearing cups on differential bearings. Cups should cover differential bearing rollers completely.

(4) Position differential assembly in housing so bearings just start into housing bearing bores (fig. 2F-44).

NOTE: *Slightly tipping the bearing cups will ease starting them into the bores. also keep the differential assembly square in the housing during installation and push it in as far as possible.*

(5) Tap outer edge of bearing cups until differential is seated in housing.

CAUTION: *Do not distort the shims by hammering them into the housing.*

(6) Install differential bearing caps. Position caps according to alignment punch marks made at disassembly. Tighten bearing cap bolts to 87 foot-pounds (118 N•m) torque.

(7) Preloading differential bearings may change backlash setting. Check and correct backlash if necessary.

(8) Install propeller shaft, aligning index marks made at disassembly.

(9) Install axle shafts, bearings, seals, and brake support plates.

(10) Fill rear axle with Jeep Axle lubricant or equivalent marked SAE 85W-90, grade API GL-5.

(11) Check and adjust axle shaft end play if necessary. Adjust end play at left side of axle shaft only.

(12) Install hubs, drums, and wheels.

(13) Lower vehicle.

DIFFERENTIAL OVERHAUL—MODEL 30-44-60 FRONT/REAR AXLES

Disassembly

NOTE: *It is not necessary to remove the axle assembly to overhaul the differential. Refer to figures 2F-45 and 2F-46 for parts nomenclature during overhaul.*

(1) Raise vehicle, drain lubricant and remove axle shafts.

NOTE: *On CJ models lower right spring. On Cherokee, Wagoneer and Truck models, lower left spring at front shackle only so spreader tool can be installed.*

(2) Remove front shock absorber at tie plate only.

(3) Remove stabilizer bar connecting link to tie plate attaching nut.

(4) Remove U-bolts and tie plate.

(5) Loosen nuts attaching rear spring shackle to spring.

(6) Support axle housing with jackstand.

(7) Remove bolts attaching spring shackle to spring and lower spring.

(8) Remove axle housing cover.

(9) Mark differential bearing caps for assembly alignment reference. Use centerpunch to mark caps.

(10) Loosen but do not remove differential bearing cap bolts.

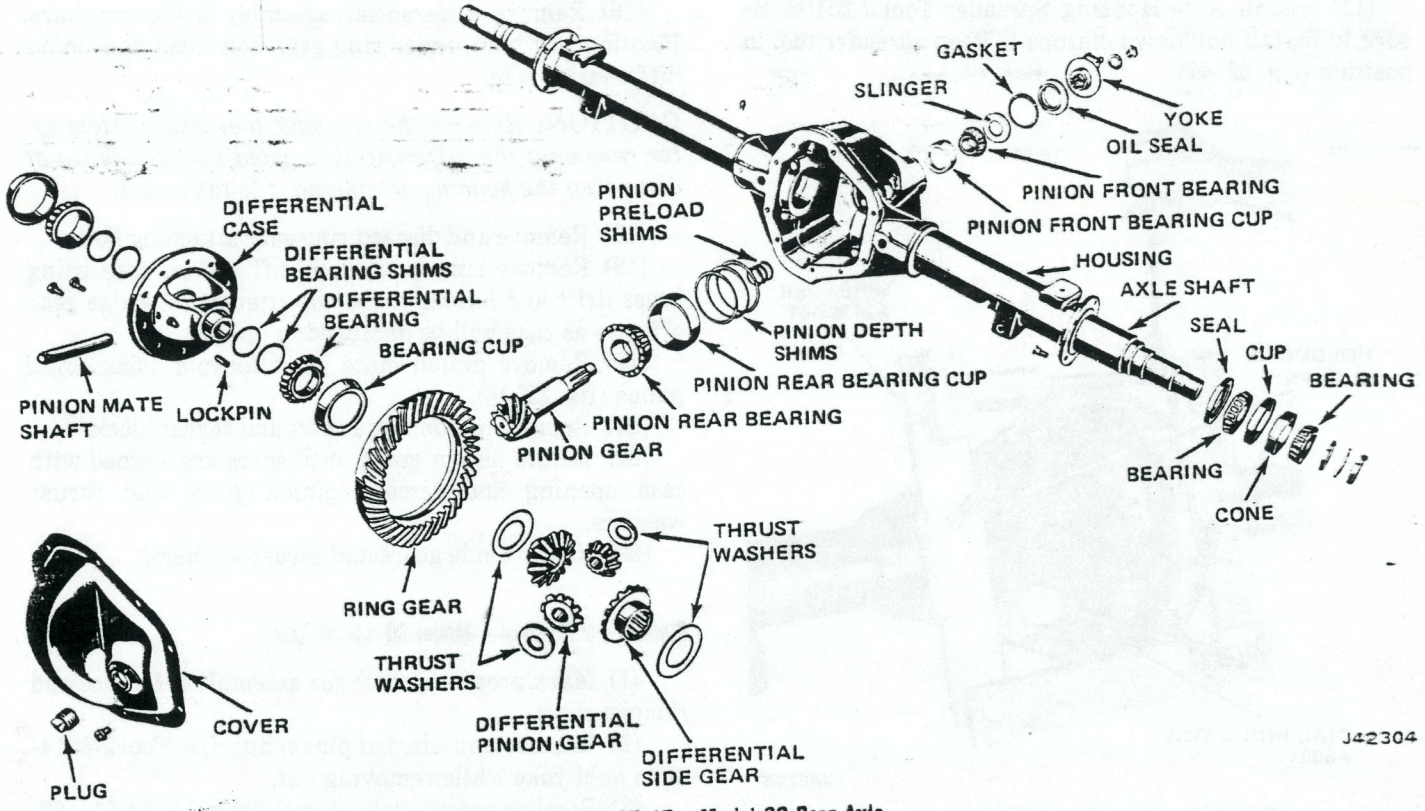

Fig. 2F-45 Model 60 Rear Axle

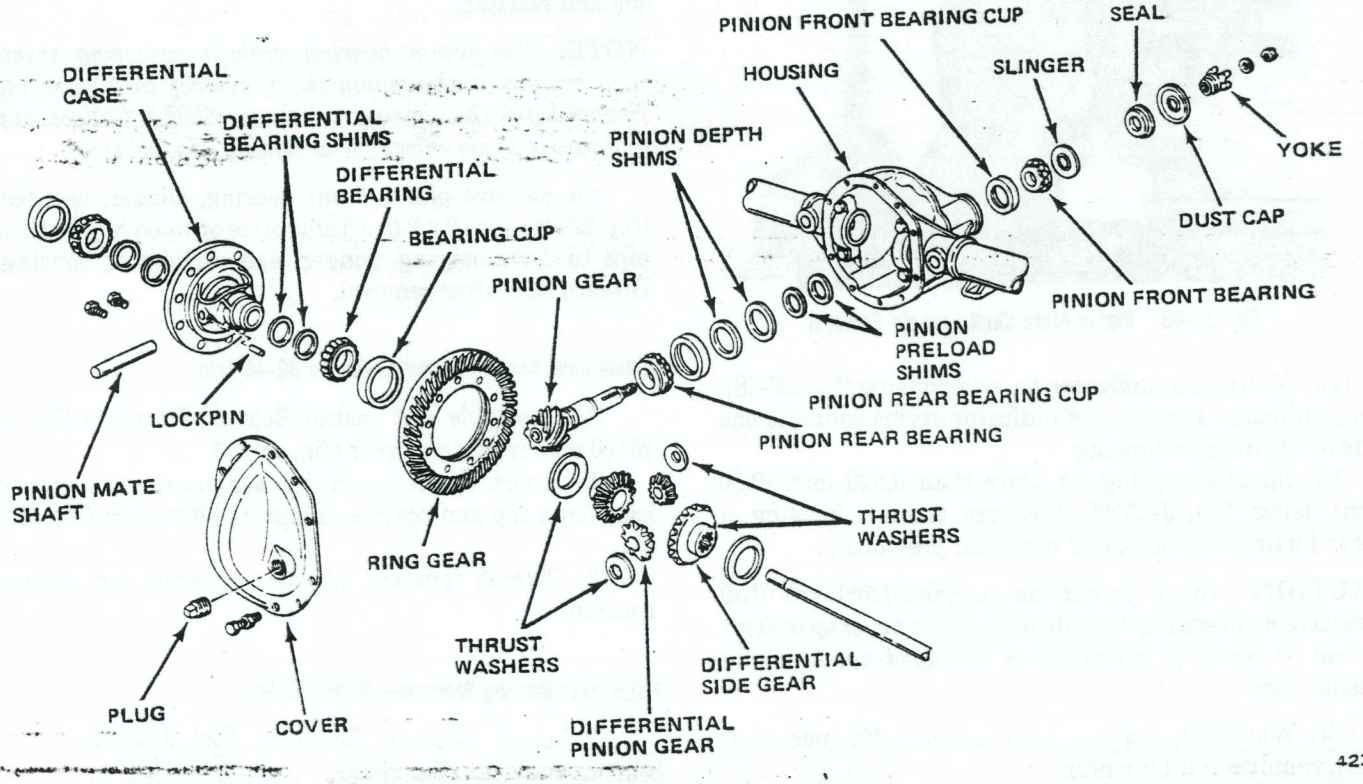

Fig. 2F-46 Model 44 Front Axle

(11) Install Axle Housing Spreader Tool J-25102. Be sure to install holddown clamps to keep spreader tool in position (fig. 2F-47).

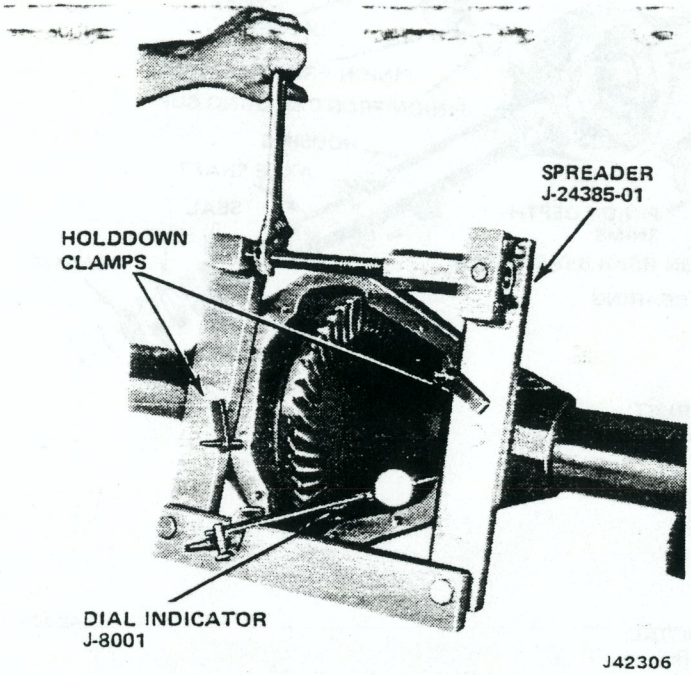

Fig. 2F-47 Spreading Axle Housing

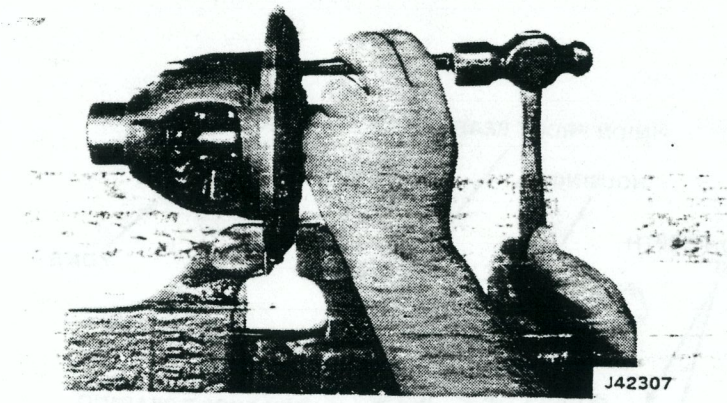

Fig. 2F-48 Pinion Mate Shaft Lockpin Removal

(12) Mount dial indicator on axle housing (fig. 2F-48). Zero indicator and be sure indicator stylus contacts one side of opening in housing.

(13) Spread housing no more than 0.020 inch (0.50 mm) using Tool J-25102. Measure amount housing is spread using dial indicator mounted previously.

CAUTION: *Do not exceed the specified 0.020 inch (0.50 mm) when spreading the housing. If the housing is overspread, it could be distorted or damaged necessitating replacement.*

(14) When housing has been spread 0.020 inch (0.50 mm), remove dial indicator.

(15) Remove differential bearing caps. Tag caps for assembly reference.

(16) Remove differential assembly using pry bars. Position pry bars under ring gear bolt head and under differential case.

CAUTION: *Remove the spreader tool immediately after removing the differential to avoid the possibility of distorting the housing or causing it to take a set.*

(17) Remove and discard ring gear attaching bolts.

(18) Remove ring gear from differential case using brass drift and hammer. Do not attempt to wedge gear off case as case will be damaged in process.

(19) Remove pinion mate shaft lockpin using small punch (fig. 2F-48).

(20) Remove pinion mate shaft and thrust block.

(21) Rotate pinion gears until gears are aligned with case opening and remove pinion gears and thrust washers.

(22) Remove side gears and thrust washers.

Pinion Gear Removal—Model 30-44-60 Axle

(1) Mark propeller shaft for assembly reference and remove shaft.

(2) Remove and discard pinion nut. Use Tool J-8614-01 to hold yoke while removing nut.

(3) Remove pinion yoke using Tools J-8614-01, -02, and -03 (fig. 2F-4).

(4) Remove dust cap from pinion gear.

(5) Remove pinion gear. Strike end of gear using rawhide hammer to force pinion out of pinion rear bearing and housing.

NOTE: *The pinion bearing preload adjusting shims may remain on the pinion shaft, or stick to the bearing remaining in the housing, or it may fall out. Collect, tag, and retain these shims for assembly (fig. 2F-46).*

(6) Remove pinion front bearing, slinger, and seal (fig. 2F-46). Use 2 x 2 (5 x 5 cm) piece of wood or length of pipe to drive bearing, slinger, and seal out of housing. Discard seal after removal.

Pinion Rear Bearing Removal—Model 30-44 Axle

(1) Assemble and install Bearing Remover Set J-25100 on bearing and gear (fig. 2F-49).

(2) Insert bearing remover adaptors into remover base from top and position adapters 180° apart (fig. 2F-49).

(3) Tighten remover tool forcing screw and remove bearing.

Pinion Rear Bearing Removal—Model 60 Axle

(1) Install Bearing Remover Tool J-22912-01 on bearing and gear (fig. 2F-50).

(2) Position chamfered edges of remover tool between bearing inner race and pinion head.

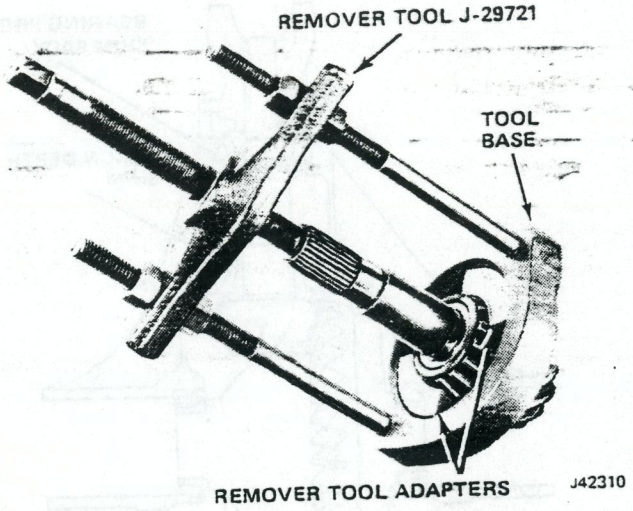

Fig. 2F-49 Pinion Rear Bearing Removal—Model 30-44 Axle

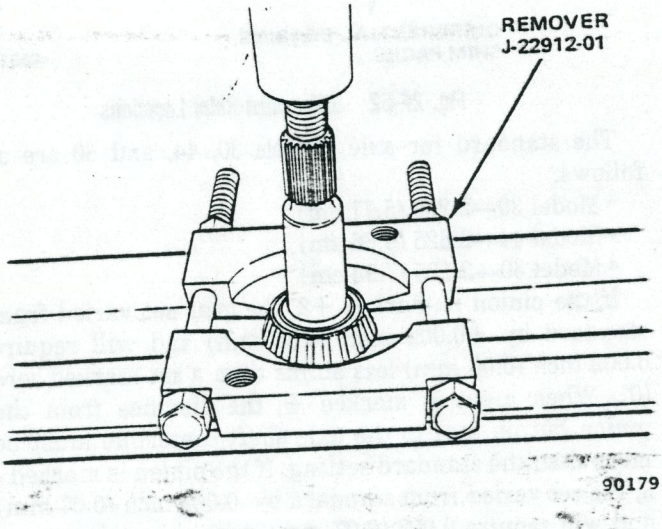

Fig. 2F-50 Pinion Rear Bearing Removal—Model 60 Axle

(3) Tighten remover tool bolts until chamfered edges of tool are well under bearing race.

(4) Position pinion gear and remover tool in arbor press and press pinion out of bearing.

Differential Bearing Removal—Model 30-44 Axle

(1) Assemble and install Bearing Remover Set J-25100 on bearing and case. Remover tools are positioned in manner similar to pinion bearing removal. Refer to figure 2F-49 for tool setup.

(2) Install two bearing adapters in remover tool base. Insert adapters into one side of tool base from top and reposition adapters 180° apart (fig. 2F-49).

(3) Install remover tool button in differential case and center remover tool forcing screw in button.

(4) Tighten remover tool forcing screw and remove bearing.

(5) Repeat operations to remove opposite bearing.

Differential Bearing Removal—Model 60 Axle

(1) Install Bearing Remover Tool J-22912-01 on case and bearing (fig. 2F-51).

(2) Position chamfered edges of remover tool between bearing inner race and case.

(3) Tighten remover tool bolts until chamfered edges of tool are well under bearing race.

(4) Install puller button in case bore.

(5) Install Puller J-22888 on Remover Tool J-22912-01 and center puller forcing screw in puller button (fig. 2F-51).

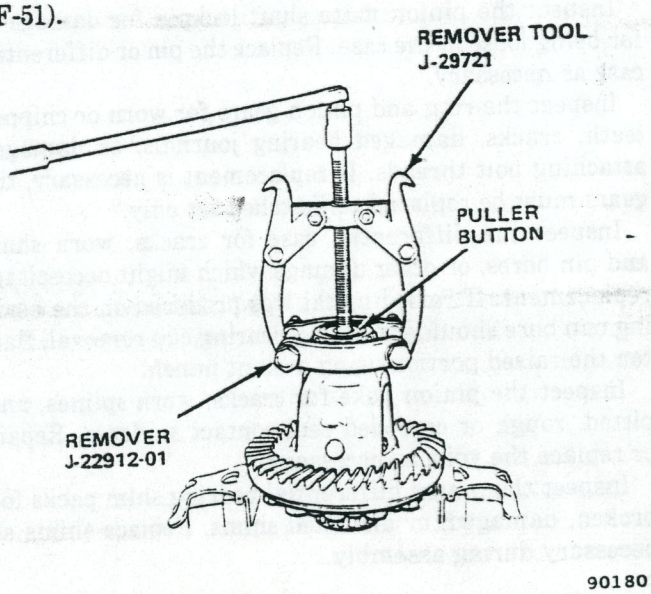

Fig. 2F-51 Differential Bearing Removal—Model 60 Axle

(6) Tighten puller forcing screw and remove bearing.

(7) Repeat operations to remove opposite bearing.

Pinion Bearing Cup Removal—Model 30-44-60 Axle

(1) Remove pinion rear bearing cup. Use brass drift and hammer to tap cup out of housing.

(2) Remove pinion depth shims from rear bearing cup bore in housing. Retain shims for assembly reference even if bent or distorted.

(3) Remove pinion front bearing cup. Use brass drift and hammer to tap cup out of housing.

Cleaning and Inspection

Clean all parts in solvent. Allow bearings to air dry. Dry other parts with compressed air.

Inspect all bearings and cups for pitting, galling, flat spots, or cracks. Replace any bearing or cup that exhibits any of these conditions.

Inspect the differential case for an elongated, or enlarged pinion mate shaft bore. The machined thrust washer surface areas and counterbores must be smooth and free of nicks, gouges, cracks, or burrs. Inspect the case for cracks or other visible damage. Replace the case if it exhibits any of these conditions.

Inspect the pinion mate shaft for excessive wear, scoring, or galling. The shaft must be smooth and concentric. Replace the shaft if worn or damaged.

Inspect the side gears and pinion gears. All gear teeth must display a uniform contact pattern. Inspect the gears and gear teeth for cracks, scoring, excessive wear, or galling. Replace all the gears if any gear exhibits these conditions. Inspect the side gear and pinion gear thrust washers for wear, scoring, galling, or distortion. Replace the washers if they exhibit any of these conditions.

Inspect the pinion mate shaft lockpin for damage or for being loose in the case. Replace the pin or differential case as necessary.

Inspect the ring and pinion gears for worn or chipped teeth, cracks, damaged bearing journals, or damaged attaching bolt threads. If replacement is necessary, the gears must be replaced as matched set only.

Inspect the differential case for cracks, worn shaft and pin bores, or other damage which might necessitate replacement. If raised metal was produced on the bearing cup bore shoulders during bearing cup removal, flatten the raised portion using a blunt punch.

Inspect the pinion yoke for cracks, worn splines, and pitted, rough or corroded seal contact surfaces. Repair or replace the yoke as necessary.

Inspect the pinion differential bearing shim packs for broken, damaged, or distorted shims. Replace shims as necessary during assembly.

Differential Assembly

Pinion Gear Installation and Depth Adjustment

Pinion gear depth is the distance, measured in inches, from the end face of the pinion gear to the axle shaft centerline (fig. 2F-35). This dimension is controlled by shims installed between the pinion rear bearing and axle housing (fig. 2F-52).

Ring and pinion gear sets are factory tested to detect machining variances. Tests are started at a standard setting which is then varied to obtain the most desirable tooth contact pattern and quietest operation. When this setting is determined, identifying numbers are etched on the the ring and pinion (fig. 2F-36).

The ring gear receives one number. The pinion gear receives two numbers which are separated by a + or - sign. The ring gear number and first number on the pinion gear identify the gears as a matched set. Do not attempt to use a set with differing numbers. This is not a matched set.

The second number on the pinion indicates pinion position in relation to the centerline of the axle shafts where tooth contact was best and operation quietest. This number represents pinion depth variance and is the amount, in thousandths of an inch, that the set varied from the standard setting.

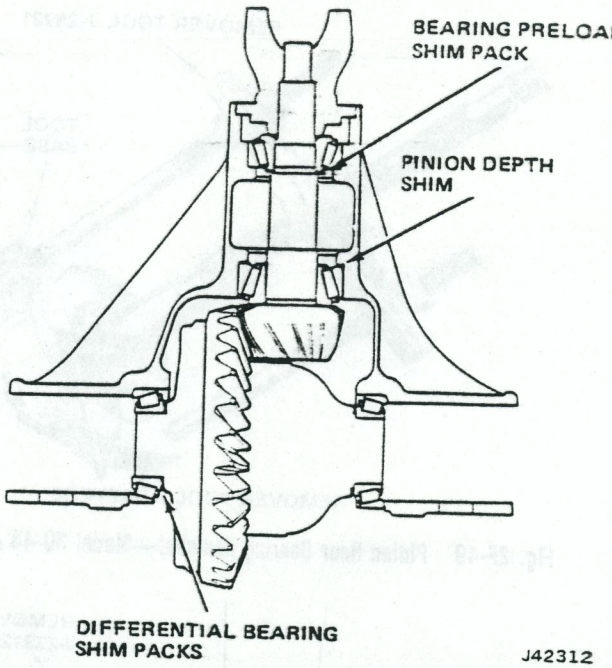

Fig. 2F-52 Differential Shim Locations

The standard for axle Models 30, 44, and 60 are as follows:

- Model 30—2.250 (5.71 cm)
- Model 44—2.625 (6.66 cm)
- Model 60—3.125 (7.93 cm)

If the pinion is marked +2, the gear set varied from standard by +0.002 inch (0.05 mm) and will require 0.002 inch (0.05 mm) less shims than a set marked zero (0). When a set is marked +, the distance from the pinion button face to the axle shaft centerline must be more than the standard setting. If the pinion is marked -3, the set varied from standard by -0.003 inch (0.07 mm) and will require 0.003 (0.07 mm) more shims than a set marked zero. When a set is marked zero, the distance from the pinion button face to the axle shaft centerline must be less than the standard setting. Refer to figure 2F-35 for an illustration of the standard setting dimension.

Pinion Variance Chart

This chart will help determine the approximate starter shim thickness needed for initial pinion depth measurement. However, the chart will not provide the exact shim thickness required for final adjustment and must not be used as a substitute for an actual pinion depth measurement.

To use the chart, proceed as follows:

(a) Measure thickness of original pinion depth shim.

(b) Note pinion depth variance numbers marked on old and new pinion gears.

(c) Refer to Old and New Pinion Marking columns in chart. Chart box where old and new pinion depth columns intersect is approximate amount of

change required to obtain desired starter shim thickness.

For example, if the old pinion is marked -3 and the new pinion +2, chart procedure would be as follows: Refer to Old Pinion Marking column at left side of chart and locate -3 figure in this column. Then read to right, across chart, until under +2 figure in New Pinion Marking column. Box where the two columns intersect will provide amount of shim thickness required. In this case, the number in the intersecting box is -0.005 (0.12 mm) which represents the amount to be subtracted from the original shim thickness. If the box number had been a + figure, this amount would be added to the original shim thickness.

CAUTION: *Front axle differentials use an oil slinger between the pinion rear bearing and the pinion head (fig. 2F-1). This slinger must be installed in order to measure and adjust pinion depth correctly.*

(1) Measure thickness of pinion depth shim removed during disassembly.

(2) Note pinion depth variance numbers on old and new pinion gears.

(3) Refer to pinion variance chart and determine amount to be added to or subtracted from original shim to arrive at starter shim thickness.

CAUTION: *Do not use or assume that the starter shim thickness will be the final shim setting. An actual pinion depth measurement must be performed and the final shim thickness adjusted as necessary.*

(4) Install pinion front bearing cup in housing bore using Driver Handle J-7079-02 and Installer J-25101.

(5) Install starter shim in rear bearing bore of housing. Be sure shim is centered in cup bore. If shim is chamfered, chamfer must face toward housing bore—not toward pinion head.

(6) Install pinion rear bearing cup in housing bore. On Model 30 axles, install cup using Driver Handle J-7079-02 and Installer J-25101. On Model 44 and 60 axles, install cup using Driver Handle J-25122 and Installer J-25157.

(7) On front axle differentials, install oil slinger on pinion gear. Be sure slinger is seated on pinion head before installing rear bearing.

(8) Install rear bearing on pinion. On Model 30 axles install cup using Installer Sleeve J-5590 (fig. 2F-53). On Model 44 and 60 axles, install bearing using Installer Sleeve J-24433 (fig. 2F-53).

(9) Install pinion gear in axle housing.

(10) Install pinion front bearing, pinion yoke, washer, and original pinion nut on pinion. Tighten nut only enough to remove end play and provide 10 to 15 inch-pounds (1 to 2 N•m) of drag torque when pinion is rotated.

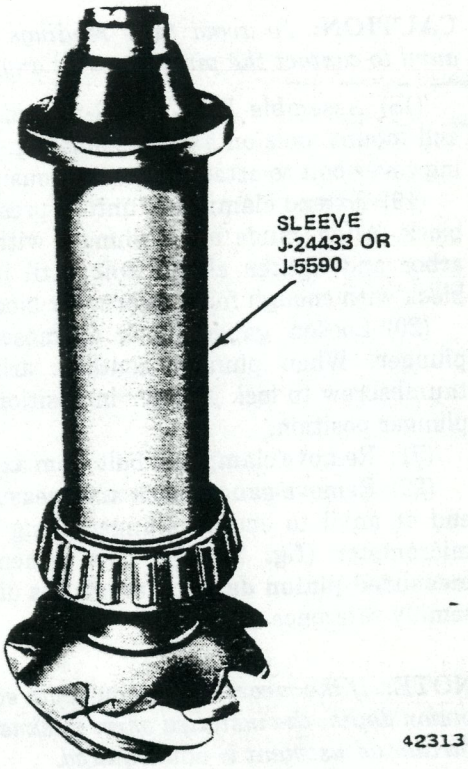

Fig. 2F-53 Pinion Bearing Installation

NOTE: *Do not install the pinion seal, slinger, or dust cap at this time. The pinion will be removed after measuring and adjusting pinion depth.*

(11) Note pinion depth variance marked on pinion gear. If number is preceded by a plus (+) sign, add that amount (in thousands or millimeters) to standard setting for axle model being overhauled. If number is preceded by a minus (-) sign, subtract that amount (in thousands or millimeters) from standard setting. Result of addition or subtraction is desired pinion depth. Record this figure for further reference.

NOTE: *If the gear is marked 0 (zero), use the standard setting.*

(12) Assemble Gauge Arbor J-5223-4 and Discs. On Model 30 axles, use Discs J-5223-26. On Model 44 and 60 axles, use Discs J-5223-25.

(13) Install assembled arbor and discs in differential bearing cup bores (fig. 2F-54). Be sure discs are firmly seated in bearing cup bores.

(14) Install differential bearing caps over discs and tighten cap bolts securely, but not to specified torque.

(15) Remove standard plunger from Gauge Block J-5223-20 and install Plunger J-5223-27.

(16) Compress plunger completely and tighten gauge block thumbscrew securely.

(17) Install Gauge Block J-5223-20. Position block so plunger is directly under Arbor J-5223-4 and flat surface on anvil side of block is seated on end face of pinion (fig. 2F-54).

CAUTION: *To avoid false readings, do not allow the anvil to contact the pinion gear at any point.*

(18) Assemble Bolt J-5223-29 and Clamp J-5223-24 and mount tools on axle housing (fig. 2F-54). Use housing cover bolt to attach clamp to housing.

(19) Extend clamp bolt until it presses against gauge block. Align gauge block plunger with center of gauge arbor and tighten clamp bolt until it presses against block with enough force to prevent block from moving.

(20) Loosen gauge block thumbscrew and release plunger. When plunger contacts arbor tool, tighten thumbscrew to lock plunger in position. Do not disturb plunger position.

(21) Remove clamp and bolt from axle housing.

(22) Remove gauge block and measure distance from end of anvil to end of plunger using 3-inch (7.62 cm) micrometer (fig. 2F-55). This dimension represents **measured pinion depth**. Record this dimemsion for assembly reference.

NOTE: *If the measured pinion depth equals the desired pinion depth, the installed shim thickness is correct and further adjustment is not required.*

(23) Remove bearing caps and remove arbor tool and discs.

(24) Remove pinion gear, rear bearing cup, and depth shim from axle housing.

(25) Measure thickness of depth shim just removed from housing and add this dimension to measured pinion depth obtained in previous step. From this total, subtract desired pinion depth. Result represents shim thickness required to adjust pinion depth.

NOTE: *The desired pinion depth is the standard setting plus or minus the pinion depth variance.*

(26) Following examples illustrate procedure for determining correct shim thickness.

Example I—Pinion Depth Variance is Plus (+) Model 44 Axle

Step 1—Determine desired pinion depth.

Add pinion depth variance (marked on pinion gear) to standard setting. Result is desired pinion depth.

Standard Setting	2.625 (66.6 mm)
Pinion Depth Variance	+0.004 (0.10 mm)
Desired Pinion Depth =	2.629 (66.7 mm)

Step 2—Determine total measured pinion depth.

Add measured pinion depth to measure shim thickness. Result is total measured pinion depth.

Measured Pinion Depth	2.601 (66.0 mm)
Starter Shim Thickness	+0.107 (2.71 mm)
Total Measured Pinion Depth =	2.708 (68.7 mm)

Step 3—Determine correct shim thickness.

Subtract desired pinion depth from total measured pinion depth. Result is correct shim thickness.

Total Measured Pinion Depth	2.708 (68.7 mm)
Desired Pinion Depth	-2.629 (66.7 mm)
Correct Shim Thickness =	0.079 (2.00 mm)

Example II—Pinion Depth Variance is Minus (-) Model 60 Axle

Step 1—Obtain desired pinion depth.

Subtract pinion depth variance (marked on pinion gear) from standard setting. Result is desired pinion depth.

Standard Setting	3.125 (79.3 mm)
Pinion Depth Variance	-0.002 (0.05 mm)
Desired Pinion Depth =	3.123 (79.35 mm)

Step 2—Determine total measured pinion depth.

Add measured pinion depth to measured shim thickness. Result equals total measured pinion depth.

Measured Pinion Depth	3.120 (79.2 mm)
Starter Shim Thickness	+0.100 (2.54 mm)
Total Measured Pinon Depth =	3.220 (81.7 mm)

Step 3—Determine correct shim thickness.

Subtract desired pinion depth from total measured pinion depth. Result is correct shim thickness.

Total Measured Pinion Depth	3.220 (81.7 mm)
Desired Pinion Depth	-3.123 (79.3 mm)
Correct Shim Thickness =	0.097 (2.46 mm)

(27) Remove pinion gear, rear bearing cup, and starter shim.

(28) Install correct thickness pinion depth shim in housing bearing cup bore and reinstall rear bearing cup.

Pinion Bearing Preload Adjustment

(1) Install pinion bearing preload shims.

(2) Install pinion gear, front bearing, oil slinger, if equipped, yoke, washer, and old pinion nut. Tighten nut to 260 foot-pounds (352 N•m) torque.

(3) Measure torque required to rotate pinion gear using 0-50 inch-pound torque wrench. Rotating torque should be 20-40 inch-pounds with new bearings, or 10-20 inch-pounds (1-2 N•m) with original bearings. Add shims to decrease preload or subtract shims to increase preload.

(4) Remove pinion nut, washer, and yoke when pinion bearing preload is adjusted.

(5) Install new pinion oil seal using Tool J-25104 on Model 30 and 44 axles, or Tool J-24384 on Model 60 axles.

(6) Install yoke and pinion washer.

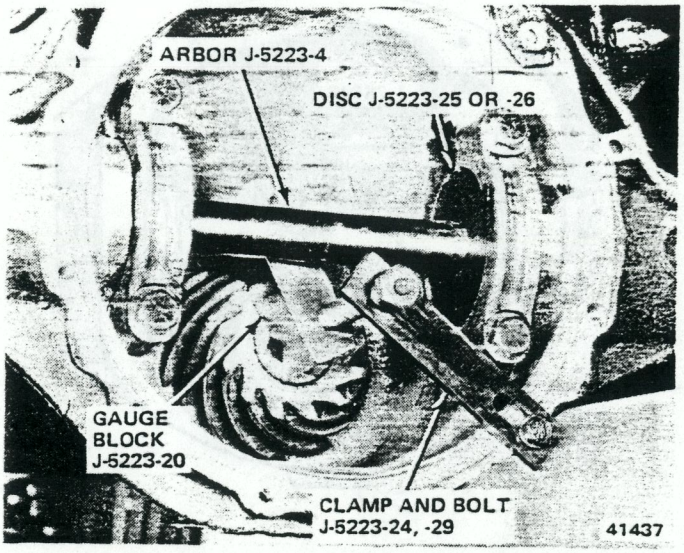

Fig. 2F-54 Installing Pinion Depth Gauge Tools

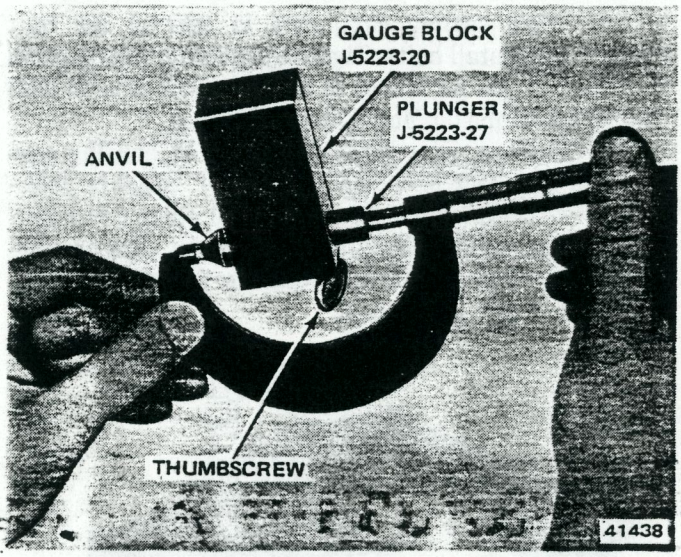

Fig. 2F-55 Measuring Gauge Block

(7) Install new pinion nut. Tighten nut to 210 foot-pounds (285 N•m) torque on Model 30 and 44 axles, and 260 foot-pounds (352 N•m) torque on Model 60 axles.

Differential Side Gear Adjustment

(1) Install thrust washers on side gears and install gears in case.

(2) Install thrust washers on differential pinion gears and install gears in case.

(3) Install thrust block and pinion mate shaft pin in case.

(4) Position differential case on end.

(5) Tap differential case lightly on flat surface to settle gears into position in case.

(6) Measure clearance between case and side gears using feeler gauges (fig. 2F-56). Clearance between gears and case must be 0.000 to 0.006 inch (0.00 to 0.15 mm).

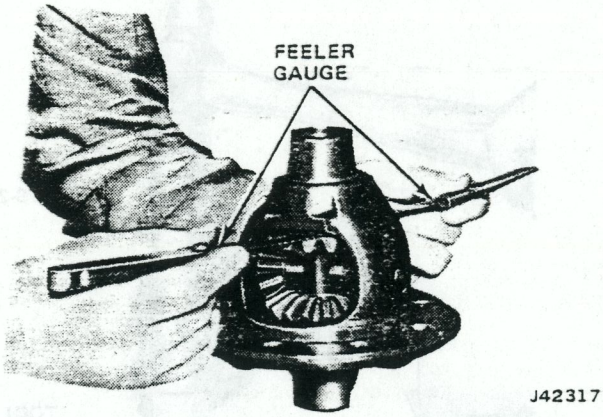

Fig. 2F-56 Checking Side Gear Clearance

(7) If clearance between gears and case exceeds 0.006 inch, replace complete differential case.

NOTE: *Shims are no longer available.*

(8) If differential case is replaced, check side gear clearance again.

(9) Install ring gear on differential case and start two bolts in holes 180 degrees apart. Tighten bolts evenly to seat ring gear.

(10) Install remaining bolts and tighten to 55 foot-pounds (74 N•m) torque.

Differential Bearing Preload and Ring Gear Backlash Adjustment

NOTE: *Differential bearing preload is controlled by shims located between the differential case and bearings.*

(1) Remove old differential bearing shims if not removed previously.

(2) Install differential bearings. On Model 30 and 44 axles, install bearings using Driver Handle J-7079-02 and Installer J-22175 (fig. 2F-57). On Model 60 axles, install bearings using Driver Handle and Installer J-24430.

(3) Install bearing cups on differential bearings.

(4) Install differential in axle housing.

(5) Install bearing caps and tighten cap bolts securely but not to specified torque.

(6) Hold ring gear in contact with pinion gear and pry differential bearing cups toward center of case using screwdriver.

(7) Insert various thickness feeler gauges between each bearing cup and axle housing until ring gear backlash is 0.001 to 0.002 inch (0.02 to 0.05 mm) with feeler gauges installed. Feeler gauges must be installed at both sides of differential and at same time to obtain accurate measurement.

(8) Assemble shim pack that will provide desired backlash. Check backlash again. If OK, tag and retain shims for assembly.

(9) Remove differential case.

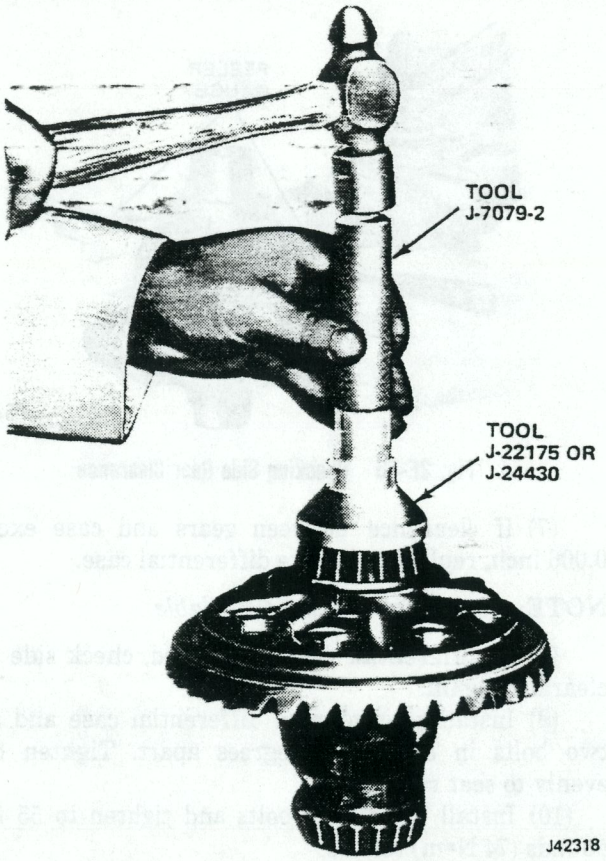

Fig. 2F-57 Differential Bearing Installation

(10) Add additional 0.015 inch (0.38 mm) thickness shim to shim pack to be installed on tooth side of ring gear.

(11) Remove differential bearings. Refer to removal procedures outlined in Differential Assembly.

(12) Install shim packs on appropriate sides of differential case and reinstall differential bearings. On Model 30 and 44 axles, install bearings using Tools J-7079-02 and J-22175. On Model 60 axles, install bearings using Tool J-24430 (fig. 2F-57).

NOTE: *When overhauling a front axle differential, check the axle housing inner oil seals. If seal replacement is required, install replacement seals using Tool J-28648 (fig. 2F-58).*

(13) Mount Spreader Tool J-25102 and Dial Indicator J-8001 on housing. Spread housing no more than 0.020 inch (0.50 mm) (fig 2F-47). Do not exceed 0.020 inch (0.50 mm) to avoid damaging housing.

(14) Remove dial indicator when housing has been spread desired amount.

(15) Lubricate differential bearings with axle lubricant and install differential bearing cups on bearings.

(16) Install differential in housing. Use rawhide mallet to seat differential. Be sure ring and pinion gear teeth mesh completely.

(17) Remove axle housing spreader tool.

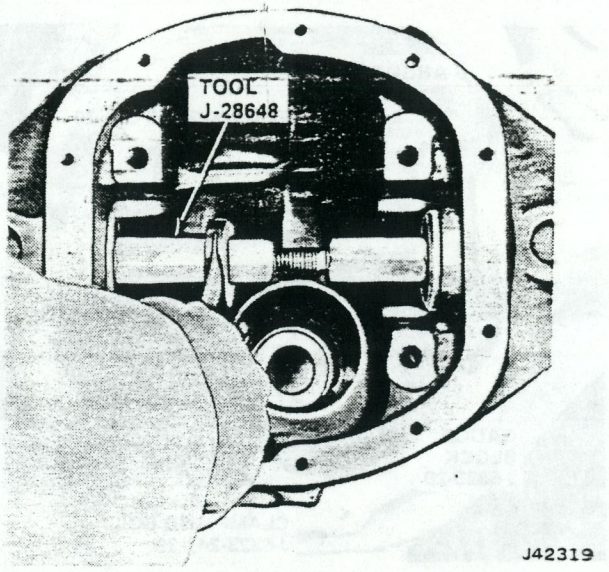

Fig. 2F-58 Front Axle Housing Inner Oil Seal Installation

(18) Apply sealing compound to bearing cap bolt threads and install bolts. Tighten bolts to 40 foot-pounds (54 N•m) torque on Model 30 axle, or to 80 foot-pounds (108 N•m) torque on Model 44 and 60 axles.

(19) Remount Dial Indicator J-8001 on housing and measure ring gear backlash (fig. 2F-59). Measure backlash at two points. Backlash should be 0.005 to 0.010 inch (0.12 to 0.25 mm). If backlash is incorrect, add or subtract shims from differential bearing shim packs until correct backlash is obtained.

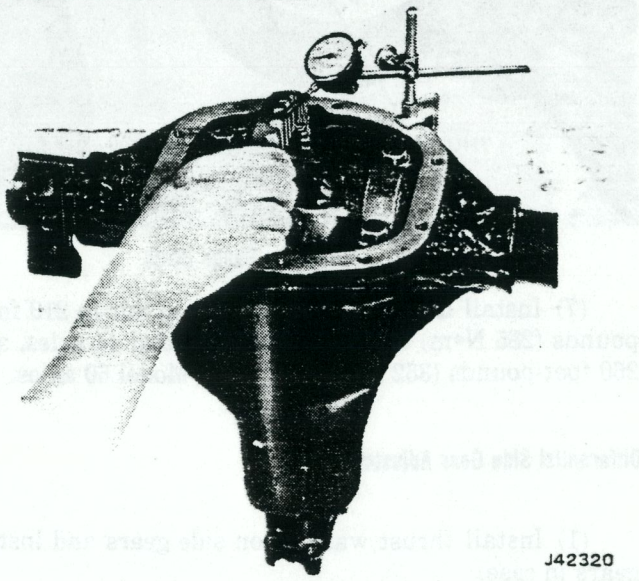

Fig. 2F-59 Measuring Ring Gear Backlash

NOTE: *Changing the position of a 0.005 inch (0.12 mm) shim from one side to the other will change the amount of backlash approximately 0.003 inch (0.07 mm).*

(20) Measure ring gear runout. If runout exceeds 0.006 inch (0.15 mm), case may be distorted, or there is dirt between case and gear, or ring gear bolts are loose. Check and correct as necessary.

(21) Raise spring and install front spring shackle to spring attaching bolts.

(22) Remove jack stand.

(23) Install tie plate and U-bolts. Tighten U-bolt nuts as follows:

1/2-20—55 foot-pounds (75 N•m)
9/16-18—100 foot-pounds (136 N•m)

(24) Tighten spring shackle to spring attaching bolts on CJ models to 24 foot-pounds (33 N•m). Cherokee, Wagoneer and Truck model bolts should be tightened to 100 foot-pounds (136 N•m) torque.

(25) Install stabilizer bar link to tie plate attaching nut.

(26) Install shock absorber. Tighten shock absorber to tie plate retaining nut to 45 foot-pounds (61 N•m) torque.

(27) Install axle shafts.

(28) Install axle housing cover. On Model 44 and 60 axles, clean cover and housing mating surfaces and apply thin bead of Jeep Gasket-In-A-Tube, or equivalent, silicone sealer to housing and cover before installation.

SPECIFICATIONS

Differential Specifications

Model 30 Front Axle	USA	Metric
Differential Bearing Preload	.015 in	0.38 mm
Differential Side Gear-to-Case Clearance	.000-.006 in	0.000-0.15 mm
Ring Gear	.005-.009 in	0.12-0.22 mm
Pinion Bearing Break-Away Preload		
Original Bearings	15-25 in-lbs.	2-3 N·m
New Bearings	20-40 in-lbs.	2-5 N·m
Model 44 Axle		
Differential Bearing Preload	0.15 in	0.38 mm
Differential Side Gear-to-Case Clearance	.000-.006 in	0.000-0.15 mm
Ring Gear Backlash	.005-.010 in	0.12-0.25 mm
Pinion Bearing Break-Away Preload		
Original Bearings	10-20 in-lbs.	1-2 N·m
New Bearings	20-40 in-lbs.	2-5 N·m
Model 60 Axle		
Differential Bearing Preload	.015 in	0.38 mm
Differential Side Gear-to-Case Clearance	.000-.006 in	0.000-0.15 mm
Drive Gear-to-Pinion Backlash	.005-.009 in	0.12-0.15 mm
Drive Pinion Bearing Break-Away		
Original Bearings	10-20 in-lbs.	1-2 N·m
New Bearings	20-40 in-lbs.	2-5 N·m
AMC/Jeep Axle		
Axle Shaft End Play (Shims — Left Side Only) - CJ	.004-.008 in (.006 in desired)	0.10-0.20 mm (0.15 mm desired)
Pinion Bearing Preload (Collapsible Sleeve)	17-25 in-lbs.	2-3 N·m
Differential Bearing Preload (Shims)	.008 in	0.20 mm
Differential Case Flange Runout (Inspection only — no adjustment)	.002 in max.	0.05 mm max.
Ring Gear Backlash (Shims)	.005-.009 in (.008 in desired)	0.12-0.15 mm (0.20 mm desired)
Pinion Gear Standard Setting (Shims)	2.547 in	64-69 mm

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Differential Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft-lbs)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Model 30 Front Axle				
Axle Housing Cover Bolts	20	15-25	27	20-34
Differential Bearing Cap Bolts	40	35-50	54	47-68
Ring Gear-to-Case Bolts	55	45-65	75	61-88
Lower Ball Stud Nut	80 min.	–	108 min.	–
Pinion Nut	210	200-220	271	285-298
Universal Joint U-Bolts	15	13-18	20	18-24
Upper Ball Stud Nut	100 min.	–	136 min.	–
Upper Ball Stud Seat	50 min.	–	68 min.	–
Wheel-to-Hub Nuts	80	65-90	108	88-122
Model 60 Axle				
Axle Housing Cover Bolts	20	15-25	27	20-34
Support Plate Bolts/Nuts	50	45-55	68	61-75
Differential Bearing Cap Bolts	80	70-90	108	95-122
Ring Gear-to-Case Bolts	105	100-110	142	135-149
Pinion Nut	260	250-270	352	339-366
Universal Joint Strap Bolts	15	13-18	20	18-24
Wheel-to-Hub Nuts	120	110-125	163	149-169
AMC/Jeep Axle				
Axle Housing Cover Bolts	170 in-lbs	150-190 in-lbs	19	17-21
Brake Tube-to-Rear Wheel Cylinder	97 in-lbs	90-105 in-lbs	11	10-12
Differential Bearing Cap Bolts	87	80-95	10	9-11
Ring Gear-to-Case Bolt	105	95-115	142	135-149
Rear Brake Support Plate Bolts	32	25-40	43	34-54
Axle Shaft-to-Hub Nuts-CJ	250 min.	250 min.	339 min.	–
Clamp Strap Bolts	16	15-19	18	14-24

All Torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

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TRAC-LOK DIFFERENTIAL

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GENERAL

The Trac-Lok limited slip differential is available as an option on Jeep vehicles equipped with the Model 208 or 300 transfer case only. Trac-Lok is used in rear axles only and is not available on vehicles equipped with Quadra-Trac. Two Trac-Lok units are used. Model 60 axles use a slightly different unit than is used in AMC/Jeep rear axles. Refer to the Overhaul section for servicing procedures.

OPERATION

In a conventional differential, torque applied to the ring gear is transmitted to the axle shafts through the differential gears. During normal operation, torque transmitted to each axle shaft is equal at all times. However, if one wheel slips, the opposite wheel will generate only as much torque as the slipping wheel.

With Trac-Lok, part of the ring gear torque is transmitted through clutch packs located between the differential side gears and case. The clutch packs contain multiple disc clutches which have radial grooves on the plates and concentric grooves on the discs.

In operation, the Trac-Lok clutches are engaged by two concurrent forces. The first being preload force exerted through Belleville springs contained within the clutch packs and the second is from separating forces generated by the side gears as torque is applied through the ring gear.

The Trac-Lok design provides the normal differential action needed for turning corners and for the transmittal of equal torque to both wheels when driving straight ahead. However, when one wheel loses traction and spins, the clutch packs transfer additional torque to the wheel having the most traction. Trac-Lok differentials resist wheel spin on bumpy roads and provide more pulling power when one wheel loses traction. Pulling power is provided continuously until both wheels lose traction. If both wheels slip due to unequal traction, Trac-Lok operation is normal. In extreme cases of differences in traction, the wheel with the least traction may spin after the Trac-Lok has transferred as much torque as possible to the nonslipping wheel.

LUBRICATION

Use Jeep axle lubricant or equivalent marked SAE 85W-90, grade GL-5 in Trac-Lok axles. In addition, the only acceptable method for cleaning the Trac-Lok differential is by disassembling the unit and wiping it clean using shop towels.

NOTE: *The Trac-Lok differential is serviced at the same time intervals as the standard differential.*

Trac-Lok Lubricant Change

(1) Warm axle lubricant. Operate vehicle in gear, on hoist, with wheels off floor for minimum of 5 minutes at 30 mph.

WARNING: *Never attempt to operate a Trac-Lok equipped vehicle in gear with only one wheel raised. The vehicle could propel itself off the jack and cause damage or personal injury.*

(2) Stop engine and raise vehicle on hoist.

(3) Remove axle housing cover drain plug or cover and drain lubricant while it is warm. If cover is removed, discard cover gasket.

(4) Remove any residual lubricant from axle housing using shop cloths.

(5) Install drain plug. If axle housing cover was removed, clean cover and housing mating surfaces and apply Jeep Gasket-In-A-Tube, or equivalent sealer to cover and housing mating surfaces. Install cover and cover bolts. Tighten cover bolts to 20 foot-pounds (27 N•m) torque.

(6) Refill axle housing with specified lubricant only. Refer to Specifications for lubricant capacities of various axle models.

(7) Operate vehicle on road for approximately ten miles (16 km). Make at least ten figure eight turns to flush old lubricant out of clutch packs.

(8) Return vehicle to shop and raise vehicle on hoist.

(9) Drain and replace axle lubricant again. If axle housing cover is removed, be sure to clean cover and housing mating surfaces and reapply Jeep Gasket-In-A-Tube, or equivalent sealer to mating surfaces before reinstalling cover.

(10) Lower vehicle.

(11) Road test vehicle and verify proper Trac-Lok operation.

NOTE: *If a slight chatter occurs after flushing and refilling the Trac-Lok differential, drive the vehicle an additional ten to twenty miles (16 to 32 km) or until chatter stops. If the chatter persists after twenty (32 km) or more miles of driving, an overhaul may be necessary.*

DIAGNOSIS

If noisy or rough operation such as chatter occurs when turning corners, the most probable cause is incorrect or contaminated lubricant. Before removing the Trac-Lok unit for repair, drain, flush, and refill the axle with the specified lubricant. Refer to the lubricant change procedure under Lubrication. A complete lubricant drain and refill with the specified lubricant will usually correct chatter.

Trac-Lok Operational Test

Trac-Lok operation can be checked quickly using the following test.

(1) Position one wheel on solid, dry pavement and opposite wheel on ice, mud, grease, or similiar low traction surface.

(2) Increase engine rpm gradually to obtain maximum traction prior to breakaway. Ability to move vehicle effectively will demonstrate proper performance.

NOTE: *If the test is performed on extremely slick surfaces such as ice or grease coated surfaces, some question may exist as to proper performance. In these extreme cases, a properly performing Trac-Lok will provide greater pulling power by lightly applying the parking brake.*

OVERHAUL

Disassembly

(1) Remove differential from axle housing. Removal procedures are same as outlined for standard differential. Refer to figures 2F-60 and 2F-61 for parts nomenclature.

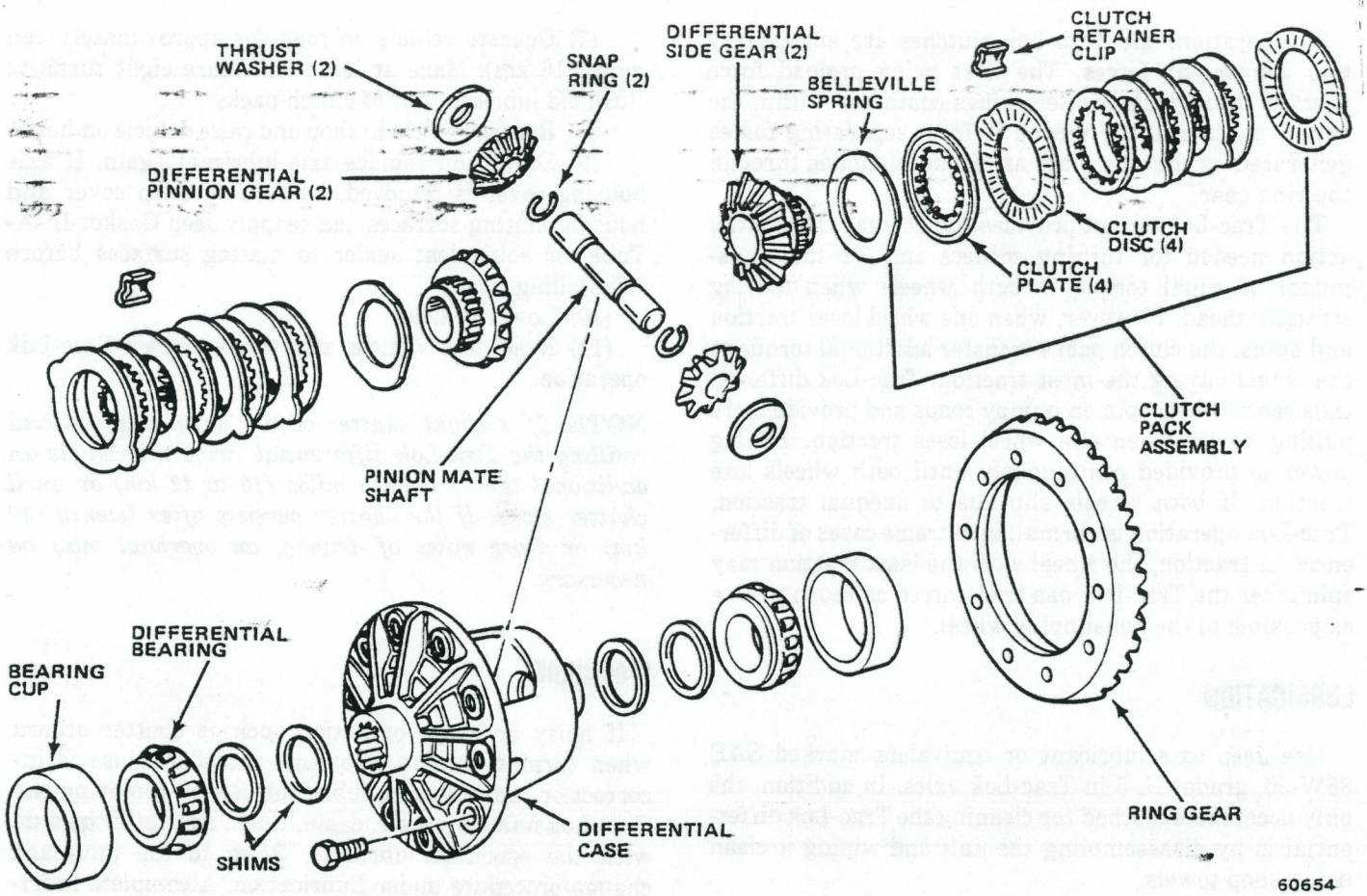


Fig. 2F-60 Trac-Lok Differential—Model 60 Axle

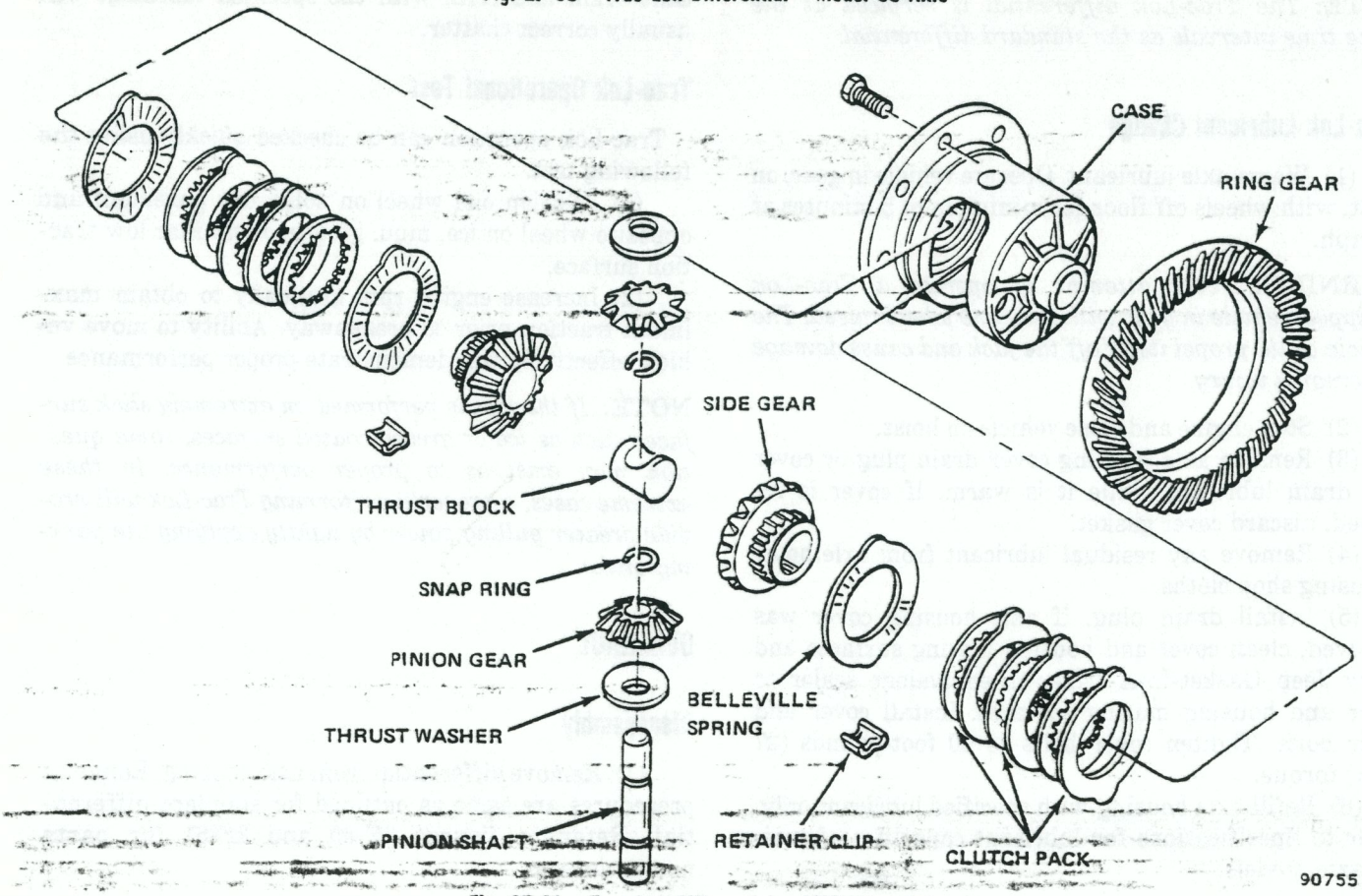


Fig. 2F-61 Trac-Lok Differential—AMC/Jeep Axle

(2) Install one axle shaft in vise with spline end facing upward and tighten vise. Do not allow more than 2-3/4 inch (7 cm) of shaft to extend above top of vise (fig. 2F-62). This prevents shaft from fully entering side gear, causing interference with step plate tool used to remove differential gears.

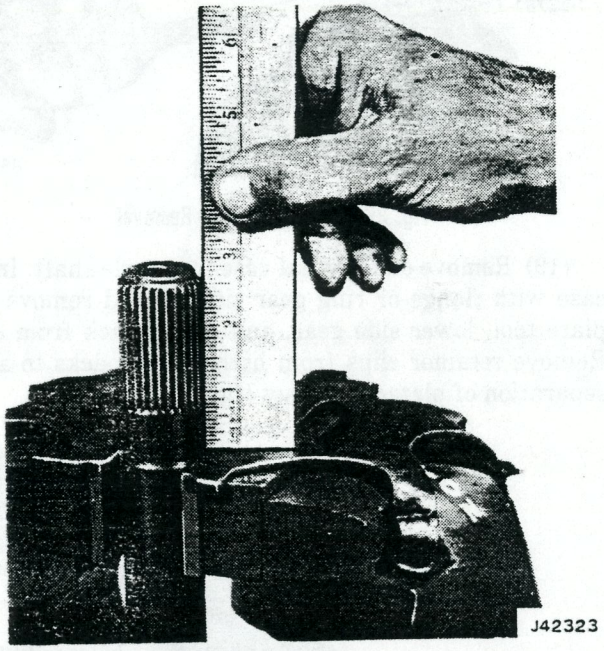


Fig. 2F-62 Axle Shaft Positioned in Vise

(3) Mount differential case on axle shaft with ring gear bolt heads facing upward (fig. 2F-63).

Fig. 2F-63 Differential Mounted on Axle Shaft

(4) Remove and discard ring gear bolts.

(5) Place shop towels under ring gear to protect gear when it is removed from case (fig. 2F-63).

(6) Remove ring gear from case using rawhide hammer.

(7) Remove differential case from axle shaft and remove ring gear.

(8) Remount differential case on axle shaft.

(9) Remove snap rings from pinion mate shaft (fig. 2F-64). Use two screwdrivers to disengage snap rings. Place shop towel on opposite opening of case to prevent snap rings from flying out of case.

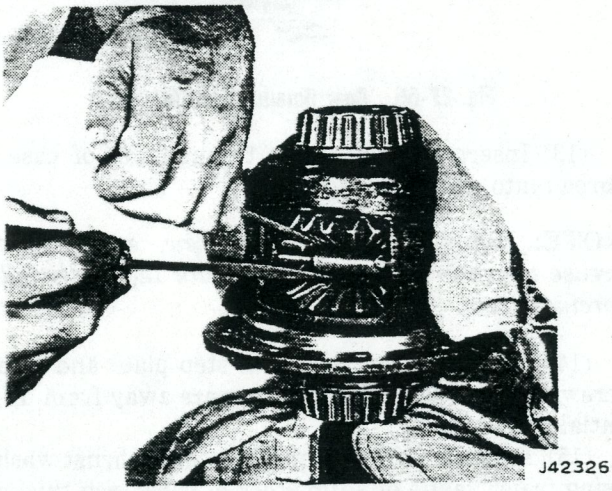


Fig. 2F-64 Pinion Mate Shaft Snap Ring Removal

NOTE: *On the Model 60 Trac-Lok, the pinion mate shaft is retained in the case by a roll pin. Use a 3/16 inch (5 mm) diameter pin punch to remove this pin.*

(10) Remove pinion mate shaft using hammer and brass drift.

NOTE: *Gear Rotating Tool J-23781 is required to perform the following steps. The tool consists of three parts: gear rotating tool, forcing screw, and step plate.*

(11) Install step plate in lower differential side gear (fig. 2F-65).

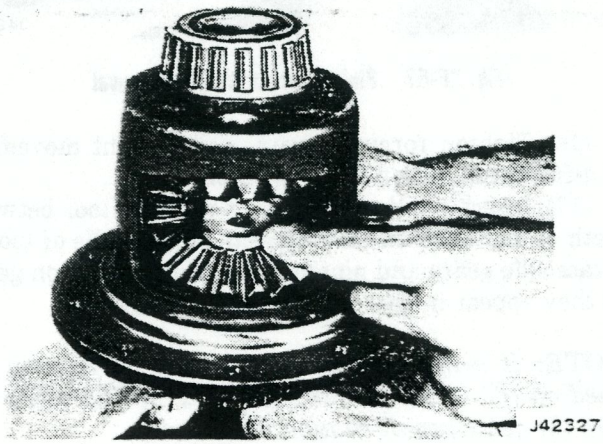


Fig. 2F-65 Step Plate Installation

(12) Position pawl end of gear rotating tool on step plate (fig. 2F-66).

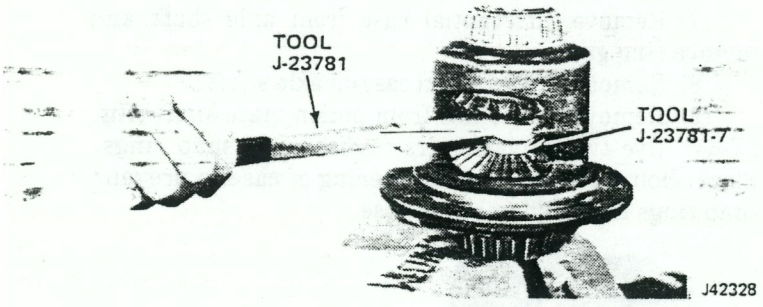


Fig. 2F-66 Gear Rotating Tool Installation

(13) Insert forcing screw through top of case and thread into gear rotating tool.

NOTE: *Before using forcing screw, apply daub of grease to centering hole in step plate and oil threads of forcing screw.*

(14) Center forcing screw in step plate and tighten screw to move differential side gears away from differential pinion gears.

(15) Remove differential pinion gear thrust washers using feeler gauge or shim stock of 0.030 inch thickness (0.76 mm). Insert shim stock or gauge between washer and case and withdraw shim stock and thrust washer (fig. 2F-67).

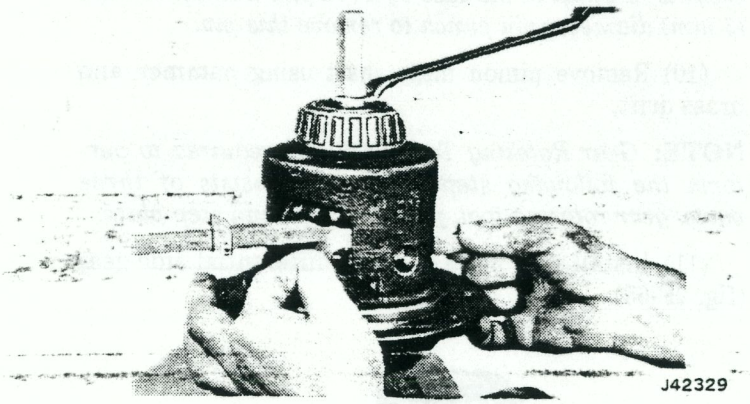


Fig. 2F-67 Pinion Thrust Washer Removal

(16) Tighten forcing screw until a slight movement of differential pinion gears is observed.

(17) Insert pawl end of gear rotating tool between teeth of one differential side gear. Pull handle of tool to rotate side gears and pinion gears. Remove pinion gears as they appear in case opening (fig. 2F-68).

NOTE: *It may be necessary to adjust the tension applied on the Belleville springs by the forcing screw before the gears can be rotated in the case.*

(18) Retain upper side gear and clutch pack in case by holding hand on bottom of rotating tool while removing forcing screw. Remove rotating tool, upper side gear, and clutch pack.

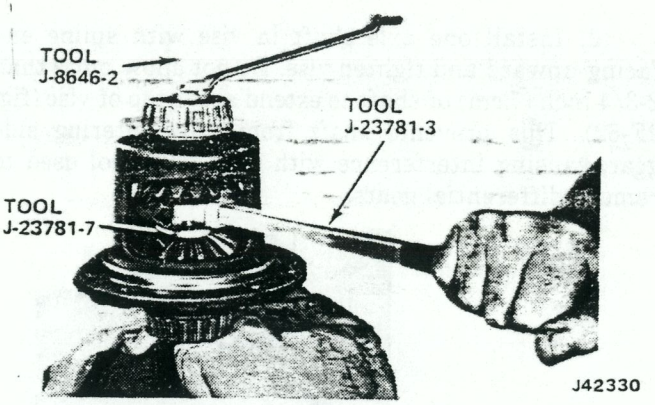


Fig. 2F-68 Pinion Gear Removal

(19) Remove differential case from axle shaft. Invert case with flange or ring gear side up and remove step plate tool, lower side gear, and clutch pack from case. Remove retainer clips from both clutch packs to allow separation of plates and discs (fig. 2F-69).

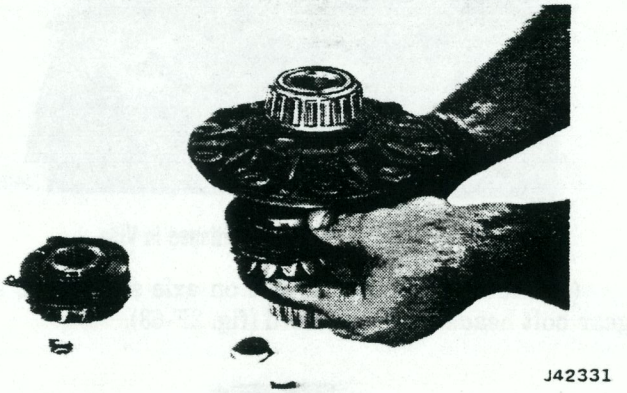


Fig. 2F-69 Side Gear and Clutch Pack Removal

Inspection

Clutch Plates and Disc

If any one member of either clutch pack shows evidence of excessive wear or scoring, the complete clutch pack must be replaced on both sides.

Differential Side and Pinion Gears

The gear teeth should be checked for extreme wear or possible cracks. The external teeth of the side gear which holds the clutch pack also should be checked for wear or cracks. If replacement of one gear is required due to wear, both side gears, pinion gears, and thrust washers must be replaced.

Pinion Mate Shaft

If excessive wear is evident on any one of the retainer clips, all clips should be replaced.

Differential Case

If scoring, wear, or metal pickup is evident on the machined surfaces, then replacement of the case is necessary.

Examples of radial groove clutch plate (A) and the concentric groove disc (B) are shown in figure 2F-70.

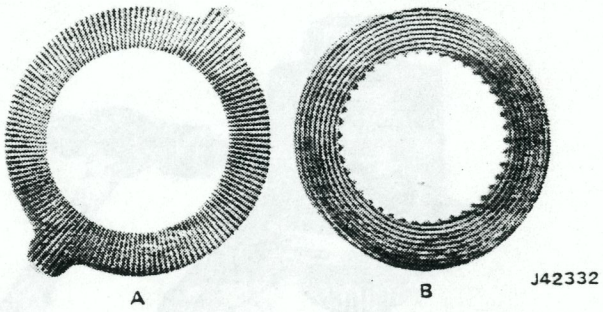


Fig. 2F-70 Clutch Plate and Disc Identification

ASSEMBLY

(1) Lubricate all differential components with Jeep axle lubricant or equivalent marked SAE 85W-90, GL-5.

(2) Assemble clutch packs. Install plates and discs in same position as when removed regardless of whether they are replacement or original parts.

(3) Install clutch retainer clips on ears of clutch plates. Be sure clutch packs are completely assembled and seated on ears of plates.

(4) Install clutch packs on differential side gears and install assembly in case.

NOTE: *Be sure clutch pack stays assembled on side gear splines and that retainer clips are completely seated in case pockets. To prevent pack from falling out of case, it will be necessary to hold them in place by hand while mounting case on axle shaft (fig. 2F-71).*

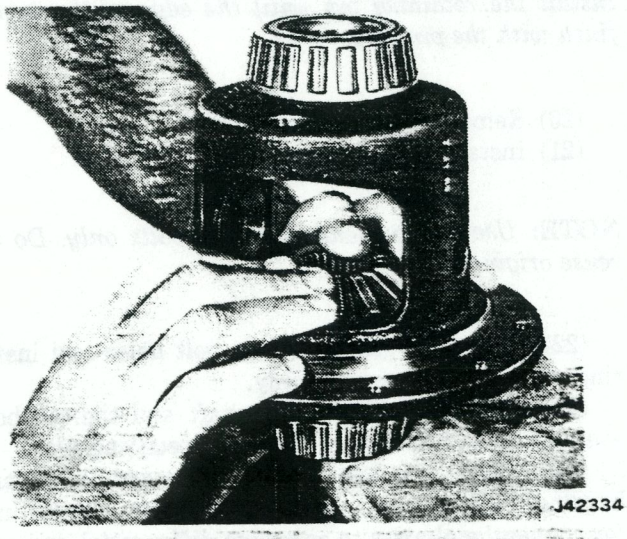


Fig. 2F-71 Mounting Differential Case on Axle Shaft

(5) Mount case assembly on axle shaft (fig. 2F-72).

CAUTION: *When installing differential case on axle shaft, be sure that splines of side gears are aligned with those of axle shaft. Be sure clutch pack is still properly assembled in case after installing case on axle shaft.*

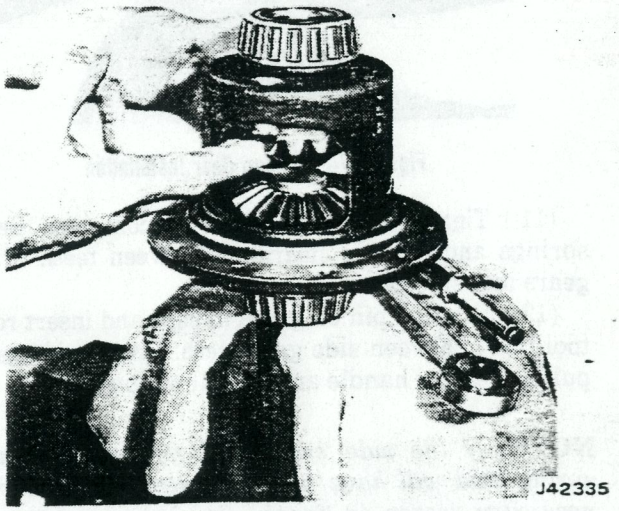


Fig. 2F-72 Clutch Pack and Side Gear Installation

(6) Install step plate tool in side gear. Apply small daub of grease in centering hole of step plate.

(7) Install remaining clutch pack and side gear. Be sure clutch pack stays assembled on side gear splines and that retainer clips are completely seated in pockets of case (fig. 2F-72).

(8) Position gear rotating tool in upper side gear.

(9) Keep side gear and rotating tool in position by holding with hand. Insert forcing screw through top of case and thread into rotating tool (fig. 2F-73).

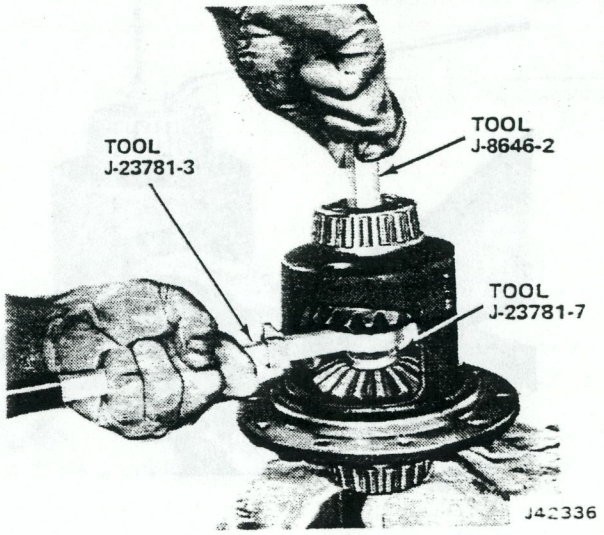


Fig. 2F-73 Threading Forcing Screw into Rotating Tool

(10) Install both differential pinion gears in case. Be sure bores of gears are aligned. Hold gears in place by hand (fig. 2F-74).

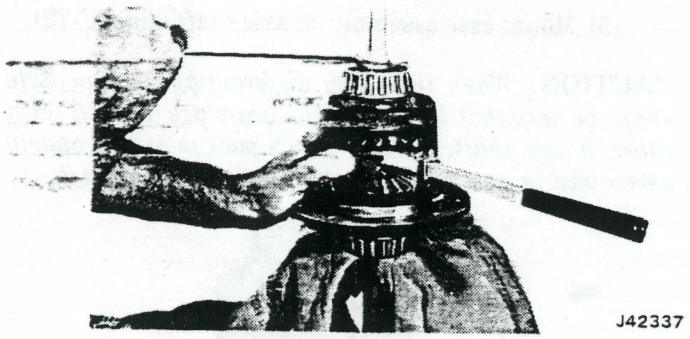


Fig. 2F-74 Pinion Gear Installation

(11) Tighten forcing screw to compress Belleville springs and provide clearance between teeth of pinion gears and side gears.

(12) Position pinion gears in case and insert rotating tool pawl between side gear teeth. Rotate side gears by pulling on tool handle and install pinion gears.

NOTE: *If the side gears will not rotate, Belleville spring load will have to be adjusted. If adjustment is necessary, loosen or tighten the forcing screw slightly until the gears will rotate.*

(13) Continue rotating side gears using rotating tool handle until shaft bores in both pinion gears are aligned with case bores.

(14) Lubricate both sides of pinion gear thrust washers.

(15) Tighten or loosen forcing screw to permit thrust washer installation.

(16) Install thrust washers. Use small screwdriver to guide washers into position (fig. 2F-75).

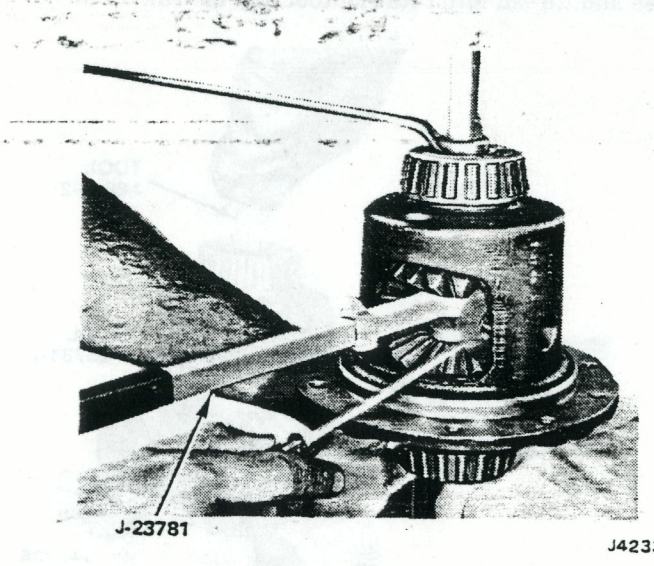


Fig. 2F-75 Pinion Gear Thrust Washer Installation

CAUTION: *Be sure the shaft bores in the washers and gears are aligned with the case bores.*

(17) Remove forcing screw, rotating tool, and step plate.

(18) Lubricate pinion mate shaft and seat shaft in case. Be sure snap ring grooves in shaft are exposed to allow snap ring installation (fig. 2F-76).

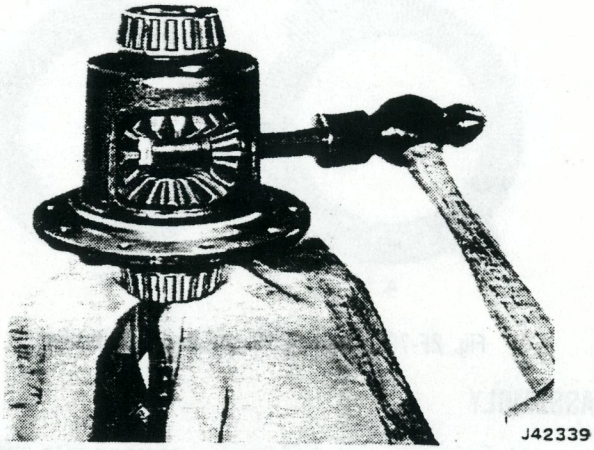


Fig. 2F-76 Pinion Mate Shaft Installation

(19) Install pinion mate shaft snap rings.

NOTE: *On Model 60 Trac-Lok, align the shaft and shaft retaining pin bore and case pin bore. Tap the shaft into position and install the retaining pin. If the case is mounted in a vise with the machined side of the ring gear flange facing upward, use a 5/16 inch (8 mm) diameter punch to install the retaining pin. Seat the pin until the punch bottoms in the case bore. If the case is mounted in a vise with the machined side of the ring gear flange facing downward, wrap a length of tape around a 3/16 inch (5 mm) diameter punch approximately 1-3/4 inch (4 cm) from the end of the punch. Install the retaining pin until the edge of the tape is flush with the pin bore.*

(20) Remove case from axle shaft.

(21) Install ring gear on case.

NOTE: *Use replacement ring gear bolts only. Do not reuse original bolts.*

(22) Align ring gear and case bolt holes and install ring gear bolts finger-tight only.

(23) Remount case on axle shaft and tighten bolts evenly to specified torque. Refer to Specifications.

(24) Install Trac-Lok differential assembly in axle housing. Follow service procedures previously outlined for conventional axles to complete differential and axle assembly servicing.

SERVICE REPLACEMENT

If the Trac-Lok unit must be replaced as an assembly, replace the unit as follows:

(1) Remove differential bearings and shims. Mark or tag each bearing and shim pack for assembly reference.

(2) Remove ring gear from case.

(3) Install original ring gear on replacement differential assembly. Be sure gear flange on replacement case is free of nicks or burrs.

(4) Inspect shims and bearings which were removed. If shims and bearings are worn or damaged, replace them. Be sure shims and bearings are used on same sides of replacement case as on old case.

(5) Install shims and differential bearings. Use step plate on bottom bearing to protect bearing from damage during installation of upper bearing. Seat bearings, using bearing driver tool.

(6) Lubricate differential bearings with 85W-90 gear lubricant and install differential assembly in axle housing.

(7) Follow service procedures previously outlined for conventional axles to complete differential and axle assembly servicing.

SPECIFICATIONS

Axle Specifications

Model 44 Axle

	USA	Metric
Differential Bearing Preload	0.15 in	0.38 mm
Differential Side Gear-to-Case Clearance	.000-.006 in	0.000-0.15 mm
Ring Gear Backlash	.005-.010 in	0.12-0.25 mm
Pinion Bearing Break-Away Preload		
Original Bearings	10-20 in-lbs.	1-2 N·m
New Bearings	20-40 in-lbs.	2-5 N·m

Model 60 Axle

Differential Bearing Preload	.015 in	0.38 mm
Differential Side Gear-to-Case Clearance	.000-.006 in	0.000-0.15 mm
Drive Gear-to-Pinion Backlash	.005-.009 in	0.12-0.15 mm
Drive Pinion Bearing Break-Away		
Original Bearings	10-20 in-lbs.	1-2 N·m
New Bearings	20-40 in-lbs.	2-5 N·m

AMC/Jeep Axle

Axle Shaft End Play (Shims — Left Side Only)	.004-.008 in (.006 in desired)	0.10-0.20 mm (0.15 mm desired)
Pinion Bearing Preload (Collapsible Sleeve)	17-25 in-lbs.	2-3 N·m
Differential Bearing Preload (Shims)	.008 in	0.20 mm
Differential Case Flange Runout (Inspection only — no adjustment)	.002 in max.	0.05 mm max.
Ring Gear Backlash (Shims)	.005-.009 in (.008 in desired)	0.12-0.15 mm (0.20 mm desired)
Pinion Gear Standard Setting (Shims)	2.547 in	64-69 mm

606578

Torque Specifications

Model 30 Front Axle

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft. lbs.)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Axle Housing Cover Bolts	20	15-25	27	20-34
Differential Bearing Cap Bolts	40	35-50	54	47-68
Ring Gear-to-Case Bolts	55	45-65	75	61-88
Lower Ball Stud Nut	80 min.	—	108 min.	—
Pinion Nut	210	200-220	271	285-298
Universal Joint U-Bolts	15	13-18	20	18-24
Upper Ball Stud Nut	100 min.	—	136 min.	—
Upper Ball Stud Seat	50 min.	—	68 min.	—
Wheel-to-Hub Nuts	80	65-90	108	88-122

Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (in-lbs)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Model 44 Front Axle				
Axle Housing Cover Bolts	20	15-25	27	20-34
Support Plate Bolts/Nuts	30	25-35	41	34-47
Differential Bearing Cap Bolts	80	70-90	108	95-122
Disc Brake Shield Bolt	8	5-10	11	7-14
Disc Brake Shield Nuts	35	30-40	47	41-54
Ring Gear-to-Case Bolts	55	45-65	75	61-81
Lower Ball Stud Nut	80 min.	—	108 min.	—
Pinion Nut	210	200-220	271	285-298
Upper Ball Stud Nut	100 min.	—	136 min.	—
Upper Ball Stud Seat	50 min.	—	68 min.	—
Universal Joint Flange Bolts	35	25-45	47	34-61
Universal Joint Strap Bolts	16	15-19	22	20-26
Wheel-to-Hub Nuts	80	65-90	108	88-122
Model 60 Axle				
Axle Housing Cover Bolts	20	15-25	27	20-34
Support Plate Bolts/Nut	50	45-55	68	61-75
Differential Bearing Cap Bolts	80	70-90	108	95-122
Ring Gear-to-Case Bolts	105	100-110	142	135-149
Pinion Nut	260	250-270	352	339-366
Universal Joint Strap Bolts	16	15-19	22	20-26
Wheel-to-Hub Nuts	120	110-125	163	149-169
AMC/Jeep Axle				
Axle Housing Cover Bolts	170 in-lbs	150-190 in-lbs	19	17-21
Brake Tube-to-Rear Wheel Cylinder	97 in-lbs	90-105 in-lbs	11	10-12
Differential Bearing Cap Bolts	87	80-95	10	9-11
Ring Gear-to-Case Bolt	105	95-115	142	135-149
Rear Brake Support Plate Bolts	32	25-40	43	34-54
Axle Shaft-to-Hub Nuts	250 min.	250 min.	339 min.	—
Clamp Strap Bolts	16	15-19	22	15-19

All Torque values given in inch-pounds and Newton-meters with dry fits unless otherwise specified.

Refer to the Standard Torque Specifications and Capscrew Markings Chart in Section A of this manual for any torque specifications not listed above.

60657A

FRONT DRIVE HUBS

	Page		Page
Front Drive Hub Diagnosis	2F-51	Hub Service	2F-51
General	2F-48	Lubrication	2F-51
Hub Removal—Installation	2F-51	Specifications	2F-53

GENERAL

Manual front drive hubs are standard equipment on Jeep vehicles equipped with a Model 208 or 300 part-time four-wheel drive transfer case only.

NOTE: *Front drive hubs are not available nor recommended on Jeep vehicles equipped with the Model 219, Quadra-Trac, full-time four-wheel drive transfer case.*

Two different front drive hub models are used. Hub model M243 is used on CJ models (fig. 2F-77) and hub model M247 is used on Cherokee, Wagoneer and Truck models (fig. 2F-78). Both hub models are manually locked or unlocked.

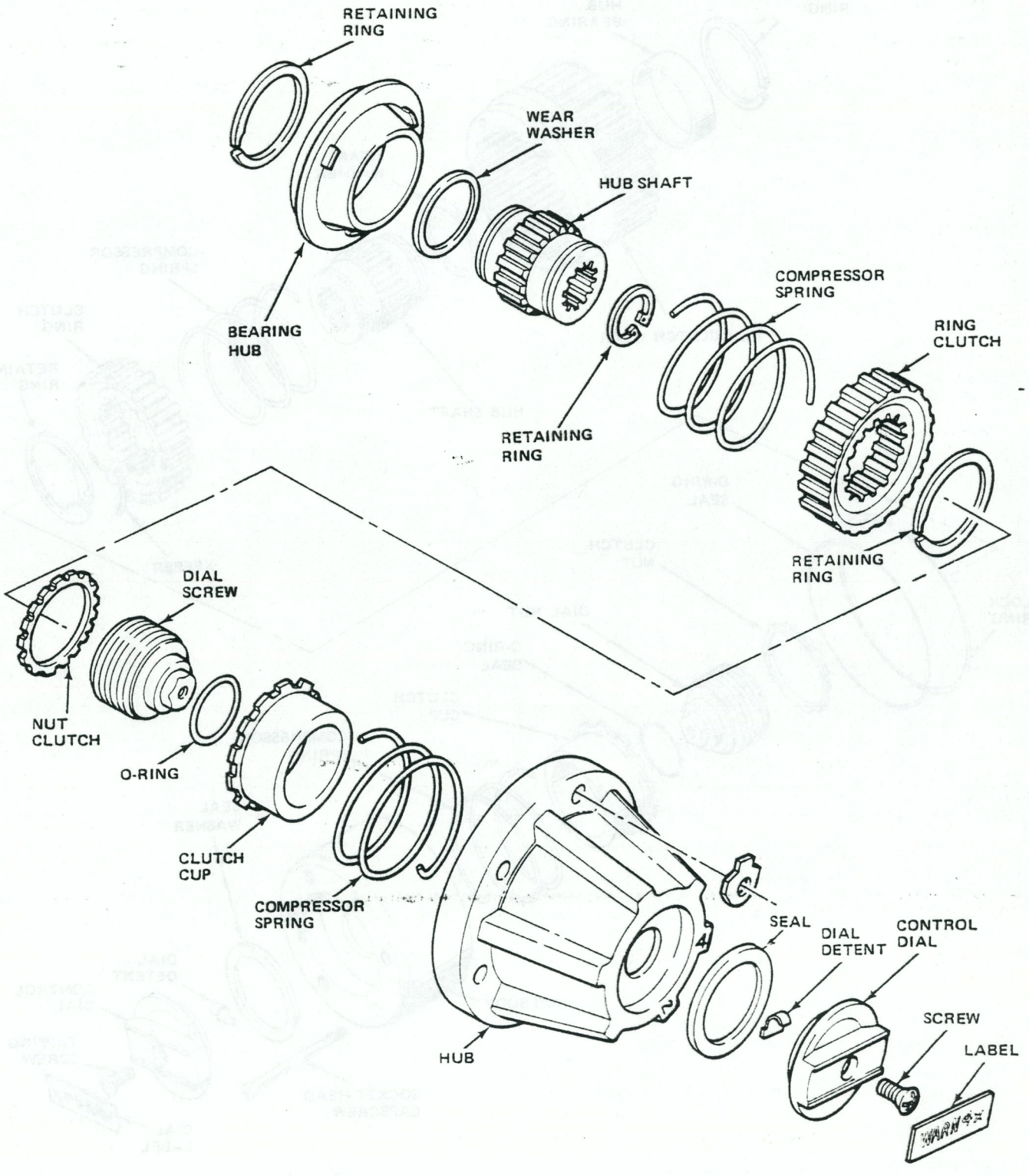


Fig. 2F-77 Model M243 Front Drive Hub—CJ Models

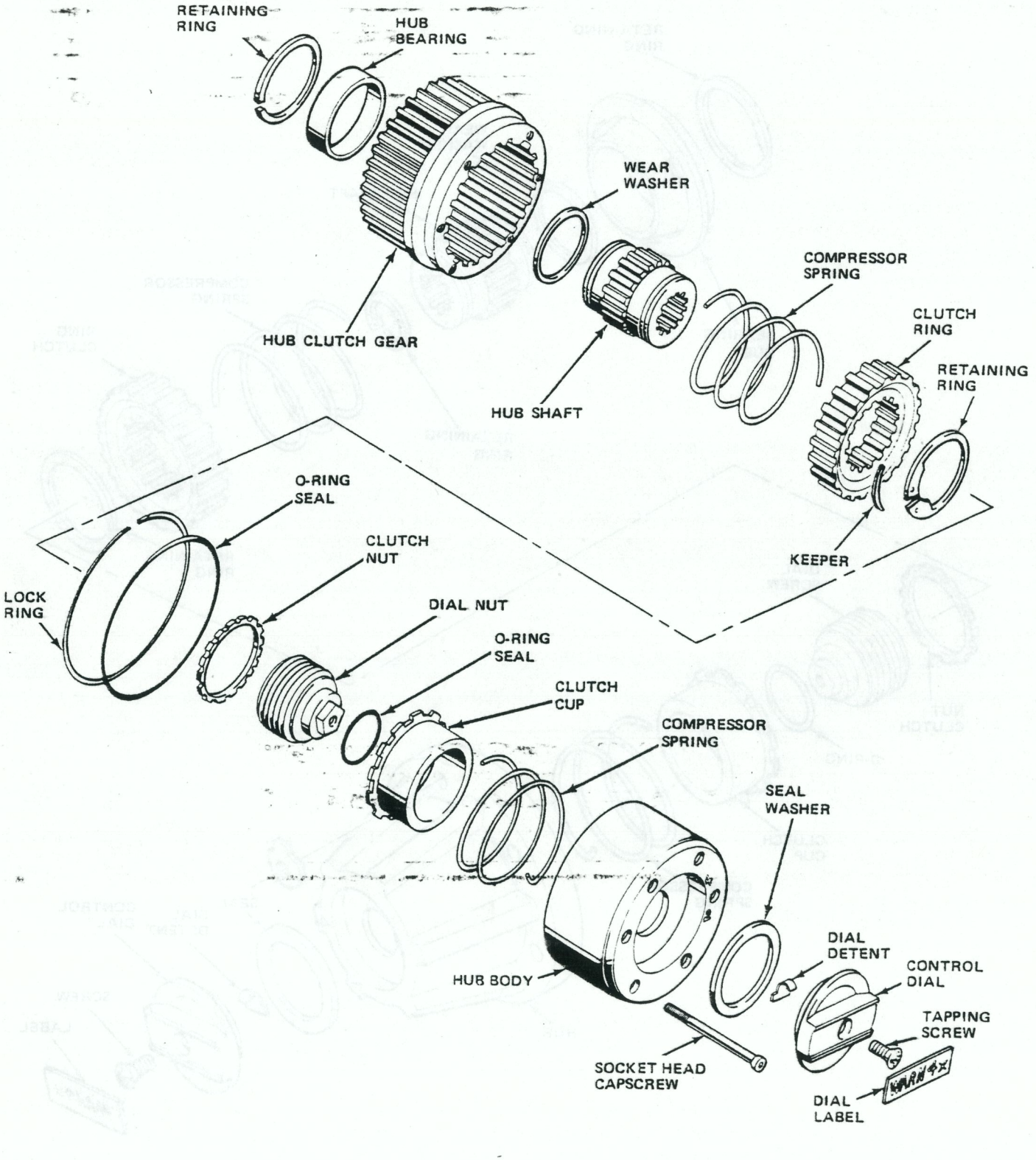


Fig. 2F-78 Model M247 Front Drive Hub—Cherokee-Wagoneer-Truck Models

LUBRICATION

Use Jeep all purpose chassis lubricant or equivalent lithium base, waterproof, EP-type chassis lubricant. When servicing front drive hubs, apply a light coating of chassis lubricant to the hub internal components. Do not pack the hubs full of lubricant, apply a light coating only.

After operation in dusty areas or if the hubs become immersed in water, the hubs, as well as the wheel end components, should be removed, cleaned, and lubricated. This should avoid the possibility of premature wear or damage caused by foreign material in the hubs or by lubricant washout.

FRONT DRIVE HUB DIAGNOSIS

The manual front drive hubs used on Jeep vehicles should provide efficient and satisfactory operation when used and maintained properly. However, if a problem should occur, refer to the following diagnosis and repair procedures.

Control Dials Hard to Turn or Will Not Engage Completely

If the control dials become hard to turn or will not engage completely, the problem is usually due to a lack of lubricant, or dirt, water or foreign material in the hub cavity or in the dials themselves. In these cases, repair involves removing, cleaning and lubricating the hubs. However, in some cases, this condition may simply be the result of driveline torque load on the hub clutch. This situation is remedied by raising the vehicle front end and turning the front wheels forward or reverse to relieve the load.

If the problem is the result of internal damage to the hub body or clutch, the damaged component will have to be replaced to restore proper operation. Refer to Hub Service.

Noisy Operation

Chatter, clicking, grating, or similar type noises from the hubs may be the result of dirt, water or foreign material in the hub. This condition can be caused by a lack of hub maintenance, loose attaching bolts or screws, or damaged hub gaskets. Noise can become especially prevalent after fording streams or after operation in sandy areas. Service correction involves cleaning and lubricating the hubs.

However, if inspection indicates the problem is the result of damaged internal components, the damaged components will have to be replaced to restore proper operation. Refer to Hub Service.

Lubricant Leaks

Generally, lubricant leaks are caused by loose hub attaching bolts or screws, damaged hub gaskets or a damaged hub body or clutch assembly. Leakage may also be caused by over lubricating during service or normal maintenance operations. In each case, the hub should be removed, inspected and repaired as necessary.

Hub Internal Damage

Axle or hub clutch or hub body component damage may be the result of improper hub usage or maintenance. The vehicle should never be moved unless the hub control dials are fully engaged. In addition, on vehicles equipped with manual hubs, the vehicle should not be operated with the transfer case in low range and the hubs in the 4 x 2 or Free position. This places high torque loads on the rear axle.

If the hubs are not maintained properly, full engagement of the control dials may not occur. This can lead to accelerated wear or damage to hub internal components. If the vehicle is driven through water deep enough to cover the hubs or in sandy, dusty areas, the hubs should be cleaned and lubricated thoroughly.

HUB SERVICE

Model M243 and M247 front drive hubs are serviced as either a complete assembly or sub assembly such as the hub body or hub clutch assembly only. Do not attempt to disassemble these units. If the entire hub or a sub assembly has malfunctioned, replace the hub assembly or the problem sub assembly as a unit only.

Although the front drive hubs are serviced as assemblies or sub assemblies only, the hubs may be removed for cleaning inspection and lubrication purposes. Refer to the Hub Removal/Installation procedures for details.

HUB REMOVAL/INSTALLATION

Removal—Model M243

(1) Remove bolts and tabbed lockwashers attaching hub body to axle hub (fig. 2F-79). Retain bolts and washer.

(2) Remove hub body and gasket. Discard gasket.

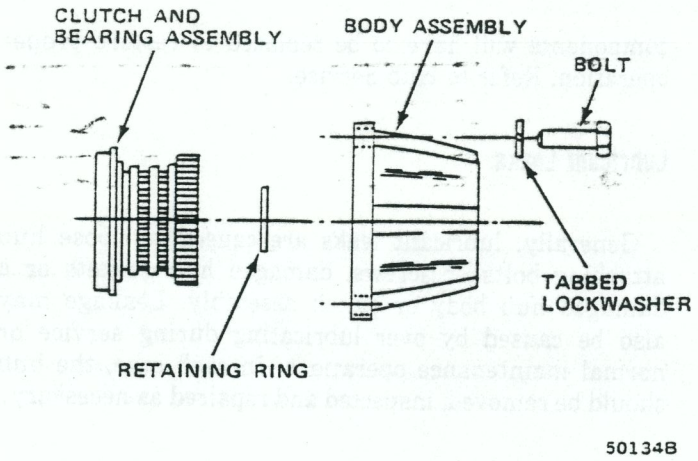


Fig. 2F-79 M243 Hub Removal/Installation

CAUTION: *Do not turn the hub control dial after removing the hub body.*

(3) Remove retaining ring from axle shaft (fig. 2F-78).

(4) Remove hub clutch and bearing assembly.

(5) Clean hub components in solvent. Dry them using compressed air, clean shop towels, or air dry. Be sure old lubricant, dirt, water or other foreign materials are flushed out.

(6) Inspect hub components for signs of wear or damage. Service components as necessary.

Installation—Model M243

CAUTION: *Do not turn the hub control dial until after the hub has been installed. The hub clutch nut and cup can be damaged serverly if the dial is rotated while the hub is off the vehicle.*

(1) Lubricate hub components with Jeep all purpose chassis lubricant or equivalent. Refer to Lubrication section. Apply light coat of lubricant only. Do not pack hub with lubricant.

(2) Install hub clutch and bearing assembly on axle shaft.

(3) Install retaining ring on axle shaft.

(4) Position new gasket on hub body and install hub body and gasket.

(5) Align bolt holes in axle and hub body and install bolts and tabbed lockwashers. Tighten bolts to 30 foot-pounds (41 N•m) torque.

(6) Raise vehicle front end.

(7) Turn hub control dials to 4 x 2 position and rotate wheels. Wheels should rotate freely. If wheels drag, check hub installation. Also, be sure control dials are fully engaged in 4 x 2 position.

(8) Lower vehicle.

Removal—Model M247

(1) Remove socket head screws from hub body assembly (fig. 2F-80).

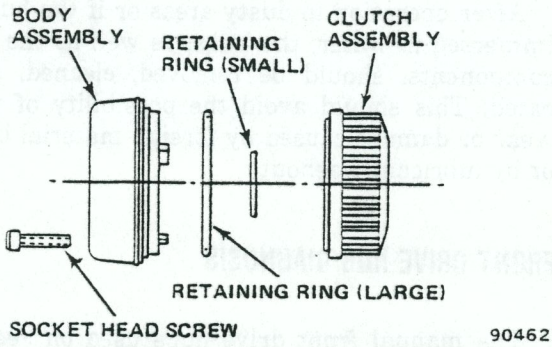


Fig. 2F-80 M247 Hub Removal/Installation

(2) Remove large retaining ring from axle hub. Remove small retaining ring from axle shaft.

(3) Remove hub clutch assembly.

(4) Clean hub components in solvent. Dry them using compressed air, clean shop towels, or air dry. Be sure old lubricant, dirt, water, or other foreign materials are flushed out.

(5) Inspect hub components for signs of wear or damage. Service components as necessary.

Installation—Model M247

(1) Lubricate hub components with Jeep all purpose chassis lubricant, or equivalent. Refer to Lubrication section. Apply light coat of lubricant only. Do not pack hub with lubricant.

(2) Install hub clutch assembly.

(3) Install small retaining ring on axle shaft. Install large retaining ring in axle hub.

(4) Install new O-ring or hub body if O-ring is being replaced.

(5) Position hub body in clutch. Align screw holes in clutch and body assemblies and install socket head screws. Tighten screws to 30 inch-pounds (3 N•m) torque.

(6) Raise vehicle front end.

(7) Turn both control dials to Free Position and rotate wheels. Wheels must rotate freely. If wheels drag, check hub installation. Also be sure control dials are fully engaged in position.

(8) Lower vehicle.

SPECIFICATIONS

Front Drive Hub Specifications

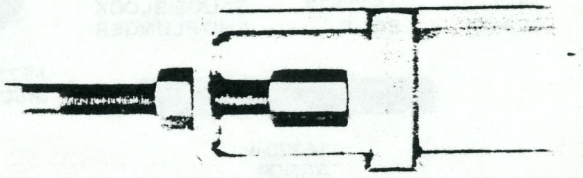
Hub Application	
M253	CJ Models
M247	Cherokee, Wagoneer, Truck
Hub Type:	2-position, manually operated locking hub
Lubricant	Use Jeep All-purpose Chassis Lubricant or equivalent lithium base, waterproof, EP-type chassis lubricant
Torque Values:	
Socket Head Screws (M247)	30 in-pounds (3 N.m)
Hub Bolts (M253)	30 foot-pounds (41 N.m)
Hub Control Dial Positions:	
M247	Lock (4 WD)-Free (2 WD)
M253	4 × 4 (4 WD)-4 × 2 (2 WD)

90591

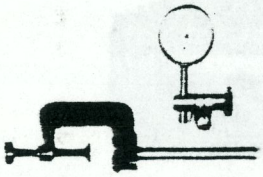
Tools

J-22575
PINION NUT SOCKET

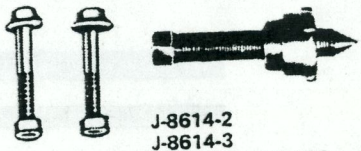
J-25104
J-22661
REAR PINION OIL SEAL INSTALLERS



J-2498
AXLE SHAFT REMOVER



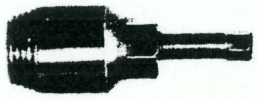
J-8001
DIAL INDICATOR SET



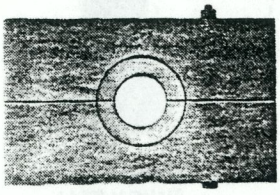
J-8614-2
J-8614-3
YOKE REMOVER TOOLS

J-21788
AXLE SHAFT OIL SEAL INSTALLER

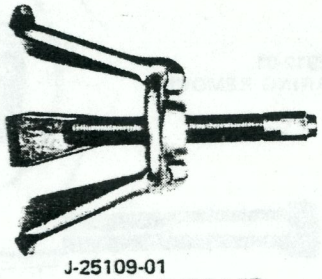
J-2092 AXLE END
PLAY CHECKING TOOL



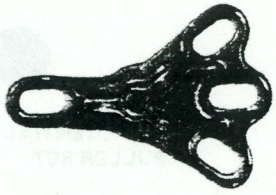
J-9233
PINION OIL SEAL REMOVER



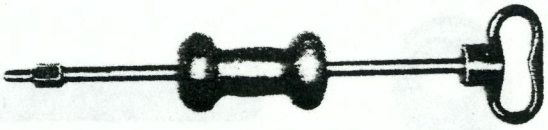
J-23674
AXLE SHAFT BEARING REMOVER-INSTALLER



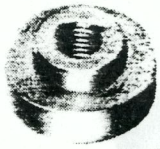
J-25109-01
AXLE HUB PULLER



J-21579
AXLE SHAFT PULLER



J-2619-01 SLIDE HAMMER



J-25135-01

80326

Tools (Continued)

J-21787
PINION FRONT
BEARING CUP
REMOVER

J-21786
PINION REAR
BEARING REMOVER

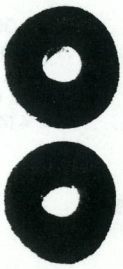
J-8608
PINION REAR BEARING
CUP INSTALLER

J-8611-01
PINION FRONT
BEARING CUP
INSTALLER

J-5223-24
CLAMP

J-5223-29
BOLT

J-5223-20
GAUGE BLOCK
AND PLUNGER



J-5223-25 OR -26
DISCS

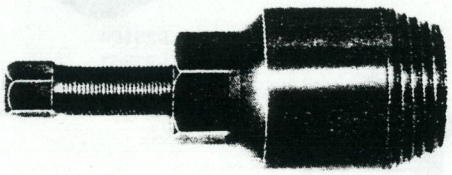
J-24433
PINION BEARING
INSTALLER SLEEVE

J-21784
DIFFERENTIAL
BEARING INSTALLER

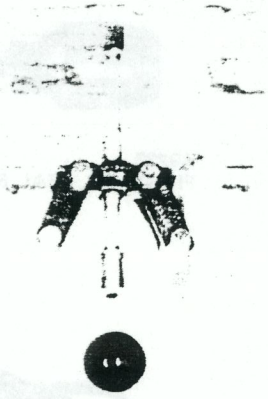
J-5223-4
ARBOR

J-5223-03
PINION DEPTH SETTING GAUGE SET

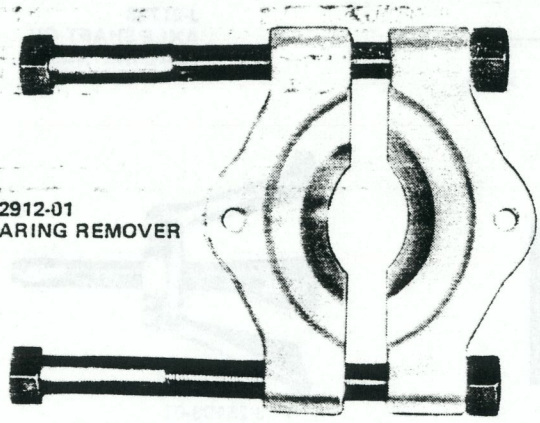
J-22697 PINION REAR
BEARING INSTALLER



J-9233
PINION SEAL REMOVER



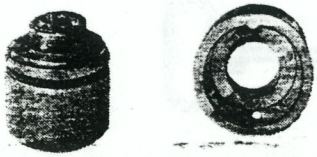
J-2497-01
DIFFERENTIAL BEARING
PULLER SET



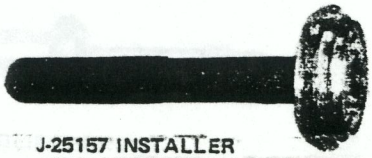
J-22912-01
BEARING REMOVER

J-22661
PINION SEAL
INSTALLER

J-5590
PINION BEARING
INSTALLER SLEEVE



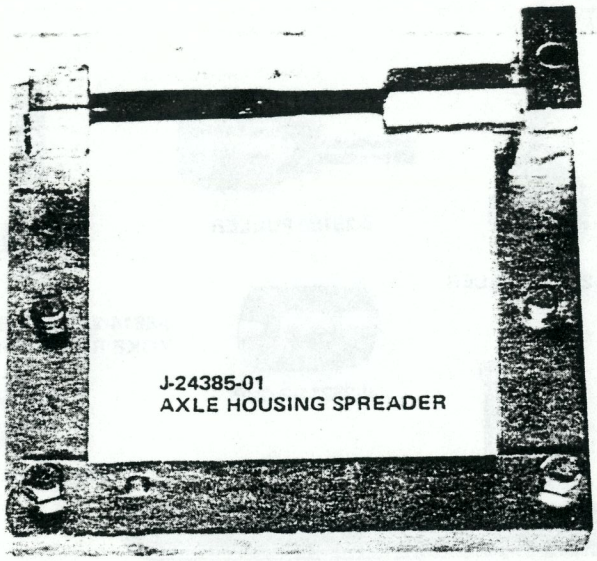
J-28648
SEAL INSTALLER



J-25157 INSTALLER
J-25122 DRIVER HANDLE

80327A

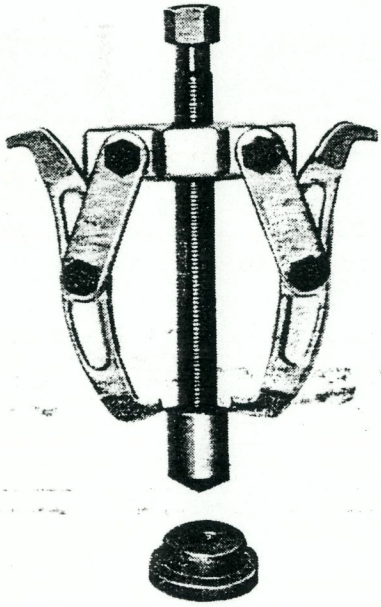
Tools (continued)



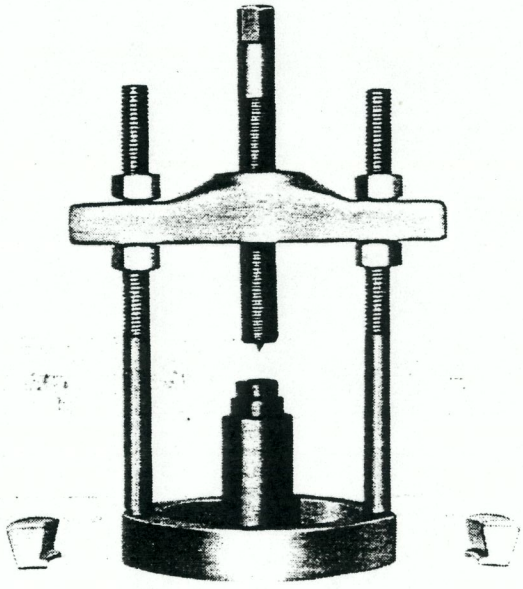
J-24385-01
AXLE HOUSING SPREADER

J-7079-2
DRIVER HANDLE (NON-THREADED)

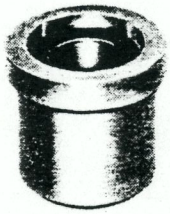
J-8092
DRIVER HANDLE (THREADED)



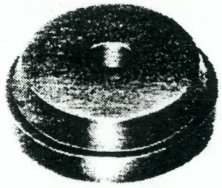
J-22888
BEARING PULLER SET



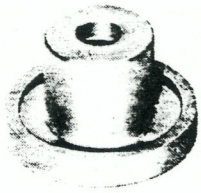
J-29721
BEARING REMOVER TOOL SET



J-25104
BEARING INSTALLER



J-25101
BEARING CUP INSTALLER



J-24430
BEARING INSTALLER

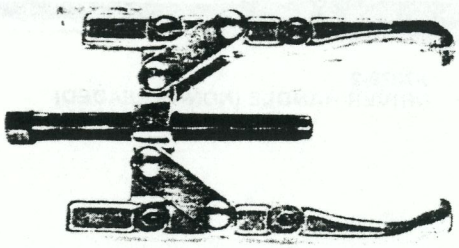
303278

J-8646-2 FORCING SCREW AND
J-23781-3 GEAR ROTATING TOOL

J-23781-7
STEP PLATE

80328

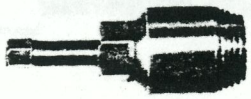
Tools (Continued)



J-25215 PULLER

J-25211-3 BUTTON

J-25133 PULLER



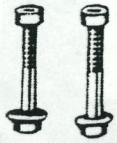
J-25180 PULLER

J-8614-2, J-8614-3
YOKE REMOVER TOOL

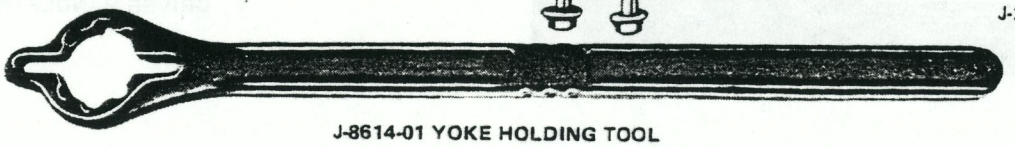
J-25211-2 CUP

J-23447 WRENCH NUT

J-25211-1 PLATE



J-25211-4 ADAPTE



J-8614-01 YOKE HOLDING TOOL

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BRAKES 2G

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GENERAL INFORMATION

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GENERAL

Jeep vehicles are equipped with single piston, floating caliper front disc brakes and self-energizing rear drum brakes.

Two different disc brake calipers are used. The caliper used on CJ models slides on abutment surfaces machined into the caliper and caliper support bracket. The caliper used on Cherokee, Wagoneer and Truck models slides on pivot bolts installed in the support shield and bracket assembly. Refer to the Brake Size and Application Chart for size and application details.

Two different drum brake units are used. They are similar in construction and operation but differ in method of automatic adjustment. Rear drum brakes on CJ models have cable operated automatic adjusters while rear drum brakes on Cherokee, Wagoneer and Truck models have linkage operated adjusters.

A dual reservoir master cylinder that provides separate hydraulic systems for the front and rear brake units is used on all models.

A three-function combination valve is used on all Jeep models. The valve consists of a one-piece housing containing a front brake metering valve, pressure differential warning valve, and rear brake proportioning valve.

Three power brake units are used. CJ models with optional power assist brakes use an 8 inch (20.3 cm) single diaphragm power unit. Cherokee, Wagoneer and J-10 Truck models use a 9-1/2 inch (24.1 cm) single diaphragm power unit. J-20 Truck models use a 9-1/2 inch (24.1 cm) tandem diaphragm power unit.

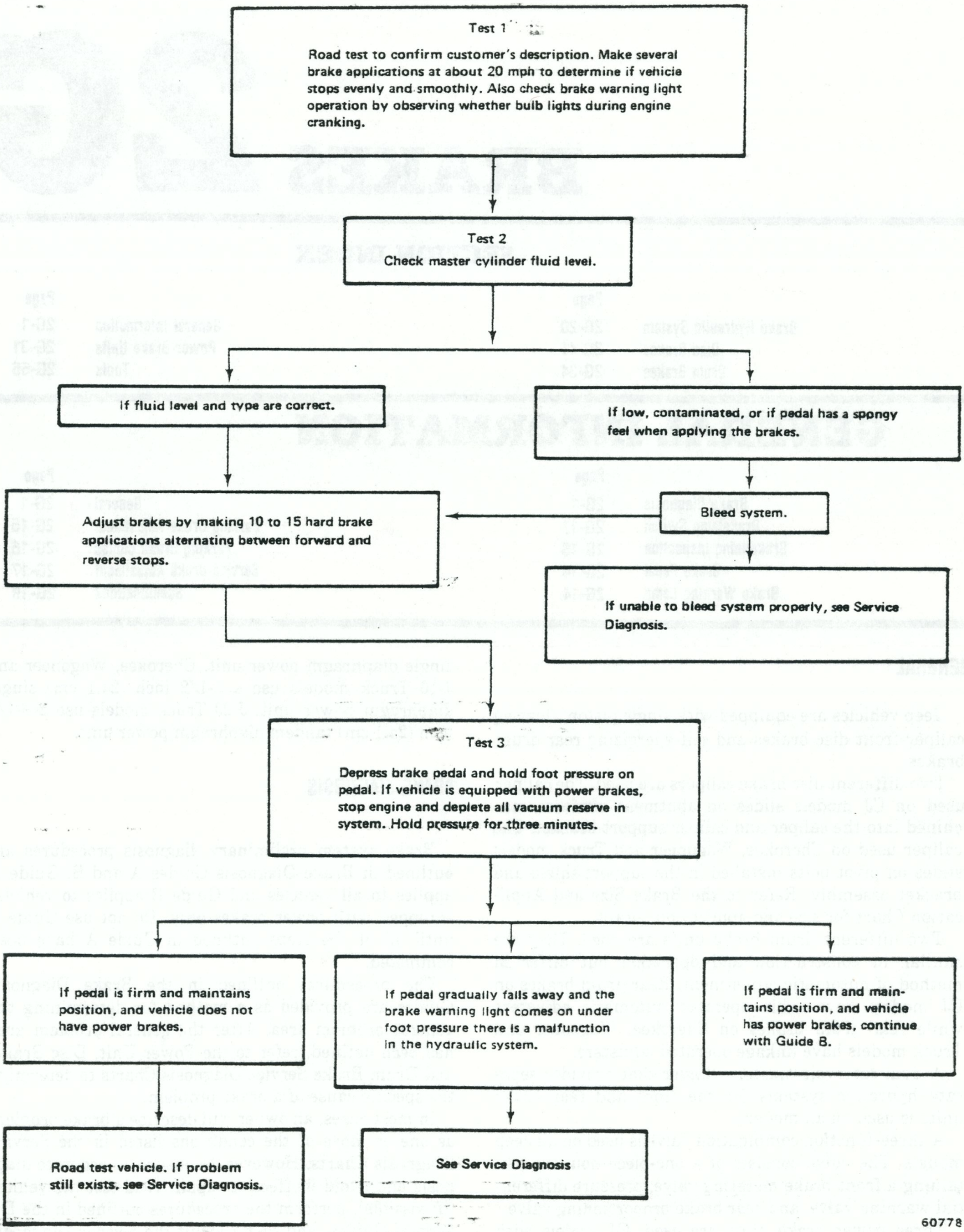
BRAKE DIAGNOSIS

Brake system preliminary diagnosis procedures are outlined in Brake Diagnosis Guides A and B. Guide A applies to all vehicles and Guide B applies to vehicles equipped with power brakes only. Do not use Guide B until all of the steps outlined in Guide A have been completed.

The procedures outlined in the Brake Diagnosis Guides are provided as a method for determining the general problem area. After the general problem area has been defined, refer to the Power Unit, Disc Brake, and Drum Brake Service Diagnosis Charts to determine the specific cause of a brake problem.

In most cases, an owner will describe a brake problem as one or more of the conditions listed in the Service Diagnosis Charts. However, to ensure an accurate diagnosis and avoid ineffective repair, road test the vehicle (if possible), perform the procedures outlined in the Diagnosis Guides, and then consult the Service Diagnosis Charts before attempting problem correction.

Brake Diagnosis Guide A



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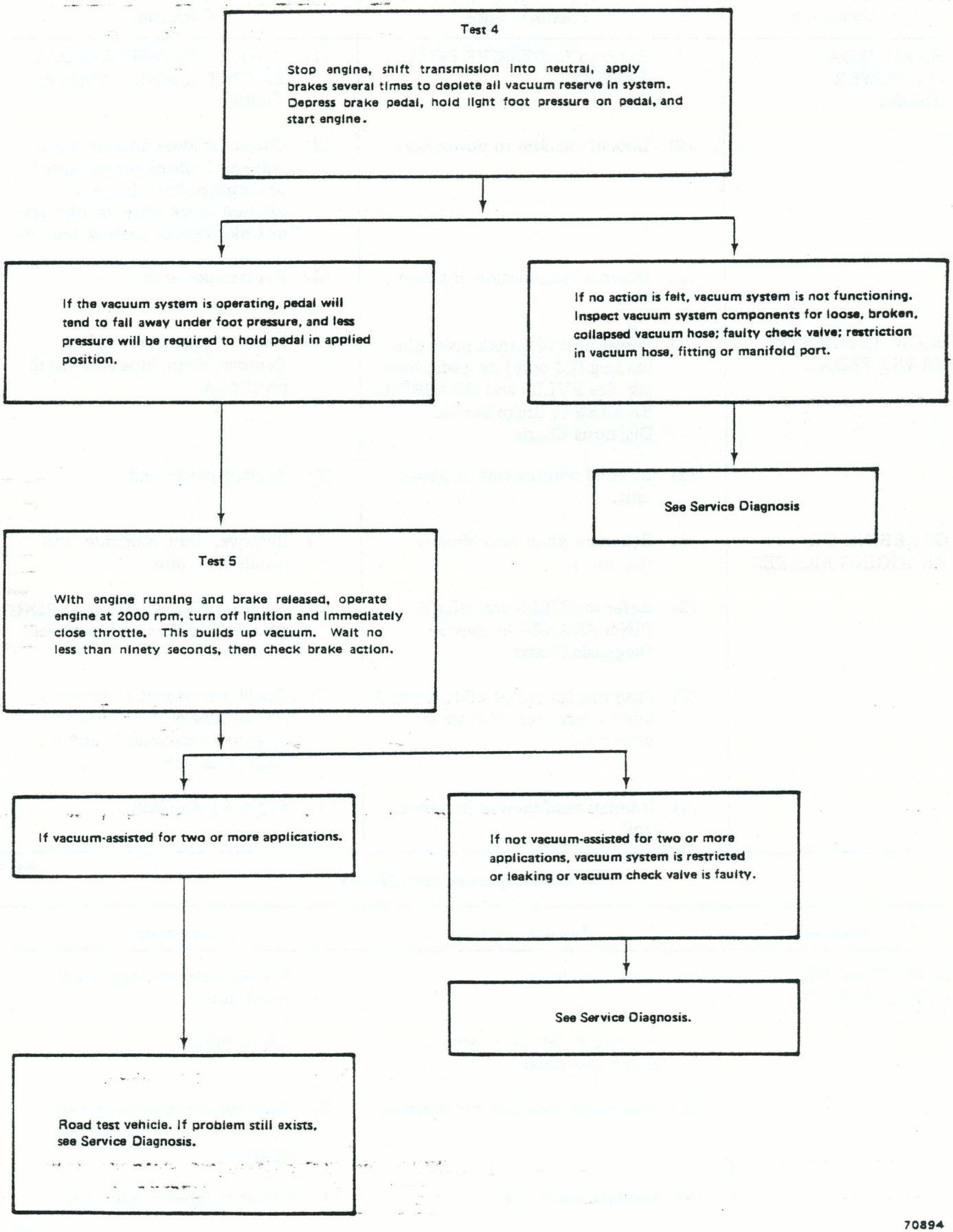
Brake Diagnosis Guide B



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Service Diagnosis-Power Unit

Condition	Possible Cause	Correction
HARD PEDAL (NO POWER ASSIST)	(1) Refer to EXCESSIVE PEDAL EFFORT.	(1) Refer to EXCESSIVE PEDAL EFFORT in Service Diagnosis Charts.
	(2) Loss of vacuum to power unit.	(2) Check for loose hose or check valve seal. Check for collapsed or damaged hose. Inspect vacuum check valve for damage or leak. Replace parts as required.
	(3) Internal malfunction in power unit.	(3) Replace power unit.
SLOW RETURN OF BRAKE PEDAL	(1) Power unit bellcrank pivot pins binding (CJ only) or, pedal binding. See PULLS and GRABBING BRAKES in Brake Service Diagnosis Charts.	(1) Lube all pedal pivot points. Remove, clean, lube and install pivot pins.
	(2) Internal malfunction in power unit.	(2) Replace power unit.
GRABBING OR DRAGGING BRAKES	(1) Bellcrank pivot pins binding (CJ only).	(1) Remove, clean, lubricate, and install pivot pins.
	(2) Refer to PULLS and GRABBING BRAKES in Service Diagnosis Charts.	(2) Refer to PULLS and GRABBING BRAKES in Service Diagnosis Charts.
	(3) Push rod (in power unit) binding due to corrosion or burrs on push rod.	(3) Check and correct as required. Do not lube push rod. Clean push rod with brake fluid and clean cloth only.
	(4) Internal malfunction in power unit.	(4) Replace power unit.

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Service Diagnosis-Drum Brakes

Condition	Possible Cause	Correction
LOW PEDAL OR PEDAL GOES TO TOE BOARD	(1) Low fluid level.	(1) Fill reservoir with approved brake fluid.
	(2) Excessive clearance between lining and drums.	(2) Adjust brakes.
	(3) Automatic adjusters not working.	(3) Make forward and reverse stops; if pedal stays low, repair faulty adjusters.
	(4) Leaking brake lines.	(4) Repair or replace faulty parts.

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Service Diagnosis-Drum Brakes (Continued)

Condition	Possible Cause	Correction
LOW PEDAL OR PEDAL GOES TO TOE BOARD (Continued)	(5) Leaking wheel cylinders.	(5) Overhaul wheel cylinder.
	(6) Internal leak in master cylinder.	(6) Overhaul master cylinder.
	(7) Air in system.	(7) Bleed system.
	(8) Improper brake fluid.	(8) Flush system and refill with approved fluid.
SPRINGY, SPONGY PEDAL	(1) Air trapped in hydraulic system.	(1) Remove air by bleeding.
	(2) Improper brake fluid.	(2) Flush and bleed system; use approved brake fluid.
	(3) Improper lining thickness or location.	(3) Install new lining or replace shoe and lining.
	(4) Drums worn too thin, (beyond 0.060 (1.52 mm) oversize specification)	(4) Replace drum(s) as required.
	(5) Master cylinder filler vent clogged	(5) Clean vent or replace cap; bleed brakes.
	(6) Hoses-lines collapsed, kinked, leaking.	(6) Replace as required.
	(7) Master cylinder compensator port blocked.	(7) Disassemble master cylinder. Repair as required.
EXCESSIVE PEDAL PRESSURE REQUIRED TO STOP VEHICLE	(1) Brake adjustment not correct.	(1) Adjust brakes.
	(2) Incorrect lining.	(2) Install new linings.
	(3) Grease or fluid-soaked lining.	(3) Repair grease seal or wheel cylinder. Install new linings.
	(4) Improper fluid.	(4) Flush system; use approved brake fluid.
	(5) Frozen master or wheel cylinder pistons.	(5) Overhaul master or wheel cylinders.
	(6) Brake pedal binding on shaft.	(6) Lubricate pivot points.
	(7) Linings watersoaked.	(7) Drive with brakes lightly applied to dry linings.
	(8) Glazed linings.	(8) Replace linings.
	(9) Bell-mouthed, barrel-shaped, or scored drums.	(9) Replace or resurface drums in left and right hand pairs.

Service Diagnosis-Drum Brakes (Continued)

Condition	Possible Cause	Correction
LIGHT PEDAL PRESSURE-BRAKES TOO SEVERE	(1) Brake adjustment not correct.	(1) Adjust brakes.
	(2) Loose support plates.	(2) Tighten support plates.
	(3) A small amount of grease or fluid on linings.	(3) Replace the linings.
	(4) Pedal linkage binding, or power unit bellcrank pivot pins binding (CJ only).	(4) Lube linkage and bellcrank pivot pins.
	(5) Internal bind in power unit.	(5) Replace power unit.
	(6) Incorrect lining.	(6) Install new linings.
	(7) Lining loose on shoe.	(7) Replace lining or shoe and lining.
	(8) Bell-mouthed, barrel-shaped, or scored drums.	(8) Turn drums in pairs or replace.
	(9) Combination valve faulty.	(9) Replace combination valve.
PULSATING BRAKE PEDAL	(1) Drums out-of-round.	(1) Refinish or replace drums.
	(2) Loose brake drum on hub.	(2) Tighten.
	(3) Worn or loose wheel bearings.	(3) Replace or adjust.
	(4) Bent shoes or linings.	(4) Replace shoe-lining assembly as required.
	(5) Bent rear axle shaft.	(5) Replace axle shaft.
	(6) Loose or bent support plate.	(6) Tighten or replace support plate.
BRAKE FADE	(1) Incorrect lining.	(1) Replace lining.
	(2) Air in lines or improper brake fluid.	(2) Bleed system. Drain and flush if fluid is improper type.
	(3) Master cylinder primary piston worn, or bore scored, corroded.	(3) Disassemble master cylinder. Repair as required.
ALL BRAKES DRAG (ADJUSTMENT IS KNOWN TO BE CORRECT)	(1) Power unit bellcrank pivot pins binding (CJ only).	(1) Lubricate pedal pivot or bellcrank pivot pins.
	(2) Improper fluid.	(2) Replace fluid and rubber parts.
	(3) On power brakes (CJ only) push rod height is incorrect.	(3) Adjust push rod height.

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Service Diagnosis-Drum Brakes (Continued)

Condition	Possible Cause	Correction
ALL BRAKES DRAG (ADJUSTMENT IS KNOWN TO BE CORRECT (Continued)	(4) Compensating or bypass port of master cylinder closed.	(4) Open with compressed air.
	(5) Use of inferior hydraulic fluid or rubber parts. (Swollen cups, corroded wheel or master cylinder bores.	(5) Overhaul wheel and/or master cylinder.
BRAKE PEDAL TRAVEL DE-CREASING	(1) Master cylinder compensating port plugged.	(1) Use compressed air to unplug.
	(2) Power unit bellcrank pivot pins binding (CJ only) or pedal pivot binding on manual brakes.	(2) Lube pedal pivot or pivot pins.
	(3) Swollen cup in master cylinder.	(3) Replace rubber parts. Flush system.
	(4) Master cylinder piston not returning.	(4) Overhaul master cylinder.
	(5) Wheel cylinder pistons sticking.	(5) Overhaul wheel cylinder.
ONE WHEEL DRAGS	(1) Weak or broken brake shoe retracting springs.	(1) Replace the defective brake shoe springs and lubricate the brake shoe ledges.
	(2) Power unit bellcrank pivot pins binding (CJ only) or pedal pivot binding.	(2) Lube pedal pivot or pivot pins.
	(3) Insufficient brake shoe-to-drum clearance.	(3) Adjust brakes. Repair automatic adjusters if necessary.
	(4) Loose wheel bearings.	(4) Adjust wheel bearings.
	(5) Wheel cylinder piston cups swollen and distorted.	(5) Overhaul wheel cylinders.
	(6) Pistons sticking in wheel cylinder.	(6) Clean or replace pistons; clean cylinder bore.
	(7) Restriction in brake line.	(7) Clean out or replace.
	(8) Loose anchor pin.	(8) Adjust and tighten lock nut.
	(9) Parking brake components seized or incorrectly adjusted.	(9) Repair or replace parts as necessary.
ONE WHEEL LOCKS	(1) Contaminated linings.	(1) Replace the linings.
	(2) Worn tire treads.	(2) Replace tire or, match up tire treads from side to side.

60637D

Service Diagnosis-Drum Brakes (Continued)

Condition	Possible Cause	Correction
BRAKES GRAB OR WON'T HOLD IN WET WEATHER	(1) Linings water-soaked.	(1) Dry out linings by driving with brakes lightly applied.
	(2) Dirt, water in drums.	(2) Clean drums.
	(3) Bent support plate allowing excessive water to enter drum.	(3) Replace support plate.
	(4) Scored drums.	(4) Replace or resurface in pairs.
BRAKES SQUEAK	(1) Support plate bent or shoes twisted.	(1) Replace damaged parts.
	(2) Metallic particles or dust imbedded in lining.	(2) Sand the surfaces of the linings and drums. Remove all particles of metal that may be found in the surface of the linings.
	(3) Lining rivets loose or lining not held tightly against the shoe at the ends.	(3) Replace rivets. Replace shoe lining assemblies if damaged.
	(4) Drums distorted.	(4) Turn or replace drums.
	(5) Shoes scraping on support plate ledges.	(5) Lubricate.
	(6) Weak or broken hold-down springs.	(6) Replace defective parts.
	(7) Loose wheel bearings.	(7) Adjust bearings.
	(8) Charred lining.	(8) Replace lining.
	(9) Loose support plate, anchor, drum, or wheel cylinder.	(9) Tighten.
	(10) Linings located wrong on shoes.	(10) Install linings correctly.
REAR BRAKES DRAG	(1) Adjustment not correct.	(1) Adjust brake shoes and parking brake mechanism.
	(2) Parking brake cables frozen.	(2) Lubricate or replace as required.
	(3) Dirty lining.	(3) Replace lining.
	(4) Wheel cylinder cups swollen or piston sticking.	(4) Overhaul cylinders.
	(5) Weak retracting springs.	(5) Replace springs.
	(6) Shoes binding on support plate.	(6) Lubricate support plate ledges

Service Diagnosis-Drum Brakes (Continued)

Condition	Possible Cause	Correction
VEHICLE PULLS TO ONE SIDE	(1) Grease or fluid-soaked lining.	(1) Locate and correct leakage; replace linings.
	(2) Adjustment not correct.	(2) Adjust the brakes.
	(3) Loose wheel bearings, loose support plate(s) or loose spring bolts.	(3) Adjust wheel bearing; tighten support plate(s) and tighten spring bolts.
	(4) Linings not of specified kind or primary and secondary shoes reversed.	(4) Install new linings.
	(5) Power unit bellcrank pivot pins binding (CJ only).	(5) Lube pivot pins.
	(6) Tires not properly inflated or unequal wear of tread. Different tread design side to side.	(6) Inflate the tires to recommended pressures. Rotate tires so that tread surfaces of similar design and equal wear will be installed on the front wheels.
	(7) Water, mud, or foreign matter in brakes.	(7) Remove foreign material from brake parts and inside of the drums. Lubricate the shoe ledges and the rear brake cable ramps.
	(8) Wheel cylinder sticking.	(8) Overhaul or replace wheel cylinder.
	(9) Weak or broken retracting springs.	(9) Check springs. Replace bent, distorted or cracked springs.
	(10) Out-of-round drums.	(10) Resurface or replace drums in left and right hand pairs (both front and both rear).
	(11) Brake dragging.	(11) Check for loose lining. Repair or replace as required.
	(12) Broken spring or loose U-bolts.	(12) Replace spring or tighten U-bolts.
	(13) Loose steering components.	(13) Tighten or repair and adjust as required.
	(14) Unequal camber.	(14) Replace axle housing.
	(15) Clogged or crimped brake line.	(15) Repair or replace line.
	(16) Wheel cylinder incorrect size.	(16) Replace with correct cylinders.
	(17) Worn steering knuckle bearings.	(17) Replace.

Service Diagnosis-Drum Brakes (Continued)

Condition	Possible Cause	Correction
BRAKES CHATTER	(1) Incorrect lining-to-drum clearance.	(1) Adjust to recommended clearances.
	(2) Loose brake support plate.	(2) Tighten support plate.
	(3) Grease, fluid, road dust on lining.	(3) Clean out dust; replace grease and fluid-soaked lining.
	(4) Weak or broken retractor spring.	(4) Replace.
	(5) Loose wheel bearings.	(5) Adjust.
	(6) Drums out-of-round.	(6) Turn or replace drums in pairs.
	(7) Cocked or distorted shoes.	(7) Straighten or replace.
	(8) Tapered or barrel-shaped drums.	(8) Turn or replace drums in pairs.
SHOE CLICK	(1) Shoes lift off support plate and snap back.	(1) Change drums side to side or turn drums (in pairs).
	(2) Holddown springs weak.	(2) Replace springs.
	(3) Shoe bent.	(3) Replace shoes on both sides.
	(4) Grooves in support plate ledges.	(4) Replace support plate.

60637G

Service Diagnosis-Disc Brakes

Condition	Possible Cause	Correction
BRAKE CHATTER OR ROUGHNESS. BRAKE PEDAL PULSATES	(1) Excessive rotor lateral runout.	(1) Check rotor runout. Refinish if not to specs (refer to Rotor Measurements).Replace if unable to refinish.
	(2) Excessive rotor thickness variation.	(2) Check rotor thickness variation. Refinish if out of spec. Replace if unable to refinish.
	(3) Loose or worn wheel bearings.	(3) Adjust to specs. Replace if worn or damaged.
	(4) Rear drums out-of-round.	(4) Check runout. If not to specs turn drum. Do not remove more than .060 inch (1.52 mm)

60638A

Service Diagnosis-Disc Brakes (Continued)

Condition	Possible Cause	Correction
BRAKE CHATTER OR ROUGHNESS. BRAKE PEDAL PULSATES (Continued)	(5) Disc brake shoes reversed (steel side of shoe riding on rotor).	(5) Replace rotor and shoes.
	(6) Shoes bent or linings worn.	(6) Replace shoes.
EXCESSIVE PEDAL EFFORT REQUIRED	(1) Malfunction in power brake unit.	(1) Check operation. Refer to Power Brake Units.
	(2) Malfunction in front or rear brake system (dual master cylinder) such as: wheel cylinder leaks, defective brake lines, caliper piston seal leak, master cylinder piston cups not holding pressure.	(2) Check both brake systems and correct as required. Check for failed brake warning light if brake failure occurred and light did not operate.
	(3) Lining worn.	(3) Check and replace linings as required.
	(4) Caliper piston sticking.	(4) Rebuild caliper.
	(5) Brake fade caused by incorrect or non-recommended linings.	(5) Replace with correct or recommended lining.
	(6) Incorrect master cylinder.	(6) Check and replace if required.
EXCESSIVE PEDAL TRAVEL	(1) Low fluid level.	(1) Add fluid as required.
	(2) Leak in system.	(2) Inspect and correct as required.
	(3) Air in system.	(3) Bleed brakes.
	(4) Rear brakes not adjusting properly.	(4) Adjust rear brakes and repair automatic adjusters.
	(5) Worn lining.	(5) Replace linings. If wear is excessive or premature, check for incorrect lining, sticking caliper pistons, binding park brake cables, shoe drag on support plate, weak return springs on drum brakes, improper rear brake adjustment.
	(6) Bent or broken shoe.	(6) Replace as required.
	(7) Master cylinder mounting bolts loose.	(7) Check and retighten.
	(8) Rotor thickness or drum diameter below specification.	(8) Inspect, measure and replace as required.
DRAGGING BRAKES NOTE: A very light drag occuring after releasing the brake pedal is a characteristic of disc brakes.	(1) Master cylinder pistons not returning properly.	(1) Remove cover, check for spurt of fluid at compensator holes as brake pedal is depressed. Rebuild master cylinder if fluid spurt is not observed. Inspect compensator ports for blockage, use compressed air to clear passages.

606388

Service Diagnosis-Disc Brakes (Continued)

Condition	Possible Cause	Correction
	(2) Restrictions in brake lines or hoses.	(2) Check for kinks or dents in steel lines . Check rubber hoses for swelling or restrictions inside hose.
	(3) Incorrect parking brake adjustment.	(3) Check and readjust to specification. Inspect cables for bind or frayed conditions.
	(4) Rear shoes not returning to normal position.	(4) Return springs weak. Shoes dragging on support plate due to lack of lube or ridges on support plate ledges. Wheel cylinder cups swollen or pistons sticking. Repair or replace faulty parts as required.
	(5) Caliper pistons not releasing. Pistons stuck due to piston scoring or corrosion or piston cocking in bore.	(5) Repair or replace pistons or caliper as required.
	(6) Lines to combination valve installed incorrectly.	(6) Check and correct as required. Port marked inlet goes to master cylinder; port marked outlet goes to calipers.
	(7) Bind in brake pedal or power unit bellcrank pivot pins (CJ only)	(7) Lube pedal pivot or pivot pins.
	(8) Check valve installed in master cylinder outlet port.	(8) Check outlet. Remove valve if present. Bleed brakes.
GRABBING BRAKES	(1) Refer to all conditions listed under PULLS WHEN BRAKES ARE APPLIED.	(1) See PULLS WHEN BRAKES ARE APPLIED.
	(2) Power brake unit malfunction or bellcrank pivot pins binding (CJ only).	(2) Check operation and replace or repair as required. Refer to POWER UNIT SERVICE DIAGNOSIS Chart.
	(3) Combination valve malfunction.	(3) Replace valve and bleed system.
	(4) Incorrect power unit.	(4) Check and replace as required.
PULLS WHEN BRAKES ARE APPLIED	(1) Incorrect tire pressures.	(1) Inflate to spec.
	(2) Mismatched tires on same axle.	(2) Install equal size, type tires.
	(3) Wheel bearings misadjusted or worn.	(3) Adjust or replace as required.

60638C

Service Diagnosis-Disc Brakes (Continued)

Condition	Possible Cause	Correction
	(4) Malfunction in caliper.	(4) Check for stuck piston.
	(5) Damaged or contaminated shoe and lining (grease on lining or bent shoe).	(5) Replace shoe and lining on both sides. Replace axle seals, wheel cylinder cups, or caliper piston seals, if leaking.
	(6) Rear brake problem: automatic adjusters inoperable, contaminated lining, defective wheel cylinders, seized or improperly adjusted park brake cables, shoes binding on support plate, linings worn, linings charred or cracked, bent support plate, weak retracting springs, drums out-of-round.	(6) Inspect and repair or replace malfunctioning parts. Check for equal size wheel cylinders on rear brakes.
	(7) Loose calipers.	(7) Check mounting bolt torque, inspect threads on bolts for galling or stripped threads, check support plate for broken welds.
	(8) Loose suspension parts.	(8) Inspect and correct as required.
	(9) Front end out of alignment.	(9) Check and correct as required.
	(10) Lining soaked with water after operation in heavy rains, or flooding conditions.	(10) Allow lining to air dry, or while driving, keep brakes lightly applied to warm up lining and evaporate water.
	(11) Disc brake rotor out of tolerance.	(11) Check and refinish or replace as required.
REAR DRUM BRAKES SKID PREMATURELY ON HARD BRAKE APPLICATION	(1) Combination valve proportioner section malfunctioning.	(1) Replace valve and bleed brakes.
	(2) Check items listed under PULLS and GRABBING.	(2) See PULLS and GRABBING.
SPONGY PEDAL	(1) Air in system.	(1) Bleed brakes. Inspect for broken lines, loose fittings, leaking caliper pistons, or wheel cylinders; check rubber seal on master cylinder cover. Check cover itself for distortion or cracks. check all bleed valves for proper torque.
	(2) Rear drums thin or cracked.	(2) Inspect and correct as required.
	(3) Calipers loose.	(3) Check mounting bolt torque.
	(4) Loose master cylinder or brake booster attaching parts.	(4) Check and correct as required.

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Service Diagnosis-Disc Brakes (Continued)

Condition	Possible Cause	Correction
SPONGY PEDAL (Continued)	(5) Compensator port blocked in master cylinder.	(5) Check and correct as required.
	(6) Improper (low quality) brake fluid in system. Fluid boils and becomes aerated.	(6) Drain and flush system.

60638E

BRAKE PEDAL

A suspended brake pedal is used on all models. The pedal is attached to the pedal support bracket by a pivot bolt (figs. 2G-1 and 2G-2). The pivot bolt serves as both attaching part and pivoting member for the pedal.

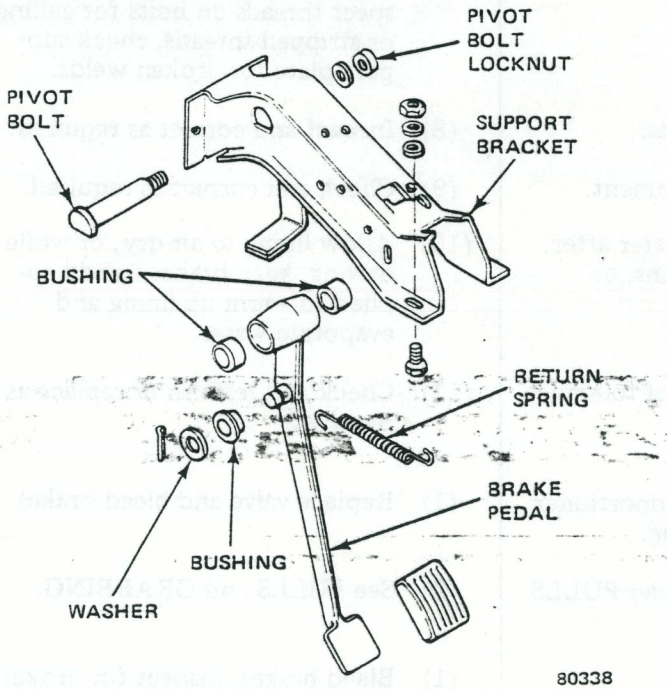

Fig. 2G-1 Brake Pedal—CJ Models

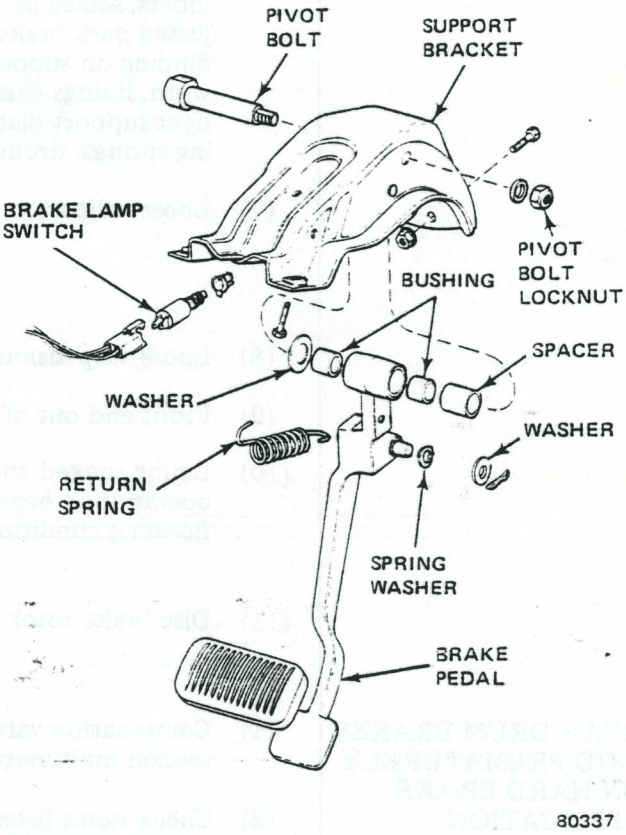

Fig. 2G-2 Brake Pedal—Cherokee-Wagoneer-Truck Models

The pedal linkage should be lubricated and inspected regularly for binding, looseness, or excessive play. Binding can cause improper pedal release which may result in brake drag and rapid lining wear. In addition, worn pedal linkage may cause a low pedal condition or frequent need for brake adjustment.

Pedal free play should be 1/16 to 1/4 inch (1.58 to 6.35 mm). Inadequate free play can result in brake drag or grab while excessive free play can produce a low pedal condition. Free play on models with nonpower brakes is governed by pedal push rod length which is preset at manufacture. The push rod is not adjustable on these models and under normal circumstances should not require further attention. Power brake equipped vehicles utilize a single push rod in the power unit which is also preset at manufacture and is not adjustable. When replacing a power unit, use the push rod supplied with the replacement power unit as it has been properly gauged for use with the replacement unit. Pedal free play for power brake equipped vehicles is the same as for vehicles with nonpower brakes.

BRAKE WARNING LAMP

A dual purpose warning lamp is located in the instrument cluster on all Jeep vehicles. The primary function of this lamp is to alert the driver if a pressure

differential between front and rear brake hydraulic systems should ever occur.

On vehicles with a parking brake warning system, the lamp also functions as a signal device to alert the driver when the parking brakes are applied.

In the parking brake signal mode, the lamp is activated by a mechanically operated switch mounted on the parking brake lever assembly. In the brake hydraulic pressure differential warning mode, the lamp is activated by a plunger-type switch located in the combination valve.

If a pressure loss should occur in either the front or rear brake hydraulic systems, a pressure differential of 70 to 300 psi (483 to 2 068 kPa) will cause a piston in the pressure differential section of the combination valve to shuttle toward the low pressure side of the valve. As the piston moves toward this side of the valve, ramps on the piston contact the differential switch plunger forcing it upward and closing the switch internal contacts. This completes the electrical circuit between switch and warning lamp causing the lamp to light. Unless the ignition lock cylinder is turned to the Off position, the lamp will remain illuminated until the cause of the pressure differential is corrected.

In normal operation, with the ignition lock cylinder turned to the Start Position, the warning lamp will illuminate and remain so until the engine is started and the lock cylinder is returned to the On position, or when the parking brakes are released. This feature is provided as a means of checking warning lamp bulb and circuit operation.

PARKING BRAKE ADJUSTMENT

NOTE: *The service brakes must be adjusted before adjusting the parking brakes.*

(1) Release parking brakes.

(2) Loosen equalizer locknuts to release tension on cables (figs. 2G-3 and 2G-4).

(3) Inspect all cables for binds, kinks, or frayed condition. Replace damaged cables.

(4) Tighten equalizer locknut until slight drag is produced at wheels.

(5) Loosen equalizer locknut until wheels rotate freely and brake drag is eliminated.

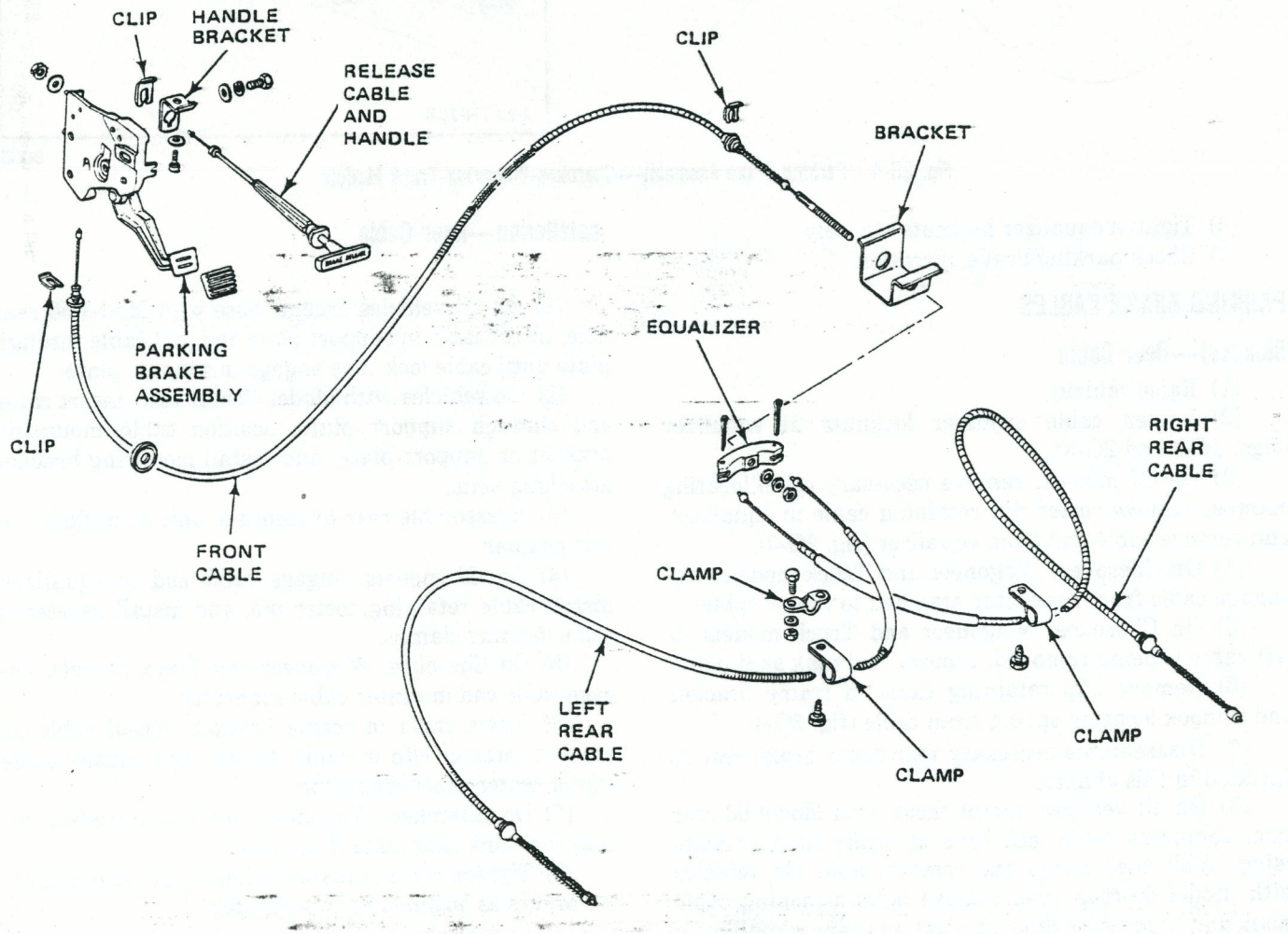

Fig. 2G-3 Parking Brake Assembly—CJ Models

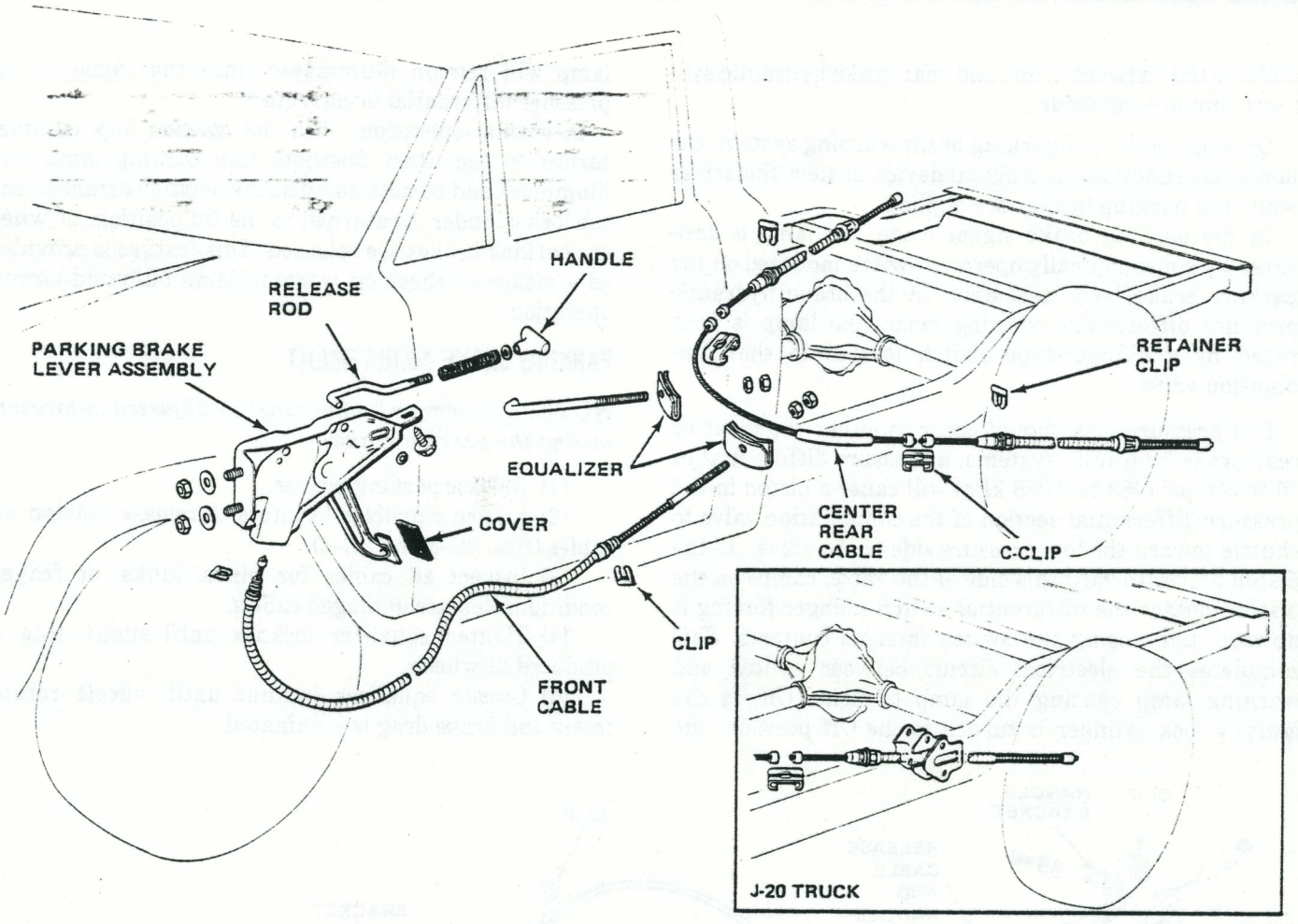

Fig. 2G-4 Parking Brake Assembly—Cherokee-Wagoneer-Truck Models

(6) Tighten equalizer locknuts securely.

(7) Check parking brake operation.

PARKING BRAKE CABLES

Removal—Rear Cable

(1) Raise vehicle.

(2) Loosen cable adjuster locknuts at equalizer (figs. 2G-2 and 2G-3).

(3) On CJ models, remove necessary cable locating clamps, remove cotter pin retaining cable in equalizer, and remove cable end from equalizer (fig. 2G-3).

(4) On Cherokee, Wagoneer and Truck models, disengage cable from connector attached to center cable.

(5) On Cherokee, Wagoneer and Truck models, if left cable is being removed, remove fuel tank skid plate.

(6) Remove clip retaining cable in frame bracket and unhook locating spring from cable (fig. 2G-4).

(7) Disassemble necessary rear drum brake unit as outlined in this chapter.

(8) On all vehicles except those with Model 60 rear axle, compress cable lock tabs at brake support plate using small hose clamp and remove cable. On vehicles with Model 60 rear axle, remove bolts attaching cable mounting bracket to support plate and remove cable.

Installation—Rear Cable

(1) On all vehicles except those with Model 60 rear axle, insert cable in support plate and pull cable through plate until cable lock tabs engage in support plate.

(2) On vehicles with Model 60 rear axle, insert cable end through support plate, position cable mounting bracket on support plate, and install mounting bracket attaching bolts.

(3) Reassemble rear drumbrake unit as outlined in this chapter.

(4) On CJ models, engage cable end in equalizer, install cable retaining cotter pin, and install necessary cable locating clamps.

(5) On Cherokee, Wagoneer and Truck models, engage cable end in center cable connecter.

(6) Insert cable in frame bracket, install cable-to-bracket retainer clip in cable ferrule, and engage cable end in center cable connector.

(7) On Cherokee, Wagoneer and Truck models, install fuel tank skid plate if removed.

(8) Tighten cable adjuster locknuts and adjust parking brakes as outlined in this chapter.

(9) Lower vehicle.

Removal—Front Cable

(1) Raise vehicle.
(2) Remove equalizer from front cable.
(3) On CJ models, remove clip retaining cable to frame bracket.
(4) On Cherokee, Wagoneer and Truck models, remove clip retaining cable to rear crossmember.
(5) Lower vehicle.
(6) Disconnect front cable return spring at parking brake lever assembly if equipped.
(7) Roll carpet back and remove front cable ferrule-to-parking brake lever assembly retaining clip.
(8) Disengage cable end from parking brake lever assembly.
(9) Remove cable.
(10) If cable is to be replaced, remove insulator or grommet from lever end of cable.

Installation—Front Cable

(1) Install front cable through floorpan and install cable grommet or insulator in floorpan.
(2) Install cable ferrule-to-parking brake lever assembly retaining clip and reposition carpet.
(3) Engage cable end in parking brake lever assembly and install cable return spring if equipped.
(4) On CJ models, install clip retaining cable to frame bracket.
(5) On Cherokee, Wagoneer and Truck models, install clip retaining cable to rear crossmember.
(6) Raise vehicle.
(7) Install cable equalizer and locknuts. On CJ models, be sure cable is properly positioned in frame bracket as well as equalizer (fig. 2G-3).
(8) Adjust parking brakes as outlined in this section.
(9) Lower vehicle.

BRAKELAMP SWITCH

The brakelamp switch is mounted on a flange attached to the brake pedal support bracket (fig. 2G-2). A spring-loaded plunger in the switch opens and closes the stoplamp circuit.

When the brake pedal is in the released position, the pedal arm contacts the switch plunger, holding it in the off position. When the brake pedal is pressed, the spring loaded plunger extends with brake pedal movement until the switch is in the On position.

Brakelamp Switch Adjustment

(1) On CJ models with air conditioning, remove screws attaching evaporator housing to instrument panel and move housing away from panel.
(2) Press and hold brake pedal in applied position.
(3) Push brakelamp switch through mounting bracket until it stops against brake pedal bracket.
(4) Release brake pedal to set switch in proper position.
(5) Check switch position. Switch plunger should be in ON position and activate brakelamps after 3/8 to 5/8 inch (9.52 to 15.87 mm) brake pedal travel. Measure pedal travel from center of brake pedal pad.
(6) On CJ models with air conditioning, reposition evaporator housing on panel and install housing attaching screws.

SERVICE BRAKE ADJUSTMENT

The rear drum brakes are the only adjustable service brakes on Jeep vehicles. If the rear brakes are disassembled for any reason, an initial adjustment must be performed before installing the drum. In addition, if diagnosis indicates the need, the rear brakes can be adjusted manually as follows:

(1) To perform initial adjustment with drums removed, use Brakeshoe-to-Drum Clearance Gauge J-21107-01 to preset brakelining adjustment (fig. 2G-5).

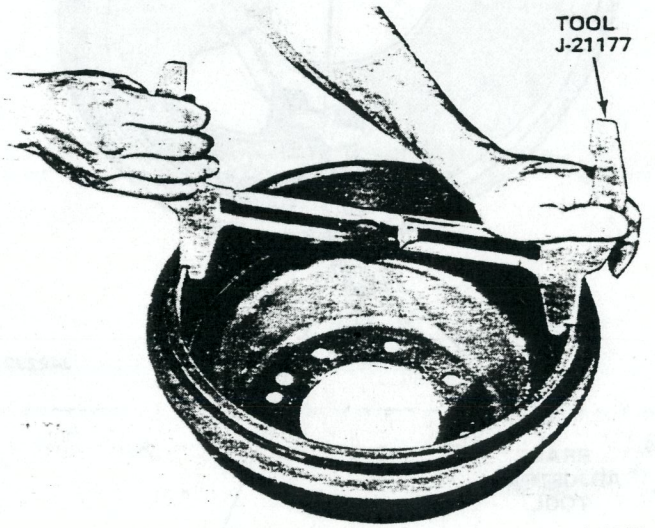

Fig. 2G-5 Presetting Brakeshoe-To-Drum Clearance

Drums should fit over brakelining with slight drag.

(2) To manually adjust rear brakes with drums in place, proceed to next step.

(3) Remove access slot covers from brake support plates.

(4) Rotate adjusting screw in clockwise direction using brake adjusting tool until brakes are locked.

(5) Rotate adjuster screw in counterclockwise direction until wheel rotates freely (fig. 2G-6).

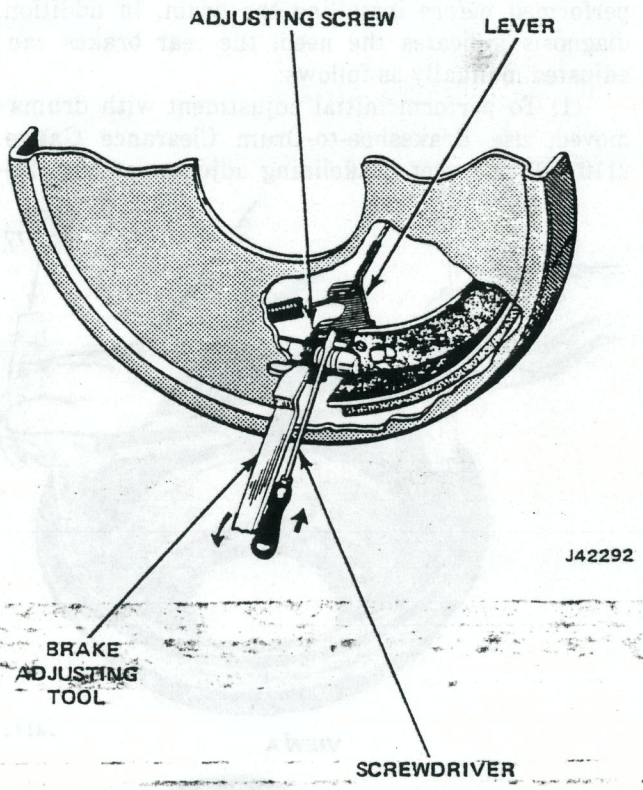

Fig. 2G-6 Adjusting Drum Brakes Manually

CAUTION: *The automatic adjuster lever must be disengaged from the adjuster screw before the screw can be rotated. Use a thin blade screwdriver or section of 1/8 welding rod to unseat the adjuster lever (fig. 2G-6).*

(6) Install access slot cover in brake support plate.

(7) Check brake operation before moving vehicle.

(8) Complete rear brake and pedal travel adjustment by driving vehicle in reverse and making 10 to 15 firm brake applications. Make one forward brake application between each reverse application to equalize adjustment.

BRAKELINING INSPECTION

Disc Brakes

The brakelining should be inspected whenever the wheels are removed for tire rotation or at the intervals specified in the Maintenance Schedule.

It is not necessary to remove the front calipers for brakelining inspection. The outboard lining can be viewed from either end of the caliper and the inboard lining can be viewed through the inspection port in the caliper body (fig. 2G-7). The lining should be replaced when it has worn to the approximate thickness of the metal brakeshoe.

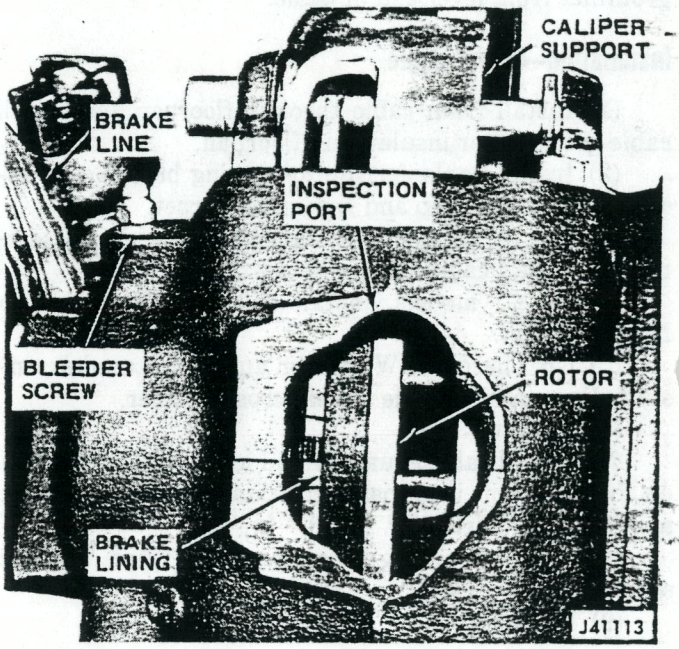

Fig. 2G-7 Caliper Inspection Port

NOTE: *The disc brakeshoes used on Cherokee, Wagoneer and Truck models have a wear sensor attached to the inboard brakeshoe. When the lining wears sufficiently, the sensor contacts the rotor making a high pitched noise to warn the driver that replacement is necessary.*

Drum Brakes

Inspect the rear drum brakelining whenever the rear wheels and drums are removed or at the intervals specified in the Mechanical Maintenance Schedule. Bonded linings should be replaced whenever the lining has worn to a thickness of 1/16 inch (1.58 mm) or less. Riveted linings should be replaced whenever the lining has worn to within 1/32 inch (0.79 mm) of the rivet heads.

SPECIFICATIONS

Brake Size and Application Chart

Model	Master Cylinder Bore Diameter	Front Brakes		Rear Brakes		Power Brake Unit Type
		Brake Size And Type	Caliper Piston Diameter	Brake Size And Type	Wheel Cyl. Diameter	
CJ	1.00 (25.4 mm)	11.7 Disc. (29.7 cm)	2.6 Single Piston (6.60 cm)	10 x 1.75 Drum (25.4 x 4.44 cm)	.875 (22.2 mm)	8.00 Single Diaphragm (20.3 cm)
Cherokee Wagoneer	1.125 (28.5 mm)	12.0 Disc. (30.48 cm)	2.937 Single Piston (7.45 cm)	11 x 2 Drum (27.94 x 5.08 cm)	.937 (23.79 mm)	9 1/2 Single Diaphragm (24.13 cm)
J-10 Truck	1.125 (28.5 mm)	12.0 Disc. (30.48 cm)	2.937 Single Piston (7.45 cm)	11 x 2 Drum (27.94 x 5.08 cm)	.937 (23.79 mm)	9 1/2 Single Diaphragm (24.13 cm)
J-20 Truck 6800 GVW	1.125 (28.5 mm)	12.5 Disc. (31.75 cm)	2.937 Single Piston (7.45 cm)	12 x 2.5 Drum (30.48 x 6.35 cm)	1.125 (28.5 mm)	9 1/2 Tandem Diaphragm (24.13 cm)
J-20 Truck 7600 GVW	1.125 (28.5 mm)	12.5 Disc. (31.75 cm)	2.937 Single Piston (7.45 cm)	12 x 2.5 Drum (30.48 x 6.35 cm)	1.125 (28.5 mm)	9 1/2 Tandem Diaphragm (24.13 cm)
J-20 Truck 8400 GVW	1.125 (28.5 mm)	12.5 Disc. (31.75 cm)	2.937 Single Piston (7.45 cm)	12 x 2.5 Drum (30.48 x 6.35 cm)	1.125 (28.5 mm)	9 1/2 Tandem Diaphragm (24.13 cm)

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Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft-lbs)		Metric (N-m)	
	Service Set - to Torque	In - Use Recheck Torque	Service Set - to Torque	In - Use Recheck Torque
Brakeline-to-Caliper Fitting Bolt (Cke, Wag, Trk)	160 in-lbs.	120 - 200 in-lbs.	18	14 23
Bleeder Screw (1/4 - 28)	45 in-lbs.	40 - 50 in-lbs.	5	5 - 6
Bleeder Screw (3/8 - 24)	90 in-lbs.	40 - 140 in-lbs.	10	5 16
Brake Support Plate Mounting Bolts/Nuts (J-20 Trk)	50	45 - 55	68	61 - 75
Brake Support Plate Mounting Bolts/Nuts (Cke, Wag, J10 Trk)	45	35 - 55	61	47 - 75
Brake Support Plate Mounting Bolts/Nuts (CJ)	33	30 - 35	45	41 - 47
Caliper Anchor Bracket to Steering Knuckle (CJ)	85	75 - 95	115	102 - 129
Master Cylinder Mounting Bolts/Nuts	30	25 - 35	41	34 - 47
Master Cylinder-to-Power Unit Mounting Nuts	25	20 - 30	34	27 - 41
Power Brake Unit-to-Dash Mounting Bolts/Nuts	22	18 - 25	30	24 - 34
Brake Line-to-Caliper Fitting Bolt (CJ)	25	20 - 30	34	27 - 41
Brake Line-to-Wheel Cylinder Fitting	160 in-lbs.	120 - 200 in-lbs.	18	14 23
Parking Brake Cable Clamp-to-Support Plate Bolts (5/16 - 18)	10	8 - 12	14	11 - 16
Wheel Nuts (CJ)	75	65 - 90	102	88 - 122
Wheel Nuts (Cke, Wag, Trk)	75	65 - 80	102	88 - 108
Wheel Nuts (8400 GVW Trk)	130	110 - 150	176	149 - 203
Brake Pedal-to-Power Unit Push Rod Bolt/Nut	35	25 - 40	47	34 - 54
Caliper Mounting Bolts (Cke, Wag, Trk)	35	30 - 40	47	41 - 54
Caliper Support Key Retaining Screw (CJ)	15	15 - 18	20	20 - 24
Disc. Brake Shield Bolts (Cke, Wag, Trk)	8	5 - 10	11	7 - 14
Disc. Brake Shield Nuts (Cke, Wag, Trk)	35	30 - 40	47	41 - 54
Wheel Bearing Outer Locknut (All)	50(min.)		68 (min.)	
Wheel Bearing Inner Locknut (Bearing Adjuster):				
CJ	Tighten to 50 ft-lbs. (68 N-m) and back off 1/3 turn while rotating wheel.			
Cke, Wag, Trk	Tighten to 50 ft-lbs. (68 N-m), loosen and retighten to 35 ft-lbs. (47 N-m), then back off 1/3 turn - all while rotating wheel.			

All Torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

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BRAKE HYDRAULIC SYSTEM

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Brake Fluid	2G-20	Master Cylinder	2G-21
Brake Fluid Level	2G-21	Specifications	2G-29
Combination Valve	2G-26	Wheel Cylinder	2G-25
General	2G-20		

GENERAL

The brake hydraulic system consists of the dual reservoir master cylinder, combination valve, front disc brake calipers, rear drum brake wheel cylinders, and the connecting brake lines, hoses, and fittings (fig. 2G-8).

The hydraulic system is a closed system and must remain free of contaminants in order to function properly. When servicing the system, prevent the entry of contaminants by capping all lines and ports, and by avoiding the use of cleaning solvents that have a mineral oil base.

CAUTION: *Never use gasoline, kerosene, carbon tetrachloride, paint thinner, alcohol, or any similar fluid containing mineral oil, to clean or lubricate hydraulic system components. These materials will cause swelling, deterioration, and premature aging of rubber parts. Use brake fluid or brake cleaning solvent only.*

To determine if dirt, moisture, or mineral oil base fluids have contaminated the hydraulic fluid, drain off a sample and check for suspended particles, discoloration, or separation of the fluid into distinct layers. Layering indicates the presence of water or mineral oil. If system contamination should occur, drain and flush the entire brake hydraulic system with an approved brake fluid only.

BRAKE FLUID

When refilling or adding brake fluid to the hydraulic system, use Jeep Brake Fluid or equivalent grade marked SAE J1703 or DOT 3 only. Do not use any brake

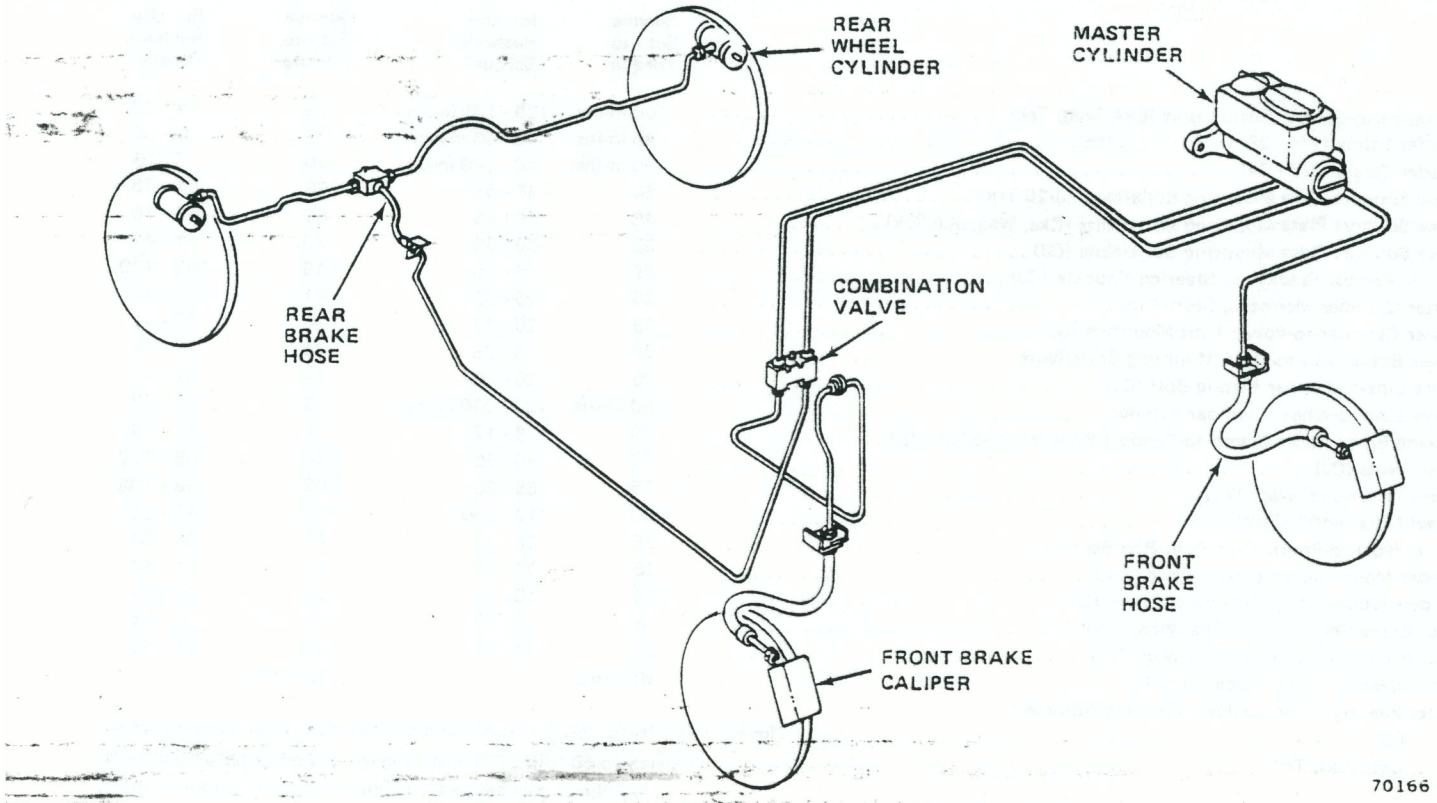

Fig. 2G-8 Brake Hydraulic System—Typical

fluid that does not have these grade markings. The use of nonapproved fluids can result in low fluid levels, spongy pedal, fluid aeration, brake fade, and deterioration of brake system components.

CAUTION: *Never refill or add used or reclaimed brake fluid to the hydraulic system.*

BRAKE FLUID LEVEL

The master cylinder fluid level should be checked at least four times a year or every 5,000 miles (8 046 km). Refer to the Maintenance Schedule for details.

When refilling or adding fluid to the system, fill the master cylinder fluid reservoirs to within 1/4 inch (6.35 mm) of each reservoir rim. This is the proper fluid level for all Jeep vehicles.

When checking the fluid level, also inspect the rubber diaphragm seal on the cylinder cover for cracks, cuts, distortion, or any other condition that might allow air or foreign material to enter the master cylinder reservoirs. In addition, when the cover is removed for any reason, do not allow the seal to contact dirt, grease, or other foreign material which could be transferred to the fluid reservoirs.

HYDRAULIC SYSTEM INSPECTION

(1) Clean master cylinder and cylinder cover thoroughly before checking fluid level.

(2) Check master cylinder cover retaining spring for proper tension and fit. Spring should provide enough tension on cover to maintain airtight seal.

(3) Remove cylinder cover and inspect cover and rubber diaphragm seal for cracks and distortion.

(4) Check master cylinder fill level.

(5) Check for dirt and foreign material in reservoirs. If fluid contamination is suspected, drain fluid sample into clean glass container and test for contamination as evidenced by fluid layering.

(6) Inspect all fittings and brake lines for leakage, kinks, or other damage.

(7) Inspect condition of front brake hoses. Replace hoses if cut, cracked, swollen, or leaking.

(8) Check for evidence of fluid leakage at rear wheel cylinders and front calipers. Repair as necessary.

MASTER CYLINDER

A dual reservoir master cylinder is used on all Jeep vehicles. The hydraulic system for the front brakes is completely separate from the rear brakes. In the event of hydraulic brake failure in the front system, the rear hydraulic brakes will still operate. If a failure occurs in the rear brakes, the front brakes will still operate.

The dual master cylinder has two outlet ports, two fluid reservoirs, and two hydraulic pistons which are operated in tandem by a single push rod.

When the master cylinder fluid reservoirs are filled and the front and rear brake systems purged of air, there is a solid column of fluid on the forward side of both the primary and secondary pistons.

During brake application, fluid is displaced by the master cylinder pistons into the front caliper and rear wheel cylinders to activate the brakes. At brake release, fluid returns from the calipers and wheel cylinders to the master cylinder reservoirs.

Cherokee, Wagoneer and Truck models are equipped with a master cylinder designed to be compatible with the low drag disc brake calipers now used on these vehicles. This unit incorporates a quick take-up feature which means the master cylinder delivers a large volume of brake fluid (at low pressure) to the wheel brakes upon initial brake application. This fluid quickly displaces the retracted caliper and rear wheel cylinder pistons which position the brake linings in contact with the brake rotors and drums.

Master Cylinder Service—All Models

Removal

(1) Disconnect brake lines at master cylinder. Cap or tape outlet ports in master cylinder and open ends of brake lines to prevent entry of dirt.

(2) On models with nonpower brakes, disconnect master cylinder push rod at brake pedal.

(3) Remove bolts or nuts attaching master cylinder to dash panel or power unit and remove master cylinder.

Disassembly

(1) Remove cover and diaphragm seal and drain fluid from master cylinder. Mount master cylinder in vise.

NOTE: *On Cherokee, Wagoneer and Truck models:*

A. Remove reservoir using pry bar (fig. 2G-9).

B. Remove reservoir grommets.

C. Remove retaining ring and quick take-up valve.

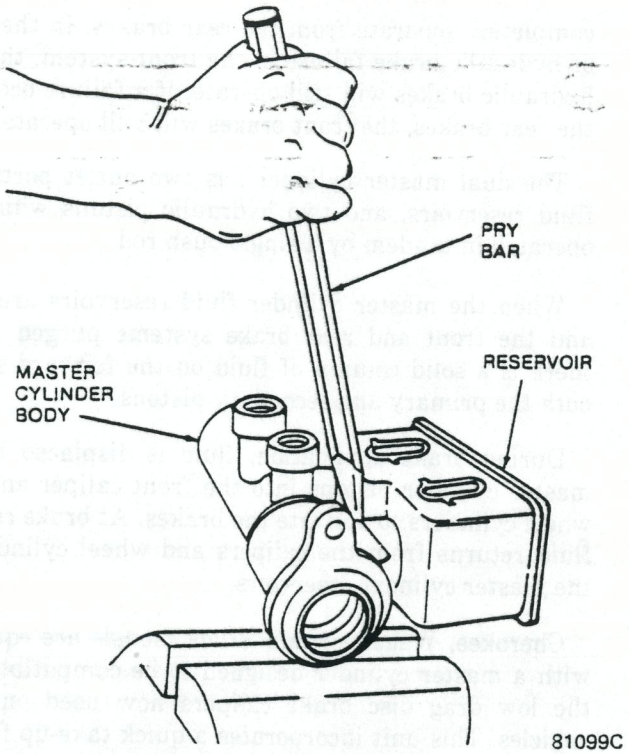

Fig. 2G-9 Removing Master Cylinder —Cherokee-Wagoneer-Truck Models

(2) On models with nonpower brakes, remove boot (figs. 2G-10 and 2G-11).

(3) Push primary piston inward using wood dowel or push rod and remove snap ring from groove in master cylinder bore.

(4) Remove primary and secondary piston assemblies from cylinder bore. Air pressure applied through compensator port in front reservoir will aid in removal of secondary piston assembly.

(5) On CJ models, remove push rod from primary piston as follows:

(a) Clamp push rod in vise with brake pedal eyelet facing downward and rear face of primary piston positioned just above vise jaws.

(b) Pry piston off push rod using suitable tool inserted between piston and vise.

(c) Remove rubber insert from primary piston and discard insert. It is not reusable.

CAUTION: *The rubber insert which retains the push rod in the primary piston on CJ models will be damaged when the piston is removed from the push rod. Do not attempt to reuse this insert. A replacement insert must be installed at assembly.*

(6) Remove piston seal and piston cups from secondary piston only. It is not necessary to disassemble primary piston as piston is supplied as complete assembly in repair kit.

(7) Clean and inspect master cylinder. Replace unit if bore is severely scored, corroded, or pitted, or if body is cracked, porous, or has sustained other damage. Check compensator and bypass ports in reservoirs. If plugged or dirty, open them using brake cleaning solvent and air pressure only. Never use wire to open ports as wire may create burr in port and push burr into cylinder bore.

CAUTION: *Clean the master cylinder with brake fluid or an approved brake cleaning solvent only. Never use solvents containing mineral oil such as gasoline, kerosene, alcohol, or carbon tetrachloride. Mineral oil is very harmful to the rubber piston cups and seals.*

(8) Inspect tube seats in outlet ports. Replace seats only if cracked, scored, cocked in bore, or loose. If replacement is necessary, remove seats as follows:

(a) On Cherokee, Wagoneer and Truck models, thread 6-32 x 5/8 self-tapping screw into tube seat. Pry upward on screw using two screwdrivers to remove seat. Remove chips using brake cleaning solvent.

(b) On CJ models, enlarge hole in tube seats using 13/64 drill. Place flat washer on each outlet port and thread 1/4-20 x 3/4 screw into seat. Tighten screw until seat is loosened. Remove seat, screw, and washer. Remove chips using brake cleaning solvent and compressed air.

Assembly

(1) Install replacement tube seats (if removed) using spare tube fitting nuts to press seats into place. Do not allow seats to become cocked during installation. Be sure seats are bottomed. Remove tube fitting nuts and check for burrs or chips. Remove burrs or chips. Rinse master cylinder in brake cleaning solvent and blow out all passages with compressed air.

(2) Install piston cups on secondary piston. Piston cup installed in groove at end of piston should have lip facing away from piston. Install next cup so lip faces piston (figs. 2G-10 and 2G-11).

(3) Install seal protector, piston seal, spring retainer, and return spring on secondary piston (figs. 2G-10 and 2G-11). Install piston seal so lip faces interior of master cylinder bore when assembly is installed. Be sure return spring seats against retainer and that retainer is located inside lip of piston seal.

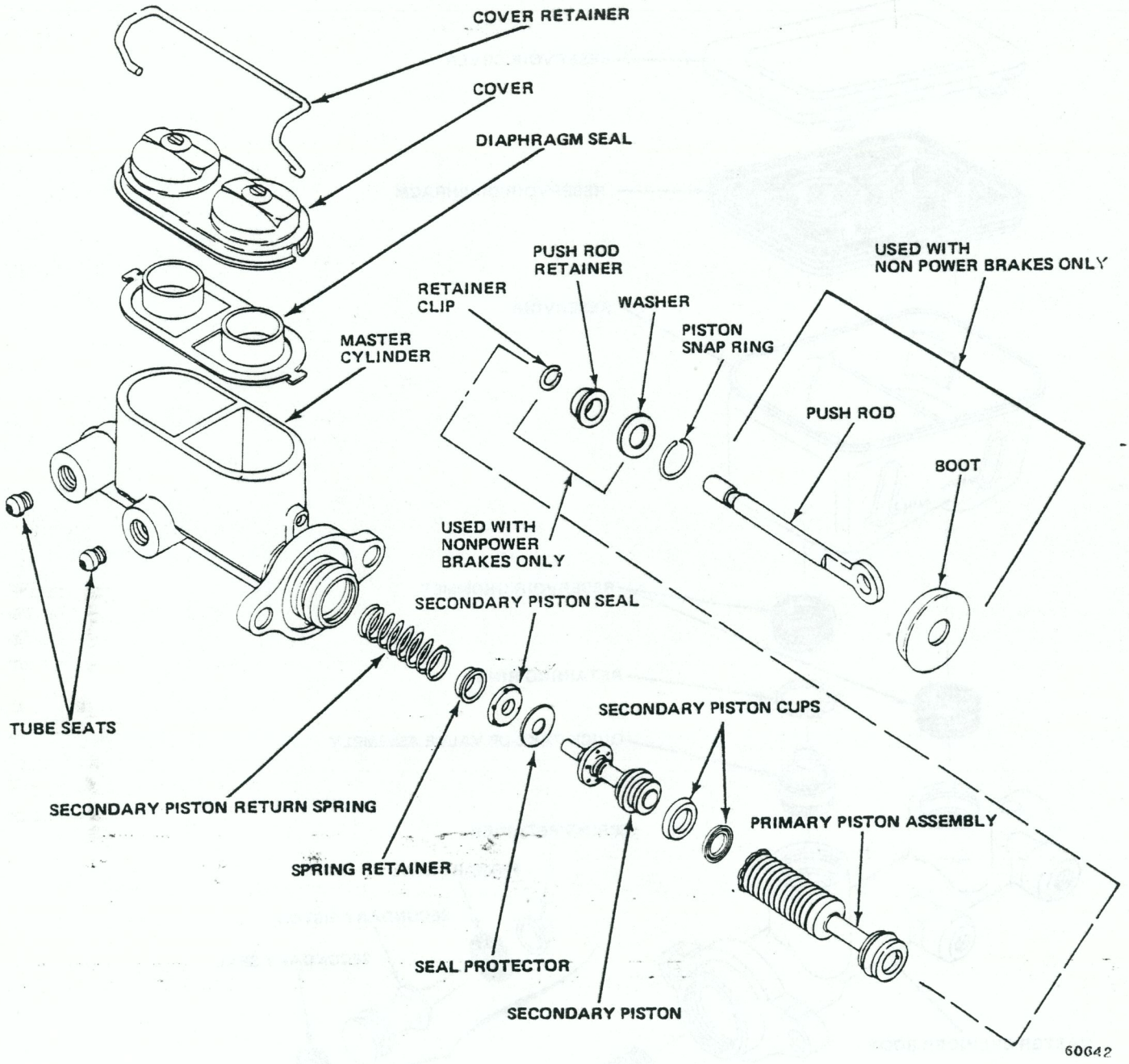

Fig. 2G-10 Master Cylinder—CJ Models

(4) Lubricate master cylinder bore and secondary piston seal and cups with clean brake fluid and install secondary piston assembly in cylinder bore.

(5) Lubricate seals on primary piston assembly with clean brake fluid and install assembly in master cylinder bore.

(6) On Cherokee, Wagoneer, and Truck models:

(a) Press primary piston inward using wood dowel and install snap ring in groove of master cylinder bore.

(b) Install quick take-up valve and secure with retaining ring. Be sure retaining ring is properly seated in master cylinder body groove.

(c) Install new reservoir grommets in master cylinder body. Be sure grommets are properly seated.

(d) Lay reservoir on flat, hard surface (fig. 2G-12). Press master cylinder onto reservoir using rocking motion.

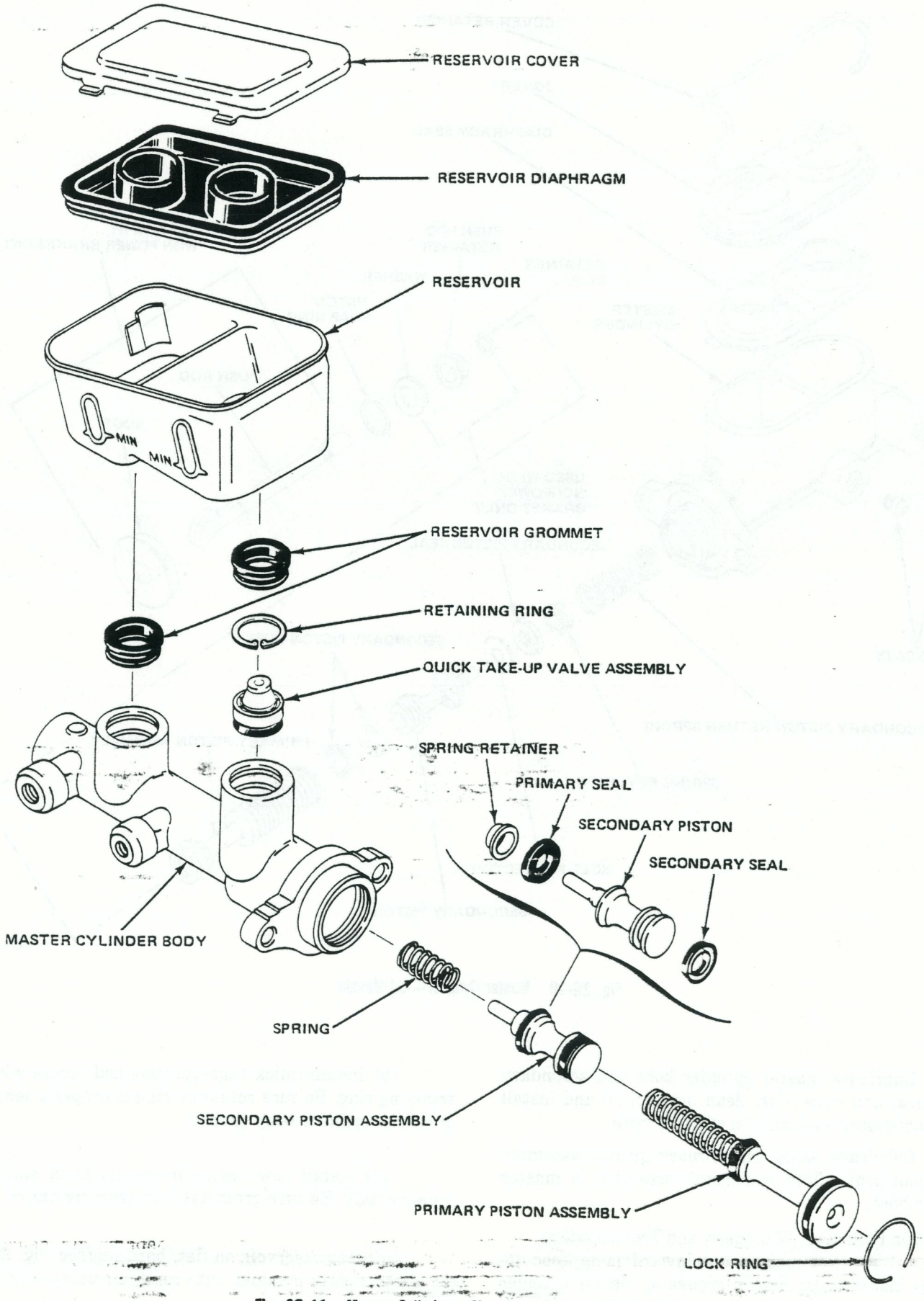

Fig. 2G-11 Master Cylinder—Cherokee-Wagoneer-Truck Models

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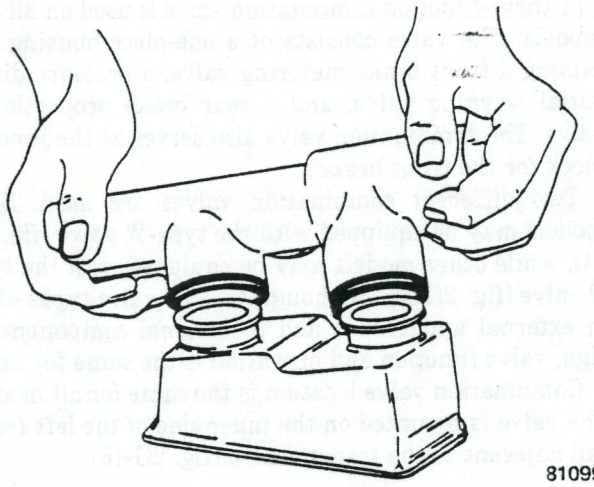


Fig. 2G-12 Installing Master Cylinder Reservoir—Cherokee-Wagoneer-Truck Models

(7) On CJ models, press primary piston inward using push rod and install snap ring in groove of master cylinder bore. Then continue pressing push rod into primary piston until rod is seated in rubber insert.

(8) On models with nonpower brakes, install boot.

(9) Install replacement diaphragm seal on master cylinder cover.

(10) Remove master cylinder from vise.

Installation

(1) Position master cylinder on dash panel or power unit and install attaching nuts and washers. Tighten nuts to 30 foot-pounds (41 N•m) torque.

(2) Connect brake lines to master cylinder.

(3) Fill master cylinder reservoirs to within 1/4 inch (6.35 mm) of rim with Jeep Brake Fluid or equivalent grade marked SAE J-1703 or DOT 3.

(4) Install cover and diaphragm seal.

(5) On models with nonpower brakes, connect push rod to brake pedal.

(6) Bleed entire brake system as outlined under Brake Bleeding.

WHEEL CYLINDER

The rear drum brake wheel cylinder consists of a cast iron housing with a piston bore machined in it. Two opposed pistons, rubber piston cups, and a compression spring with integral cup expanders are contained within the piston bore (fig. 2G-13). Rubber dust boots are installed at each end of the cylinder to prevent entry of dirt and water. Each cylinder is equipped with a bleeder screw to facilitate brake bleeding.

The compression spring is used to hold the piston cups tightly against the pistons and the integral cup expanders hold the piston cups tightly against the walls of the piston bore. The expanders prevent air from being drawn past the cups and into the hydraulic system when the brakes are released.

Removal

(1) Remove wheels, brakedrums, and brakeshoes. Refer to Drum Brake Section for procedure.

(2) Disconnect brake line at wheel cylinder. Do not bend line away from cylinder. When cylinder is removed, line will separate from cylinder easily.

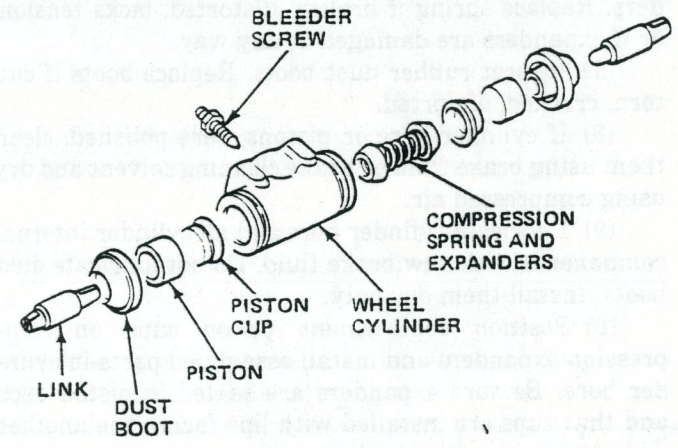
(3) Remove cylinder-to-support plate bolts and remove cylinder.

Overhaul

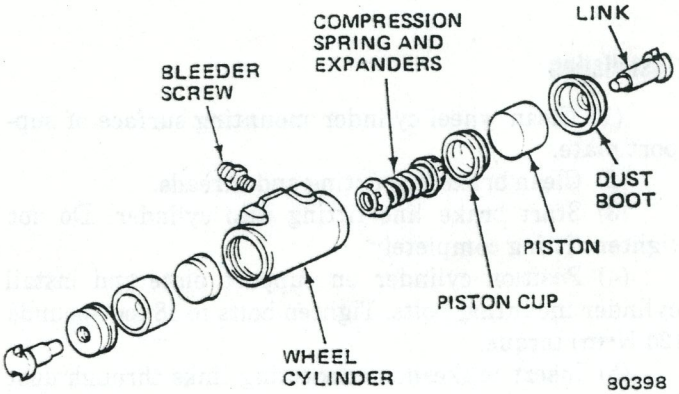
(1) Remove brakeshoe links and dust boots.

(2) Push pistons, piston cups, and compression spring and expanders out of piston bore. Discard piston cups, they are not reusable.

(3) Clean all cylinder components using brake cleaning solvent or brake fluid only.



CJ MODELS



CHEROKEE, WAGONEER TRUCK MODELS

Fig. 2G-13 Wheel Cylinder

CAUTION: *Do not clean brake parts with solvents containing mineral oil such as gasoline, carbon tetrachloride, kerosene, alcohol, paint thinner or similar fluids. Mineral oil causes swelling, deterioration, and premature aging of all rubber parts in the hydraulic system. Use clean brake fluid or an approved brake cleaning solvent only.*

(4) Inspect wheel cylinder and pistons. Replace cylinder if bore or pistons are scored, corroded, rusted, pitted, worn, or cracked. If bore or pistons are only discolored, or stained, polish bore or pistons lightly using crocus cloth only. Do not polish cylinder bore in lengthwise direction, polish by rotating cylinder around crocus cloth supported on fingers.

CAUTION: *Do not hone the wheel cylinders at any time or for any reason.*

(5) Inspect bleeder screw and screw threads in cylinder. Screw must turn freely. Replace screw if damaged or replace cylinder if cylinder threads are damaged.

(6) Inspect compression spring and integral expanders. Replace spring if broken, distorted, lacks tension, or if expanders are damaged in any way.

(7) Inspect rubber dust boots. Replace boots if cut, torn, cracked, distorted.

(8) If cylinder bore or pistons were polished, clean them using brake fluid or brake cleaning solvent and dry using compressed air.

(9) Lubricate cylinder bore and all cylinder internal components with new brake fluid. Do not lubricate dust boots. Install them dry only.

(10) Position replacement piston cups on compression expanders and install assembled parts in cylinder bore. Be sure expanders are seated in piston cups and that cups are installed with lips facing one another and toward interior of cylinder bore.

(11) Install pistons in cylinder bore. Be sure pistons are installed with flat sides facing interior of bore.

(12) Install dust boots.

Installation

(1) Clean wheel cylinder mounting surface of support plate.

(2) Clean brake line fitting and threads.

(3) Start brake line fitting into cylinder. Do not tighten fitting completely.

(4) Position cylinder on support plate and install cylinder mounting bolts. Tighten bolts to 18 foot-pounds (24 N•m) torque.

(5) Insert brakeshoe connecting links through dust boots and into pistons.

(6) Install Wheel Cylinder Clamp Tool J-8002 over cylinder to retain internal components in cylinder.

(7) Tighten wheel cylinder brake line fitting.

COMBINATION VALVE

A three-function combination valve is used on all Jeep models. The valve consists of a one-piece housing containing a front brake metering valve, a pressure differential warning valve, and a rear brake proportioning valve. The combination valve also serves as the junction block for the front brakes.

Two different combination valves are used. Some models may be equipped with the type-W valve (fig. 2G-14), while other models may be equipped with the type-D valve (fig. 2G-15). Although the two valve types differ in external appearance and in internal component design, valve function and operation is the same for both.

Combination valve location is the same for all models. The valve is mounted on the inner side of the left frame rail adjacent to the transmission (fig. 2G-16).

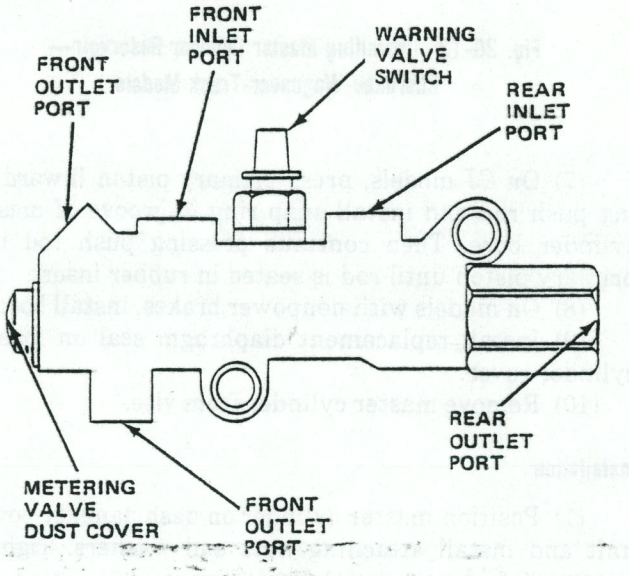


Fig. 2G-14 Type-W Combination Valve

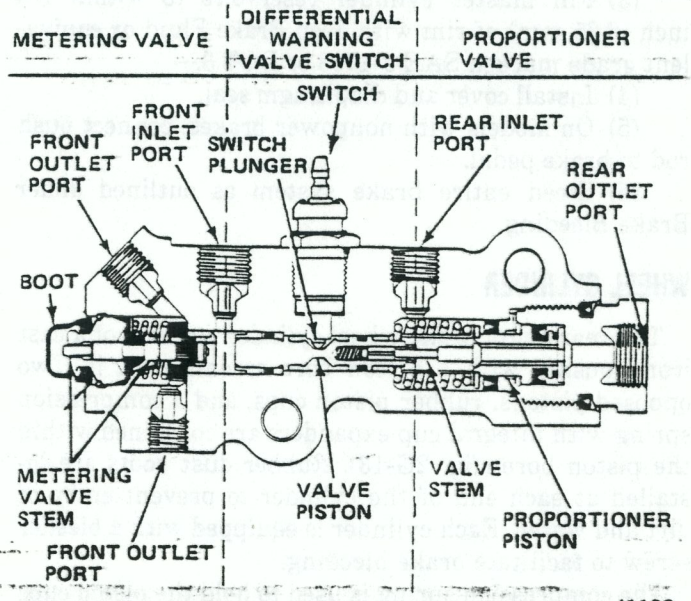


Fig. 2G-15 Type-D Combination Valve

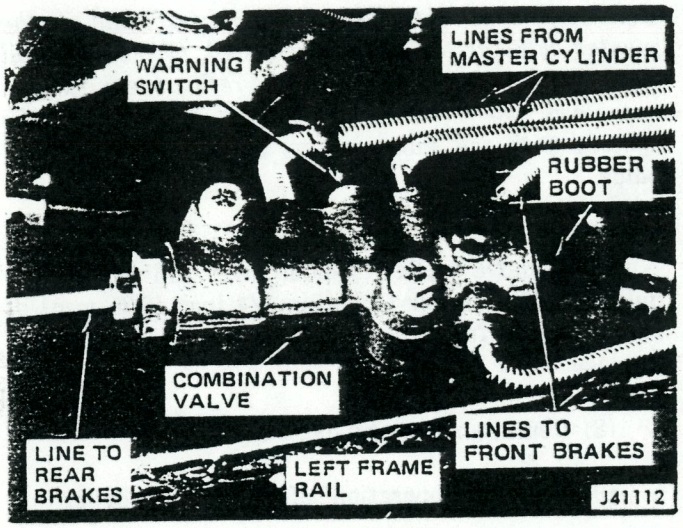


Fig. 2G-16 Combination Valve Location (Type-D Valve Shown)

Combination Valve Operation

The front brake metering valve assists in providing balanced front-to-rear braking. To accomplish this, the metering valve holds off (delays) full hydraulic fluid pressure to the front disc brakes until the rear drum brakes overcome return spring tension and the linings contact the drums.

When the brakes are not applied, the metering valve permits the free flow of brake fluid. This feature allows the fluid to expand and contract with changes in temperature.

When bleeding the front disc brakes, the metering valve stem must be held out using tool J-26869 on type-W valves or tool J-23709 on type-D valves. Refer to Brake Bleeding for specific details regarding tool use.

The pressure differential warning valve activates the brake warning lamp if a pressure loss in the front or rear hydraulic system should ever occur. This feature is provided as a method for alerting the driver if such a system malfunction ever occurs.

The valve consists of a valve piston, and plunger-type switch. If a pressure loss in either system occurs, a pressure differential of 70 to 300 psi (483 to 2 068 kPa) will cause the piston to shuttle toward the low pressure side of the valve. As the piston moves, ramps on the piston force the switch contact plunger upward closing the switch contacts. This action completes the electrical circuit between the switch and brake warning lamp causing the light to illuminate. Unless the lock cylinder is turned to the Off position, the warning light will remain illuminated until the cause of the malfunction is corrected and the valve recentered.

NOTE: *The type D and W combination valves are hydraulic self-reset types which do not require manual recentering.*

The rear brake proportioning valve provides balanced front-to-rear braking action during high pedal pressure stops. During light pedal pressure application, the proportioner does not operate. Brake fluid normally flows through the proportioner valve and into the rear brake wheel cylinders. Spring pressure on the valve piston holds it against the piston stop plate for normal brake pressures.

Combination Valve Service

The combination valve is not repairable. If any section of the valve is found defective, the entire valve assembly must be replaced.

BRAKE BLEEDING

General

The brake hydraulic system must be purged of air whenever a line has been disconnected or if air has entered the system.

In most cases, it will be necessary to bleed only that portion of the hydraulic system (front or rear) being serviced. However, if a firm brake pedal cannot be obtained, or if diagnosis indicates the need, the entire system must be bled.

Brake bleeding can be performed manually or with pressure equipment. Bleeder screws are provided at the calipers and wheel cylinders to simplify the bleeding procedure.

Manual Bleeding Procedure

(1) Remove all accumulated dirt from master cylinder and cover.

(2) Remove master cylinder cover.

(3) Fill master cylinder if required and install cover.

(4) On vehicles equipped with type-W combination valve, remove dust cover from metering valve stem and install tool J-26869 on stem to hold valve open (fig. 2G-17).

(5) On vehicles equipped with type-D combination valve, loosen valve front mounting bolt and insert slotted end of tool J-23709 under bolt. Push metering valve stem inward (using tool) to hold valve open and tighten mounting bolt to secure tool (fig. 2G-18).

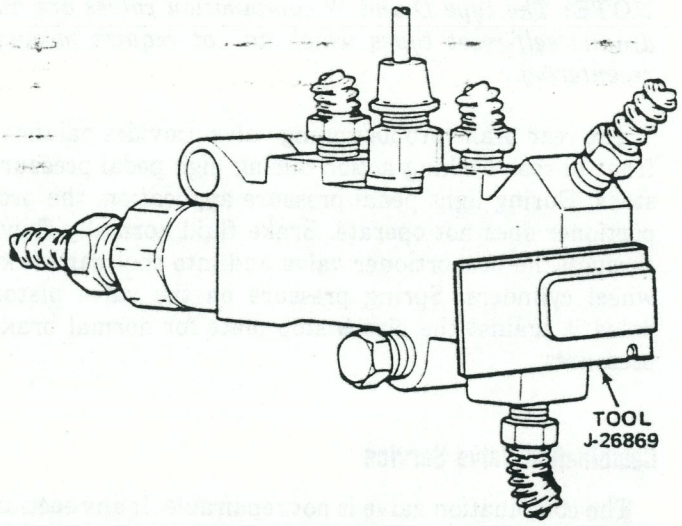


Fig. 2G-17 Metering Valve Tool Installation Type-W Combination Valve

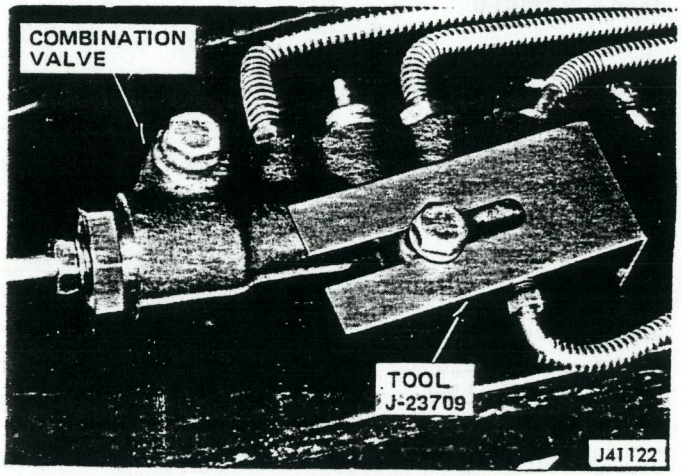


Fig. 2G-18 Metering Valve Tool Installation Type-D Combination Valve

(6) Bleed brake system in following sequence:
- (a) right rear wheel
- (b) left rear wheel
- (c) right front wheel
- (d) left front wheel
- (e) master cylinder brake line connections

NOTE: *Correct bleeding procedure is as follows: Place wrench on bleeder screw. Install rubber hose on screw with free end of hose* **submerged** *in a transparent container partially filled with clean brake fluid. Open bleeder screw 3/4 turn. Have helper depress brake pedal. Close bleeder screw before pedal reaches end of travel. Have helper pump up pedal each time bleeder screw is closed to ensure a good surge of fluid when the screw is reopened. Repeat bleeding process until fluid comes out in a solid stream without the presence of air bubbles.*

CAUTION: *Do not allow the supply of fluid in the master cylinder to become exhausted. Check the fluid level frequently while bleeding and refill as required. Do not bleed two wheels at a time and do not bleed the system with the front calipers or rear drums not in place.*

(7) Remove master cylinder cover and refill as required. Fill reservoir to within 1/4 inch (6.35 mm) of reservoir rim. Install cover. Make sure cover retainer is in place.

(8) Remove metering valve tool.

(9) Test brake operation before moving vehicle.

Pressure Bleeding Procedure

(1) Remove all accumulated dirt from master cylinder and cover.

(2) Remove cover and rubber diaphragm seal. Place cover on work bench or on lint-free cloth. Do not allow diaphragm seal to contact dirt or foreign material.

(3) Fill master cylinder if required.

(4) Install brake bleeder adapter cover on master cylinder (figs. 2G-19 and 2G-20).

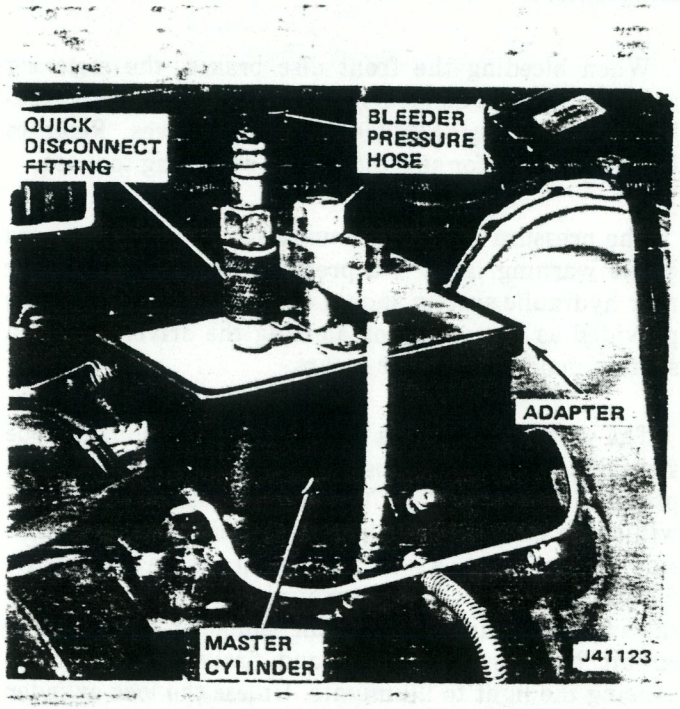


Fig. 2G-19 Pressure Bleeder Adapter Installation—Typical

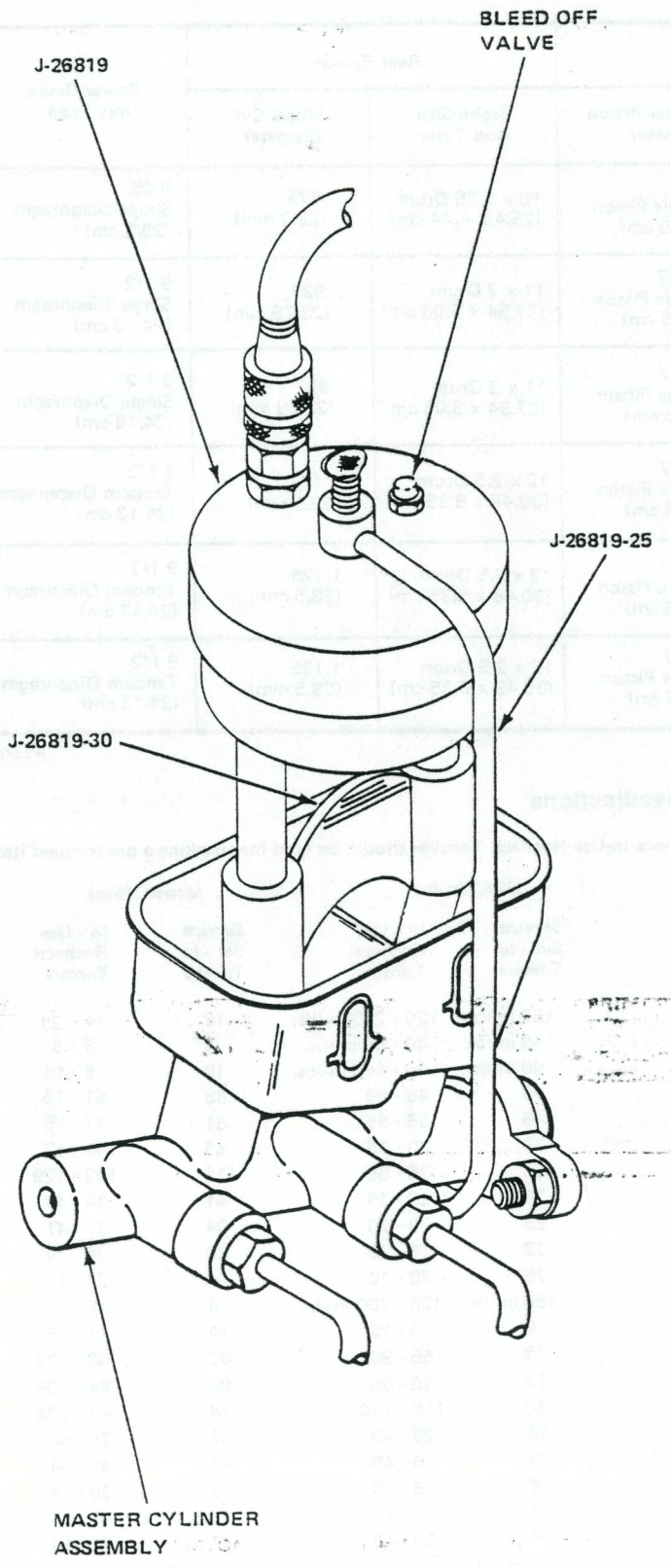


Fig. 2G-20 Pressure Bleeder Adapter Installation—Cherokee-Wagoneer-Truck Models

(5) Connect hose from pressure bleeder to fitting on adapter and open pressure bleeder release valve.

(6) On vehicles with type-W combination valve, remove dust cover from metering valve stem and install tool J-26869 on stem to hold valve open (fig. 2G-17).

(7) On vehicles equipped with type-D combination valve, loosen valve front mounting bolt and insert slotted end of tool J-23709 under bolt. Push metering valve stem inward (using tool) to hold valve open and tighten mounting bolt to secure tool (fig. 2G-18).

(8) Bleed brake system in following sequence:
- (a) right rear wheel
- (b) left rear wheel
- (c) right front wheel
- (d) left front wheel
- (e) master cylinder brake line connections

NOTE: *When using pressure equipment, the bleeding procedure is the same as outlined in the Manual Bleeding Procedure except that a helper is not required to apply the brake pedal. The pressure bleeder develops enough system pressure to permit bleeding without the use of the brake pedal.*

(9) When system has been purged of all air, turn off pressure bleeder and close bleeder fluid release valve.

(10) Disconnect pressure bleeder hose at adapter fitting and remove master cylinder cover adapter.

(11) Refill master cylinder reservoirs to within 1/4 inch (6.35 mm) of reservoir rims.

(12) Install cover and rubber diaphragm seal. Make sure cover retainer is in place.

(13) On vehicles equipped with type-W combination valve, remove tool J-26869 from metering valve stem and install dust cover. On vehicles equipped with type-D combination valve, loosen valve front mounting bolt, remove tool J-23709, and retighten mounting bolt.

(14) Test brake operation before moving vehicle.

SPECIFICATIONS

General Specifications

Brake Fluid	Use Jeep brake fluid or equivalent marked DOT 3 or SAE-J-1703 only.
Brake Fluid Level	Fill master cylinder reservoirs to within 1/4 inch (6.35 mm) of reservoir rims.

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Brake Size and Application Chart

Model	Master Cylinder Bore Diameter	Front Brakes		Rear Brakes		Power Brake Unit Type
		Brake Size And Type	Caliper Piston Diameter	Brake Size And Type	Wheel Cyl. Diameter	
CJ	1.00 (25.4 mm)	11.7 Disc. (29.7 cm)	2.6 Single Piston (6.60 cm)	10 x 1.75 Drum (25.4 x 4.44 cm)	.875 (22.2 mm)	8.00 Single Diaphragm (20.3 cm)
Cherokee Wagoneer	1.125 (28.5 mm)	12.0 Disc. (30.48 cm)	2.937 Single Piston (7.45 cm)	11 x 2 Drum (27.94 x 5.08 cm)	.937 (23.79 mm)	9 1/2 Single Diaphragm (24.13 cm)
J-10 Truck	1.125 (28.5 mm)	12.0 Disc. (30.48 cm)	2.937 Single Piston (7.45 cm)	11 x 2 Drum (27.94 x 5.08 cm)	.937 (23.79 mm)	9 1/2 Single Diaphragm (24.13 cm)
J-20 Truck 6800 GVW	1.125 (28.5 mm)	12.5 Disc. (31.75 cm)	2.937 Single Piston (7.45 cm)	12 x 2.5 Drum (30.48 x 6.35 cm)	1.125 (28.5 mm)	9 1/2 Tandem Diaphragm (24.13 cm)
J-20 Truck 7600 GVW	1.125 (28.5 mm)	12.5 Disc. (31.75 cm)	2.937 Single Piston (7.45 cm)	12 x 2.5 Drum (30.48 x 6.35 cm)	1.125 (28.5 mm)	9 1/2 Tandem Diaphragm (24.13 cm)
J-20 Truck 8400 GVW	1.125 (28.5 mm)	12.5 Disc. (31.75 cm)	2.937 Single Piston (7.45 cm)	12 x 2.5 Drum (30.48 x 6.35 cm)	1.125 (28.5 mm)	9 1/2 Tandem Diaphragm (24.13 cm)

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Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft-lbs)		Metric (N-m)	
	Service Set - to Torque	In - Use Recheck Torque	Service Set - to Torque	In - Use Recheck Torque
Brakeline-to-Caliper Fitting Bolt (Cke, Wag, Trk)	160 in-lbs.	120 - 200 in-lbs.	18	14 - 23
Bleeder Screw (1/4 - 28)	45 in-lbs.	40 - 50 in-lbs.	5	5 - 6
Bleeder Screw (3/8 - 24)	90 in-lbs.	40 - 140 in-lbs.	10	5 - 16
Brake Support Plate Mounting Bolts/Nuts (J-20 Trk)	50	45 - 55	68	61 - 75
Brake Support Plate Mounting Bolts/Nuts (Cke, Wag, J10 Trk)	45	35 - 55	61	47 - 75
Brake Support Plate Mounting Bolts/Nuts (CJ)	33	30 - 35	45	41 - 47
Caliper Anchor Bracket to Steering Knuckle (CJ)	85	75 - 95	115	102 - 129
Master Cylinder Mounting Bolts/Nuts	30	25 - 35	41	34 - 47
Master Cylinder-to-Power Unit Mounting Nuts	25	20 - 30	34	27 - 41
Power Brake Unit-to-Dash Mounting Bolts/Nuts	22	18 - 25	30	24 - 34
Brake Line-to-Caliper Fitting Bolt (CJ)	25	20 - 30	34	27 - 41
Brake Line-to-Wheel Cylinder Fitting	160 in-lbs.	120 - 200 in-lbs.	18	14 - 23
Parking Brake Cable Clamp-to-Support Plate Bolts (5/16 - 18)	10	8 - 12	14	11 - 16
Wheel Nuts (CJ)	75	65 - 90	102	88 - 122
Wheel Nuts (Cke, Wag, Trk)	75	65 - 80	102	88 - 108
Wheel Nuts (8400 GVW Trk)	130	110 - 150	176	149 - 203
Brake Pedal-to-Power Unit Push Rod Bolt/Nut	35	25 - 40	47	34 - 54
Caliper Mounting Bolts (Cke, Wag, Trk)	35	30 - 40	47	41 - 54
Caliper Support Key Retaining Screw (CJ)	15	15 - 18	20	20 - 24
Disc. Brake Shield Bolts (Cke, Wag, Trk)	8	5 - 10	11	7 - 14
Disc. Brake Shield Nuts (Cke, Wag, Trk)	35	30 - 40	47	41 - 54
Wheel Bearing Outer Locknut (All)	50(min.)		68 (min.)	
Wheel Bearing Inner Locknut (Bearing Adjuster):				
CJ	Tighten to 50 ft-lbs. (68 N-m) and back off 1/6 turn while rotating wheel.			
Cke, Wag, Trk	Tighten to 50 ft-lbs. (68 N-m) and back off 1/6 turn while rotating wheel.			

All Torque values given in foot-pounds and newton-meters with dry-fits unless otherwise specified.

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POWER BRAKE UNITS

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General	2G-31	Power Unit Removal	2G-33
Power Unit Diagnosis	2G-33	Power Unit Service	2G-33
Power Unit Installation	2G-33	Specifications	2G-33

GENERAL

Three power units are used on Jeep vehicles. An 8-inch single diaphragm unit is used on CJ models (fig. 2G-21). A 9-1/2 single diaphragm unit is used on Cherokee, Wagoneer and J-10 Truck models (fig. 2G-22) and a 9-1/2 tandem diaphragm unit is used on J-20 Truck models.

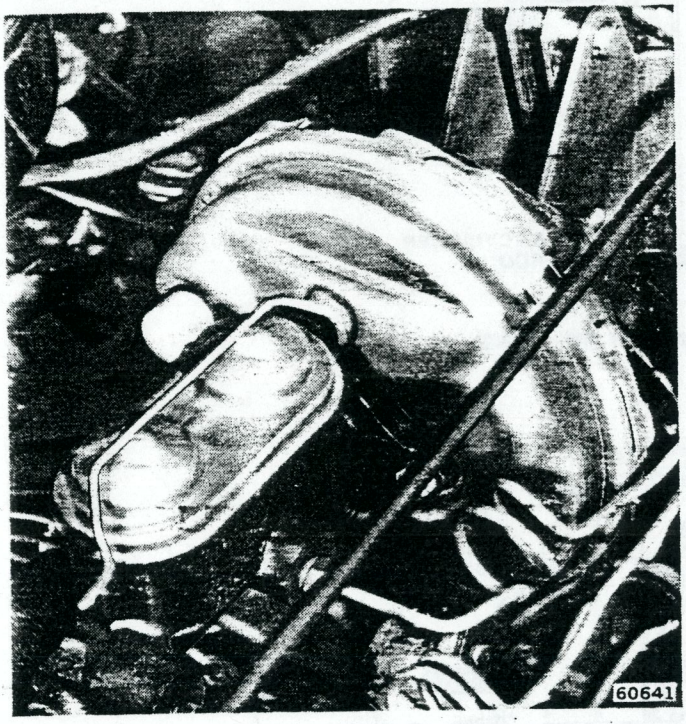

Fig. 2G-21 Power Brake Unit and Bellcrank—CJ Models

The power units consist of a two-piece outer shell containing the single or dual diaphragms, air inlet valve, air filter, control valve, power piston, reaction plate and master cylinder push rod, and vacuum check valve (figs. 2G-23 and 2G-24).

Power Unit Operation

The power unit utilizes a combination of engine vacuum and atmospheric pressure to increase brake apply force without increasing brake pedal efforts.

In the neutral (nonapplied) position, a vacuum is present within the chamber formed by the two halves of the outer shell and on both sides of the power piston and diaphragm.

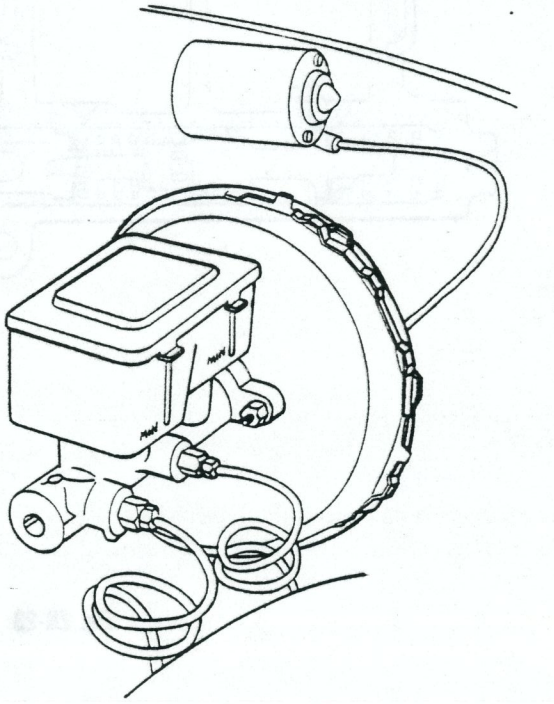

Fig. 2G-22 Power Brake Unit
Cherokee-Wagoneer-Truck Models

As the brake pedal is pressed, the brake pedal push rod moves the air inlet valve away from the control valve (figs. 2G-23 and 2G-24). The control valve then follows the air inlet valve until the control valve contacts the raised seat on the power piston. When contact occurs, vacuum to the chamber space at the right side of the power piston is shut off.

At vacuum shut off, air under an atmospheric pressure of 14.7 psi (101.3 kPa), then flows into the right side of the chamber through the air filter. Since a vacuum still exists in the left side of the chamber, the force of air at atmospheric pressure on the right side of the power piston forces the piston and master cylinder push rod to the left applying the brakes.

When the brake pedal is released, the control valve returns to its seat against the air inlet valve shutting off the supply of air under atmospheric pressure. At this point, engine vacuum coming through the vacuum check valve again enters the right side of the chamber past the power piston.

In operation, the single and tandem diaphragm units function in exactly the same manner with one exception.

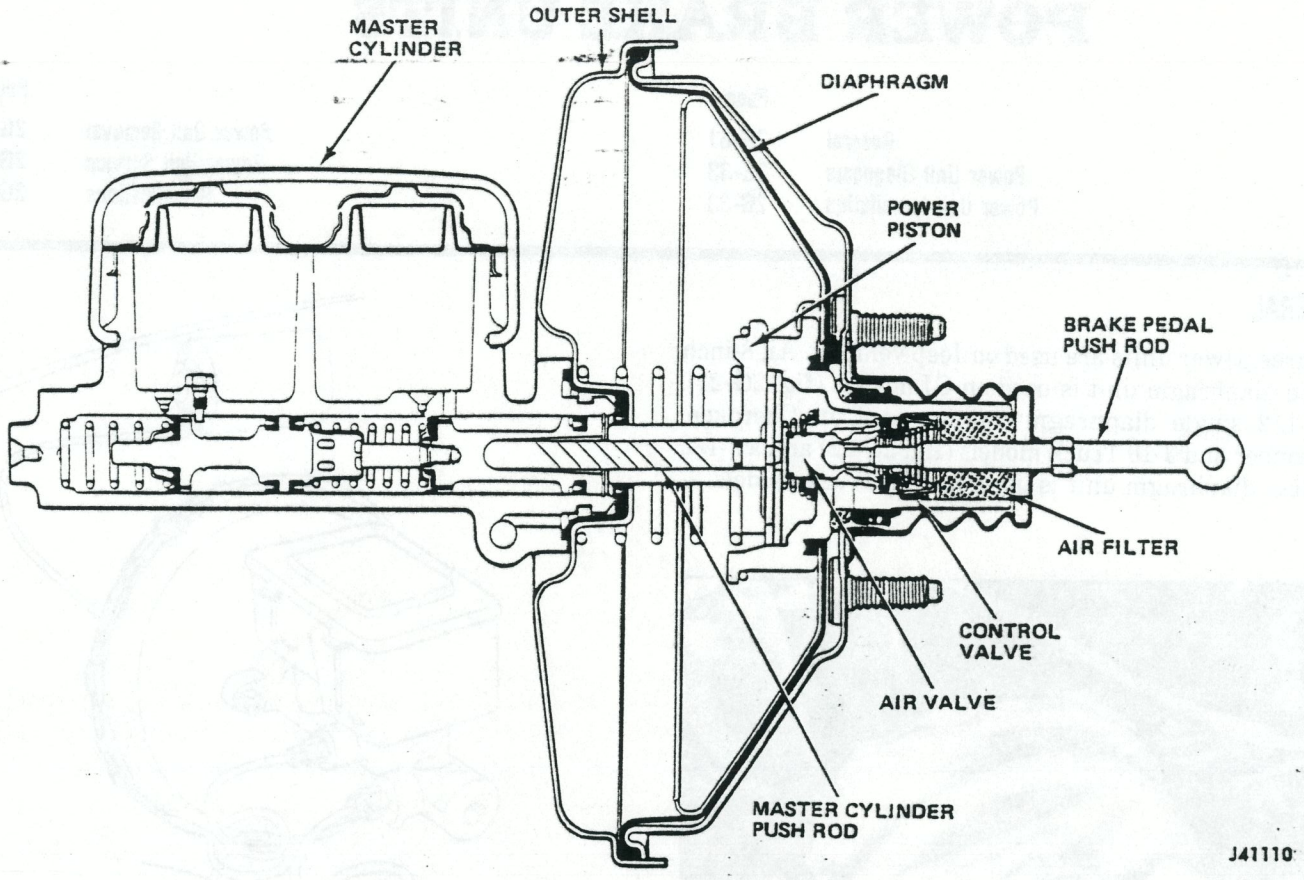

Fig. 2G-23 Single Diaphragm Power Unit—Typical

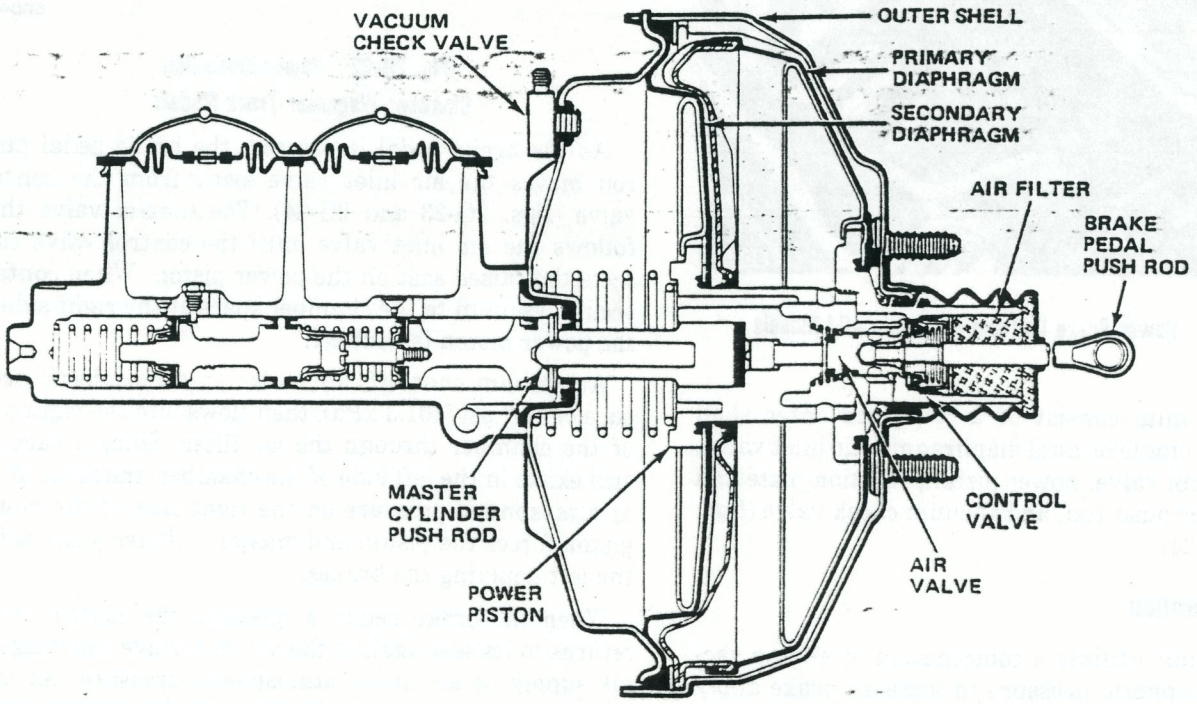

Fig. 2G-24 Tandem Diaphragm Power Unit—Typical

The tandem unit utilizes two chambers on the right side of the power piston to develop atmospheric air pressure on the power piston.

POWER UNIT SERVICE

All power units are serviced as assemblies only. If diagnosis indicates that an internal malfunction has occured within a power unit, replace the unit as an assembly. Do not attempt to repair the unit.

All power units have a single master cylinder push rod of a preset, nonadjustable length. When replacing a power unit, use the push rod supplied with the replacement power unit only. This push rod has been correctly gauged to the replacement unit.

POWER UNIT DIAGNOSIS

Power unit malfunction should be diagnosed using Brake Diagnosis Guide B and the Power Unit and Service Diagnosis Charts. When diagnosing suspected power unit malfunctions, always perform the preliminary diagnosis procedures outlined in Brake Diagnosis Guide A first. This is an important step in avoiding inaccurate diagnosis and ineffective repair.

POWER UNIT REMOVAL

(1) Disconnect power unit push rod at brake pedal. Discard bolt and nut attaching rod to pedal.

(2) Disconnect vacuum at power unit check valve.

(3) Remove nuts and washers attaching master cylinder to power unit and move master cylinder aside. Do not disconnect brake lines at master cylinder.

(4) On CJ models, remove nuts and bolts attaching power unit bellcrank to dash panel and remove power unit and bellcrank as assembly.

(5) On Cherokee, Wagoneer and Truck models, remove nuts and washers attaching power unit to dash panel and remove power unit.

NOTE: *If the power unit is to be replaced on CJ models, remove the bellcrank from the original power unit, lubricate the bellcrank pivot pins with chassis lubricant, and transfer the bellcrank to the replacement unit.*

POWER UNIT INSTALLATION

(1) On Cherokee, Wagoneer and Truck models, mount power unit on dash panel and install attaching washers and nuts. Tighten nuts to 35 foot-pounds (47 N•m) torque.

(2) On CJ models, mount assembled power unit and bellcrank on dash panel. Install bellcrank-to-dash panel attaching bolts and nuts. Tighten bolts to 35 foot-pounds (47 N•m) torque.

(3) Connect vacuum hose to power unit check valve.

(4) Position master cylinder on power unit and install cylinder attaching washers and nuts. Tighten nuts to 30 foot-pounds (41 N•m) torque.

(5) Align power unit push rod and brake pedal and install replacement pedal attaching bolt and nut. Tighten bolt and nut to 35 foot-pounds (47 N•m) torque.

SPECIFICATIONS

Brake Size and Application Chart

Model	Master Cylinder Bore Diameter	Front Brakes		Rear Brakes		Power Brake Unit Type
		Brake Size And Type	Caliper Piston Diameter	Brake Size And Type	Wheel Cyl. Diameter	
CJ	1.00 (25.4 mm)	11.7 Disc. (29.7 cm)	2.6 Single Piston (6.60 cm)	10 x 1.75 Drum (25.4 x 4.44 cm)	.875 (22.2 mm)	8.00 Single Diaphragm (20.3 cm)
Cherokee Wagoneer	1.125 (28.5 mm)	12.0 Disc. (30.48 cm)	2.937 Single Piston (7.45 cm)	11 x 2 Drum (27.94 x 5.08 cm)	.937 (23.79 mm)	9 1/2 Single Diaphragm (24.13 cm)
J-10 Truck	1.125 (28.5 mm)	12.0 Disc. (30.48 cm)	2.937 Single Piston (7.45 cm)	11 x 2 Drum (27.94 x 5.08 cm)	.937 (23.79 mm)	9 1/2 Single Diaphragm (24.13 cm)
J-20 Truck 6800 GVW	1.125 (28.5 mm)	12.5 Disc. (31.75 cm)	2.937 Single Piston (7.45 cm)	12 x 2.5 Drum (30.48 x 6.35 cm)	1.125 (28.5 mm)	9 1/2 Tandem Diaphragm (24.13 cm)
J-20 Truck 7600 GVW	1.125 (28.5 mm)	12.5 Disc. (31.75 cm)	2.937 Single Piston (7.45 cm)	12 x 2.5 Drum (30.48 x 6.35 cm)	1.125 (28.5 mm)	9 1/2 Tandem Diaphragm (24.13 cm)
J-20 Truck 8400 GVW	1.125 (28.5 mm)	12.5 Disc. (31.75 cm)	2.937 Single Piston (7.45 cm)	12 x 2.5 Drum (30.48 x 6.35 cm)	1.125 (28.5 mm)	9 1/2 Tandem Diaphragm (24.13 cm)

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Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft-lbs)		Metric (N-m)	
	Service Set - to Torque	In - Use Recheck Torque	Service Set - to Torque	In - Use Recheck Torque
Brakeline-to-Caliper Fitting Bolt (Cke, Wag, Trk)	160 in-lbs.	120 - 200 in-lbs.	18	14 - 23
Bleeder Screw (1/4 - 28)	45 in-lbs.	40 - 50 in-lbs.	5	5 - 6
Bleeder Screw (3/8 - 24)	90 in-lbs.	40 - 140 in-lbs.	10	5 - 16
Brake Support Plate Mounting Bolts/Nuts (J-20 Trk)	50	45 - 55	68	61 - 75
Brake Support Plate Mounting Bolts/Nuts (Cke, Wag, J10 Trk)	45	35 - 55	61	47 - 75
Brake Support Plate Mounting Bolts/Nuts (CJ)	33	30 - 35	45	41 - 47
Caliper Anchor Bracket to Steering Knuckle (CJ)	85	75 - 95	115	102 - 129
Master Cylinder Mounting Bolts/Nuts	30	25 - 35	41	34 - 47
Master Cylinder-to-Power Unit Mounting Nuts	25	20 - 30	34	27 - 41
Power Brake Unit-to-Dash Mounting Bolts/Nuts	22	18 - 25	30	24 - 34
Brake Line-to-Caliper Fitting Bolt (CJ)	25	20 - 30	34	27 - 41
Brake Line-to-Wheel Cylinder Fitting	160 in-lbs.	120 - 200 in-lbs.	18	14 - 23
Parking Brake Cable Clamp-to-Support Plate Bolts (5/16 - 18)	10	8 - 12	14	11 - 16
Wheel Nuts (CJ)	75	65 - 90	102	88 - 122
Wheel Nuts (Cke, Wag, Trk)	75	65 - 80	102	88 - 108
Wheel Nuts (8400 GVW Trk)	130	110 - 150	176	149 - 203
Brake Pedal-to-Power Unit Push Rod Bolt/Nut	35	25 - 40	47	34 - 54
Caliper Mounting Bolts (Cke, Wag, Trk)	35	30 - 40	47	41 - 54
Caliper Support Key Retaining Screw (CJ)	15	15 - 18	20	20 - 24
Disc. Brake Shield Bolts (Cke, Wag, Trk)	8	5 - 10	11	7 - 14
Disc. Brake Shield Nuts (Cke, Wag, Trk)	35	30 - 40	47	41 - 54
Wheel Bearing Outer Locknut (All)	50(min.)		68 (min.)	
Wheel Bearing Inner Locknut (Bearing Adjuster):				
CJ	Tighten to 50 ft-lbs. (68 N-m) and back off 1/6 turn while rotating wheel.			
Cke, Wag, Trk	Tighten to 50 ft-lbs. (68 N-m) and back off 1/6 turn while rotating wheel.			

All Torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

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DRUM BRAKES

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GENERAL

Two different drum brake units are used on Jeep vehicles. The brakes used on CJ models have a cable operated automatic adjuster mechanism, while the brakes used on Cherokee, Wagoneer and Truck models have a linkage operated automatic adjuster mechanism. Although the units differ slightly in construction, operation and service procedures for both units are similar.

Each drum brake unit consists of a support plate, a primary and a secondary brakeshoe, two brakeshoe return springs, an adjusting screw assembly, two hold-down springs, automatic adjuster components, and a wheel cylinder assembly (figs. 2G-25 and 2G-26).

OPERATION AND WEAR COMPENSATION

Operation

When the brakes are applied, fluid pressure developed in the master cylinder is transmitted to the wheel cylinders forcing the cylinder pistons outward. This motion is transferred to the upper ends of the brakeshoes through links which interconnect the brakeshoes and wheel cylinder pistons.

As the brakeshoes are expanded and contact the drum, they tend to rotate with the drum. This action causes the primary brakeshoe to pivot downward and away from the support plate anchor pin and the secondary brakeshoe to pivot upward and against the anchor pin.

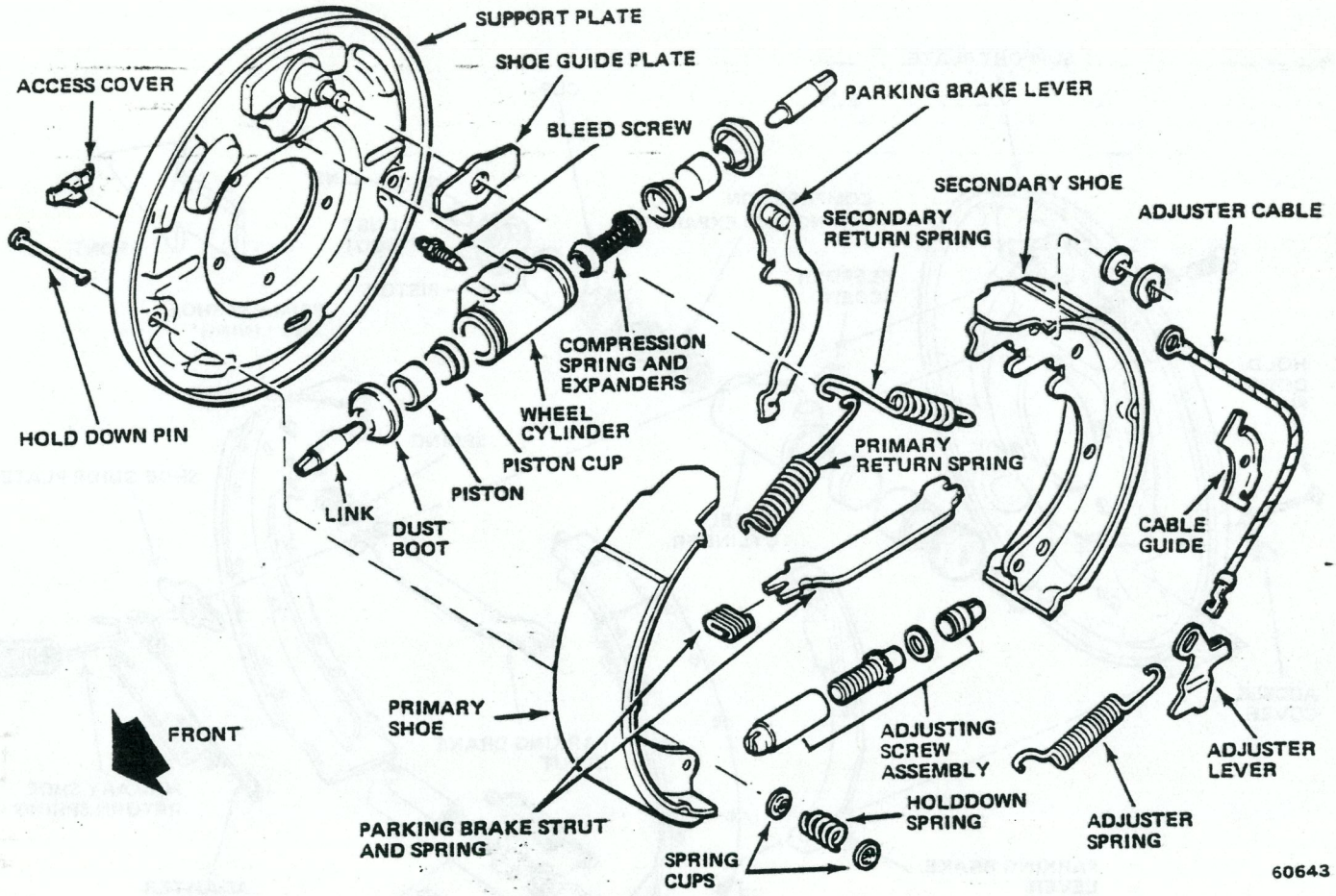

Fig. 26-25 Drum Brake Assembly—CJ Models

As the primary brakeshoe pivots downward, it exerts a rearward force on the adjuster screw assembly. Since the adjuster screw interconnects the lower ends of the brakeshoes, this additional force is transmitted directly to the secondary brakeshoe increasing its braking action. The additional force applied to the secondary brakeshoe accounts for the fact that the secondary brakeshoe linings are generally thicker and have more contact area.

When the brakes are released, the return springs overcome the diminishing fluid pressure and return the brakeshoes and wheel cylinder pistons to the neutral position.

During a reverse stop, the drum brakes operate in the same mode as for a forward stop. However, because the drum is rotating in the opposite direction, the secondary brakeshoe now operates, in effect, as the primary brakeshoe.

Parking Brake Operation

The parking brake lever is mounted on the back of the brakeshoe and is connected to it by a pivot pin installed in the upper end of the lever. The pin is retained in the brakeshoe by a washer and U-clip. The parking brake cable is attached to the lower end of the lever. A strut, located just below the pivot pin, connects the lever to the primary brakeshoe. The strut is notched at each end and fits into matching notches in the brakeshoe and lever. The strut is positioned in the brakeshoe by an oval shaped spring.

When the parking brakes are applied, the cable pulls the lower end of the lever forward causing the connecting strut to push the primary brakeshoe forward also. At the same time, the upper end of the lever pushes the secondary brakeshoe rearward. The combined action of lever and strut expands the brakeshoes forcing them against the drum to develop braking action.

Wear Compensation

The automatic adjuster mechanism continuously maintains correct lining-to-drum operating clearance by adjusting the brakes in small increments in direct proportion to lining wear. This continuous adjustment prevents a gradual increase in brake pedal travel as the linings wear. The adjuster mechanism also adds the

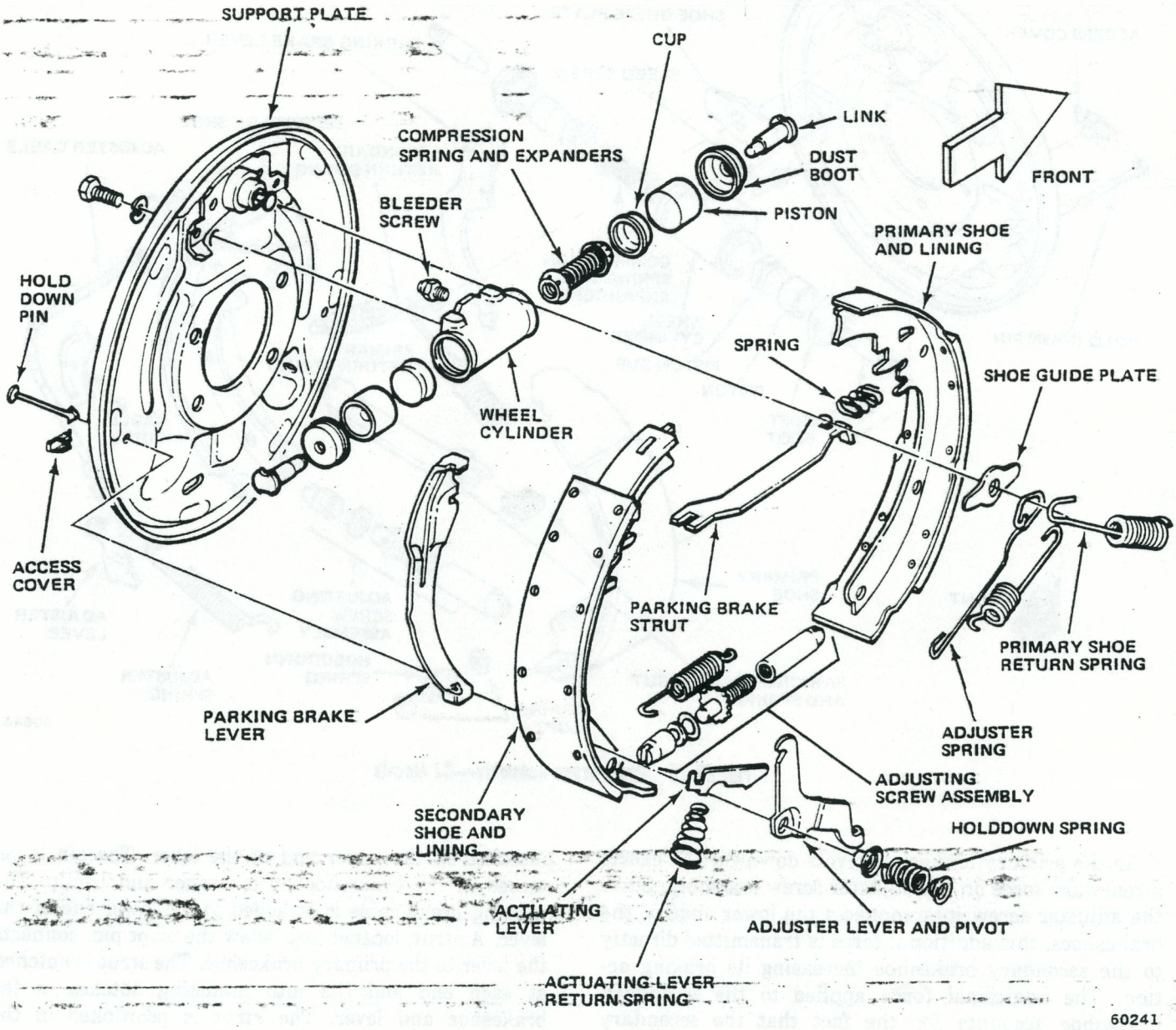

Fig. 2G-26 Drum Brake Assembly—Cherokee-Wagoneer-Truck Models

safety feature of maintaining adequate pedal reserve during the service life of the lining.

When the lining wears enough to require adjustment, the adjusting cable (CJ) or actuating lever (Cherokee, Wagoneer and Truck) lifts the lever into engagement with the next tooth of the adjusting screw during reverse brake applications. When the brakes are released, the brakeshoes return to the anchor pin.

The adjuster mechanism utilizes movement of the secondary shoes during reverse brake applications to actuate the adjuster mechanism.

This action will repeat on subsequent brake applications until the drum-to-lining clearance is reduced to a point where shoe movement is no longer sufficient to cause the adjuster mechanism to lift the lever to the next adjuster screw tooth.

BRAKE SERVICE—CJ MODELS

Disassembly

WARNING: *When servicing wheel brake parts, do not create dust by grinding or sanding brakelinings or by cleaning wheel brake parts with a dry brush or with compressed air. Use water dampened cloths only to remove dirt from brake parts prior to disassembly. Many wheel brake parts contain asbestos fibers which can*

become airborne if dust is created during servicing. Breathing dust containing asbestos fibers may cause serious bodily injury.

(1) Raise vehicle.
(2) Remove wheels and drums.
(3) Grasp adjusting lever with pliers and remove lever tang from hole in secondary shoe.
(4) Place Brake Cylinder Clamps J-8002 over wheel cylinders to hold pistons in place while shoes are removed.
(5) Remove return springs using Brake Spring Remover Tool J-8057.
(6) Remove secondary return spring, adjuster cable, primary return spring, cable guide, adjuster lever, and adjuster springs.
(7) Remove holddown springs and brakeshoes.
(8) Disengage parking brake cable from parking brake lever.

Cleaning and Inspection

Clean all parts, except the brakeshoes and brake drums, with brake cleaning solvent only. Clean brake drums with a soap and water solution only and replace brakeshoes that are contaminated with grease or brake fluid. Remove dirt and dust from the support plate using water dampened shop cloths only.

Pull the wheel cylinder dust boots aside and check for evidence of leakage. If leakage is observed, overhaul the wheel cylinders.

Polish the brake support plate ledges with fine sandpaper or emery cloth. If grooves, which may restrict shoe movement, still exist after polishing, replace the support plate. Do not attempt to remove grooves by grinding the ledges smooth as this could result in improper shoe-to-drum contact.

Inspect the lining wear pattern. If the wear across the width of the lining is uneven, check the drums for a bell-mouthed condition, inspect the drums for correct positioning, and inspect the support plate for distortion. Inspect all springs for evidence of overheating (discoloration), fractures, or distortion.

On CJ models, inspect the adjuster cable for kinks, fraying, or for an elongated (worn) eyelet. On all other models, inspect the adjuster levers for wear, cracks, or distortion.

Inspect the adjusting screw for freedom of rotation and the adjuster lever for wear and distortion.

Inspect the brake lines for evidence of leakage, swelling, distortion, kinks, or cracks.

Clean the support plates using compressed air or dry cloths and polish the anchor pins with crocus cloth. Also check the pins for being loose, worn, or damaged. Inspect the support plates for distortion or cracks and check the support plate-to-axle flange bolt torques.

Clean the brakedrums with a soap and water solution only. Inspect the drums for excessive wear, scoring, runout, cracks, heat checks, hard spots, or distortion. Mount the drums on a brake lathe and check runout using a dial indicator. Radial runout must not exceed 0.005 inch. If runout exceeds this figure, replace or turn the drum. If the drums are machined, do not remove more than 0.030 inch (0.76 mm) total. Maximum allowable oversize for any drum is 0.060 inch (1.52 mm) over the original diameter. In addition, do not attempt to refinish drums with hard spots. Replace drums with this condition.

Assembly and Adjustment

NOTE: *When it is necessary to replace the brakeshoes on one wheel, the brakeshoes must also be replaced on the opposite wheel to maintain braking balance.*

(1) Lubricate support plate ledges, anchor pin, self-adjuster cable guide, adjuster screw threads and pivot, and parking brake cable lever and pivot with molydisulphide grease or chassis lubricant.
(2) Install parking brake lever on secondary brakeshoe and install washer and replacement lever retaining U-clip. Crimp ends of clip using pliers to retain it on pivot.
(3) Position brakeshoes on brake support plate and install holddown springs (figs. 2G-25 and 2G-26).
(4) Install parking brake cable in lever and install parking brake strut and positioning spring.
(5) Place adjuster cable eyelet on anchor pin.
(6) Install primary return spring (fig. 2G-27).

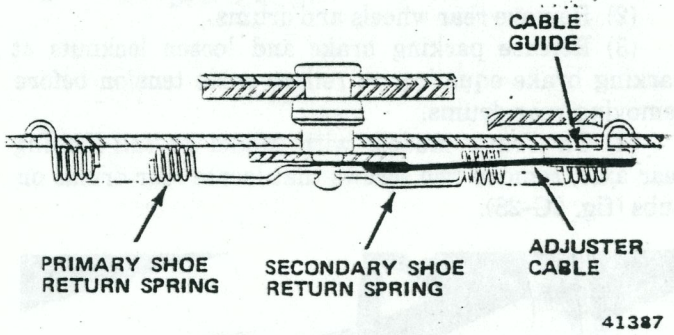

Fig. 2G-27 Return Spring Installation

(7) Install cable guide on secondary brakeshoe.
(8) Install secondary return spring (fig. 2G-27).
(9) Install adjusting screw and spring on brakeshoes. Insert small hooked end of spring in large hole in primary brakeshoe and large hooked end of spring in adjuster lever.
(10) Position adjuster cable in cable guide groove insert hooked end of cable in adjuster lever.
(11) Grip adjuster lever with pliers and hook lever tang in large hole at bottom of secondary brakeshoe.

(12) Perform initial brake adjustment using clearance gauge or manual adjustment procedure. Refer to Service Brake Adjustment.

(13) Install brakedrums.

(14) If any brake lines were disconnected, bleed brakes. Refer to Brake Bleeding.

(15) Install rear wheels and tires.

(16) Lower vehicle.

(17) Check brake operation before moving vehicle.

(18) Drive vehicle in reverse and make 10 to 15 firm brake applications to complete brake adjustment. Make one forward brake application after each reverse application to equalize adjustment.

NOTE: *If the vehicle has an automatic transmission, do not use the forward range to halt vehicle movement in reverse. This procedure will prevent the automatic adjuster mechanism from operating properly resulting in unsatisfactory pedal heights. All stops must be completed.*

BRAKE SERVICE—CHEROKEE-WAGONEER-TRUCK MODELS

WARNING: *When servicing wheel brake units, do not create dust by grinding or sanding brakelinings or by cleaning wheel brake parts with a dry brush or with compressed air. Use water dampened cloths only to remove dirt and dust from brake parts prior to disassembly. Many wheel brake parts contain asbestos fibers which can become airborne if dust is created during servicing operations. Breathing dust containing asbestos fibers may cause serious bodily harm.*

Disassembly

(1) Raise vehicle.

(2) Remove rear wheels and drums.

(3) Release parking brake and loosen locknuts at parking brake equalizer to relieve cable tension before removing rear drums.

(4) On Truck models with Model 60 full-floating rear axle, remove two screws that locate rear drums on hubs (fig. 2G-28).

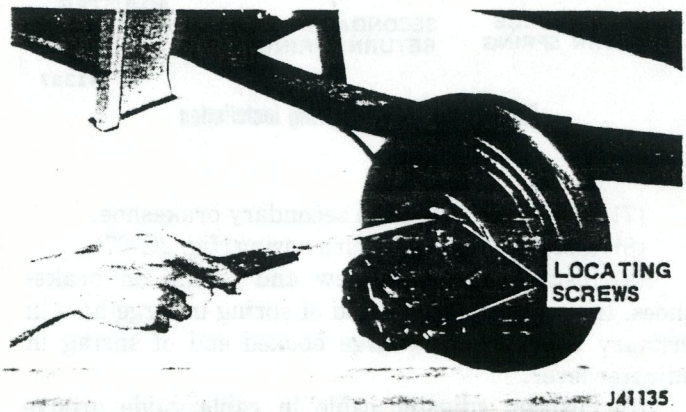

Fig. 2G-28 Brakedrum Locating Screw Removal—Model 60 Axle

(5) Remove primary brakeshoe return spring (fig. 2G-26).

(6) Remove automatic adjuster actuating spring and secondary brakeshoe return spring using Spring Remover Tool J-8057.

(7) Remove holddown springs and remove brakeshoes.

(8) Disengage parking brake cable from parking brake lever on secondary brakeshoe.

(9) Place Wheel Cylinder Clamps J-8002 over wheel cylinders to retain pistons (fig. 2G-29).

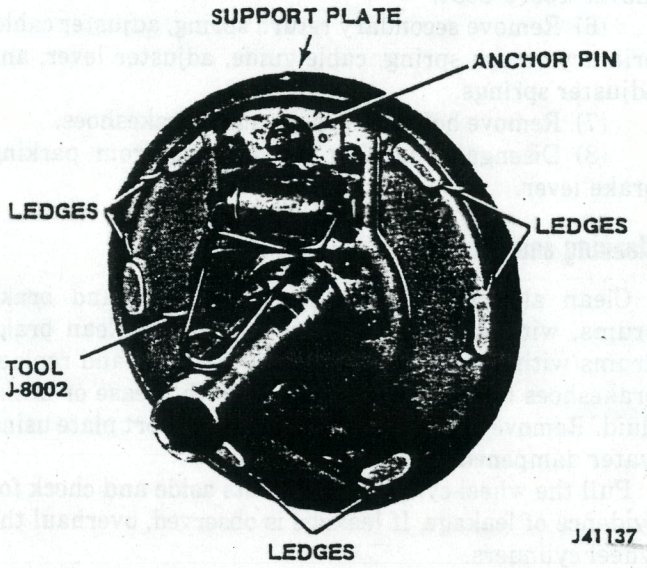

Fig. 2G-29 Wheel Cylinder Clamps Installed

Cleaning and Inspection

Inspect brakelining wear. Replace riveted lining if it is worn to within 1/32 inch (0.79 mm) of the rivet heads. Replace bonded lining if it is worn to a total thickness of approximately 1/16 inch (1.58 mm) or less.

Inspect the lining wear pattern. If wear is uneven across the width of the lining, replace the lining and check the drum for distortion and runout. Inspect the lining for cracks, charred surface, or broken rivets. Replace the lining if contaminated with brake fluid, axle lubricant, or similar contaminants or if the lining exhibits any of the conditions described previously.

Inspect the adjusting screw spring, return springs, holddown springs, actuating lever return spring, and automatic adjuster spring. Replace any springs that are distorted, broken, discolored (overheated), or lack tension.

Inspect the parking brake lever, automatic adjuster lever and pivot, and actuating lever for wear and defects. Replace levers if bent, broken, or excessively worn.

Inspect the adjusting screw pivot and screw threads. The screw must rotate freely. Inspect the screw serrations for excessive wear which could effect automatic adjustment.

Inspect the parking brake cables for being frayed, worn, kinked, or seized. Also check for missing or loose cable end retainer buttons. Inspect the parking brake lever for distortion, worn pivot pin, and for proper cable retention.

Inspect the wheel cylinders for evidence of leakage. Pull back the dust boots and check for signs of leakage past the piston cups. If necessary, overhaul the cylinder as described in this chapter. Inspect the bleeder screw and hydraulic line connection for evidence of leakage or damaged threads. Replace the wheel cylinder if the internal threads are damaged. Check the brake lines for swelling, distortion, kinks, or cracks. Replace any line exhibiting these conditions.

Clean the support plates using shop cloths or compressed air. Polish the anchor pins with crocus cloth and polish the support plate ledges with emery cloth. If the ledges have deep grooves or ridges which might restrict shoe movement, the support plate should be replaced. Do not attempt to reduce deep ridges or grooves by grinding. This can result in improper shoe-to-drum contact. Inspect the support plates for distortion or cracks and check the support plate-to-axle flange bolt torques. Inspect the anchor pins for wear or for being loose. Replace the support plate if it exhibits any of the conditions described previously.

Clean the brakedrums using a soap and water solution only.

CAUTION: *Do not use brake fluid, gasoline, kerosene, or similar solvents to clean the drums. Use a soap and water solution only to clean the drums.*

Inspect the drums for scoring, cracks, heat checking, hard spots, and distortion and check the drums for excessive runout. Mount the drums on a brake lathe and check runout using a dial indicator. Drum runout must not exceed 0.005 inch (0.12 mm). If drum runout is excessive, replace or remachine the drum.

CAUTION: *When machining drums, do not remove more than 0.030 inch (0.76 mm). Maximum allowable oversize for any drum is 0.060 inch (1.52 mm) over original diameter. In addition, do not attempt to machine drums with hard spots. Replace drums with this condition.*

Assembly and Adjustment

NOTE: *When it is necessary to replace the brakelining on one wheel, the lining must also be replaced on the opposite wheel to maintain braking balance.*

(1) Apply thin film of molydisulphide grease, or chassis lubricant to support plate ledges, anchor pin, adjusting screw threads and pivot, adjuster lever-to-secondary brakeshoe contact surface, parking brake lever pivot and portion of lever that contacts secondary brakeshoe.

(2) Connect parking brake cable to parking brake lever on secondary brakeshoe.

NOTE: *When installing the parking brake lever on replacement brakeshoes, pinch the U-clip to retain the lever on the shoe.*

(3) Install secondary brakeshoe, automatic adjuster lever, and lever pivot as assembly and install brakeshoe holddown spring.

(4) Install actuating lever and adjusting lever. Install return spring on actuating lever tang. Large end of tapered spring should rest on brakeshoe.

(5) Install primary shoe and holddown spring.

(6) Install guide plate on anchor pin.

(7) Install parking brake strut and spring on brakeshoes.

(8) Install adjusting screw and spring. Short hooked end of spring goes on primary brakeshoe. Long hooked end goes on secondary brakeshoe (fig. 2G-26).

(9) Install return springs and adjuster spring in following sequence (fig. 2G-26):

(a) install adjuster spring.

(b) install secondary brakeshoe return spring on brakeshoe and adjuster spring.

(c) install primary shoe return spring.

CAUTION: *Be sure the brakeshoes are seated against the anchor pin after installing the springs.*

(10) Perform initial brake adjustment. Refer to Service Brake Adjustment.

(11) Install brakedrums.

(12) If brake lines were disconnected, bleed brakes. Refer to Brake Bleeding.

(13) Install wheels and tires.

(14) Lower vehicle.

(15) Test brake operation before moving vehicle.

(16) Perform final brake adjustment by making 10 to 15 forward and reverse stops to equalize adjustment and until satisfactory brake pedal height is obtained.

NOTE: *If the vehicle has an automatic transmission, do not use the forward range to halt reverse movement of the vehicle. This procedure will prevent the automatic adjusters from operating properly resulting in unsatisfactory pedal heights. All stops must be completed.*

BRAKEDRUM SERVICE

Inspection and Measurement

(1) Raise and support vehicle.

(2) Remove wheels.

(3) Remove brakedrums.

(4) Clean drums using soap and water solution. If drums are grease or oil contaminated, clean drums with alcohol before cleaning with soap and water.

(5) Inspect drums for cracks, severe scoring, distortion, or hard spots (a series of shiny or dark colored spots on contact surface). Replace drums that exhibit these conditons. If drums appear in good condition, proceed to next step.

(6) Refer to Specifications and measure drum inside diameter. If diameter is within limits and refinishing would not create an oversize condition, proceed to next step. If diameter exceeds limits or if drum needs refinishing but would exceed allowable size limits after machining, replace drum.

(7) Mount drum in lathe according to lathe manufacturer's instructions.

(8) Mount dial indicator on lathe so indicator stylus contacts lining surface of drum; zero dial indicator.

(9) Measure drum radial runout.

(a) Rotate drum 360 degrees and observe readings.

(b) Move indicator stylus until readings have been taken across entire contact surface of drum.

(c) Drum runout must not exceed 0.005 inch (0.12 mm) total indicator reading at any point. Also note if indicator readings increase or decrease greatly as stylus is moved across drum surface. Large changes may indicate tapered or bell-mouthed drum.

(10) If drum is within limits and does not need refinishing, install drum. If drum is not within limits or is lightly scored, refinsh drum. Refer to Brakedrum Refinishing.

Brakedrum Refinishing

(1) Sharpen or replace cutting tool bit if necessary.

(2) Install anti-chatter band on drum.

(3) Machine drum according to lathe manufacturer recommendations for feed and speed. Do not remove more than 0.010 inch (0.25 mm) of stock during any cut.

(4) Check drum radial runout again after completing machining operations.

NOTE: *When brakeshoes are replaced on one wheel, they must also be replaced on the opposite wheel to ensure balanced braking.*

SPECIFICATIONS

General Specifications

Brake Drum Radial Runout Limit ..... 0.005 inches (0.12 mm)
Brake Drum Internal Diameter Limit:
CJ Models ..... 10.060 inches (25.5 cm)
Cherokee—Wagoneer—J-10 Truck ... 11.060 inches (28.09 cm)
J-20 Truck ..... 12.060 inches (30.6 cm)
Brake Lining Wear Limits:
Riveted Lining ..... Replace when worn to within 1/32 inch (0.79mm) of rivet heads.
Bonded Lining ..... Replace when worn to thickness of approximately 1/16 inch (1.58 mm) or less.

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Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft-lbs)		Metric (N-m)	
	Service Set - to Torque	In - Use Recheck Torque	Service Set - to Torque	In - Use Recheck Torque
Brakeline-to-Caliper Fitting Bolt (Cke, Wag, Trk)	160 in-lbs.	120 - 200 in-lbs.	18	14 - 23
Bleeder Screw (1/4 - 28)	45 in-lbs.	40 - 50 in-lbs.	5	5 - 6
Bleeder Screw (3/8 - 24)	90 in-lbs.	40 - 140 in-lbs.	10	5 - 16
Brake Support Plate Mounting Bolts/Nuts (J-20 Trk)	50	45 - 55	68	61 - 75
Brake Support Plate Mounting Bolts/Nuts (Cke, Wag, J10 Trk)	45	35 - 55	61	47 - 75
Brake Support Plate Mounting Bolts/Nuts (CJ)	33	30 - 35	45	41 - 47
Caliper Anchor Bracket to Steering Knuckle (CJ)	85	75 - 95	115	102 - 129
Master Cylinder Mounting Bolts/Nuts	30	25 - 35	41	34 - 47
Master Cylinder-to-Power Unit Mounting Nuts	25	20 - 30	34	27 - 41
Power Brake Unit-to-Dash Mounting Bolts/Nuts	22	18 - 25	30	24 - 34
Brake Line-to-Caliper Fitting Bolt (CJ)	25	20 - 30	34	27 - 41
Brake Line-to-Wheel Cylinder Fitting	160 in-lbs.	120 - 200 in-lbs.	18	14 - 23
Parking Brake Cable Clamp-to-Support Plate Bolts (5/16 - 18)	10	8 - 12	14	11 - 16
Wheel Nuts (CJ)	75	65 - 90	102	88 - 122
Wheel Nuts (Cke, Wag, Trk)	75	65 - 80	102	88 - 108
Wheel Nuts (8400 GVW Trk)	130	110 - 150	176	149 - 203
Brake Pedal-to-Power Unit Push Rod Bolt/Nut	35	25 - 40	47	34 - 54
Caliper Mounting Bolts (Cke, Wag, Trk)	35	30 - 40	47	41 - 54
Caliper Support Key Retaining Screw (CJ)	15	15 - 18	20	20 - 24
Disc. Brake Shield Bolts (Cke, Wag, Trk)	8	5 - 10	11	7 - 14
Disc. Brake Shield Nuts (Cke, Wag, Trk)	35	30 - 40	47	41 - 54
Wheel Bearing Outer Locknut (All)	50(min.)		68 (min.)	
Wheel Bearing Inner Locknut (Bearing Adjuster):				
CJ	Tighten to 50 ft-lbs. (68 N-m) and back off 1/6 turn while rotating wheel.			
Cke, Wag, Trk	Tighten to 50 ft-lbs. (68 N-m) and back off 1/6 turn while rotating wheel.			

All Torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

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DISC BRAKES

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GENERAL

Jeep vehicles are equipped with single piston, floating caliper front disc brakes. Two different calipers are used. On CJ models, the caliper is positioned on abutment surfaces machined into the leading and trailing edges of the caliper anchor bracket (fig. 2G-30). On Cherokee, Wagoneer, and Truck models, the caliper is positioned on mounting bolts located in the caliper support bracket (fig. 2G-31). Although the two caliper designs differ in construction, caliper operation and service procedures are similar.

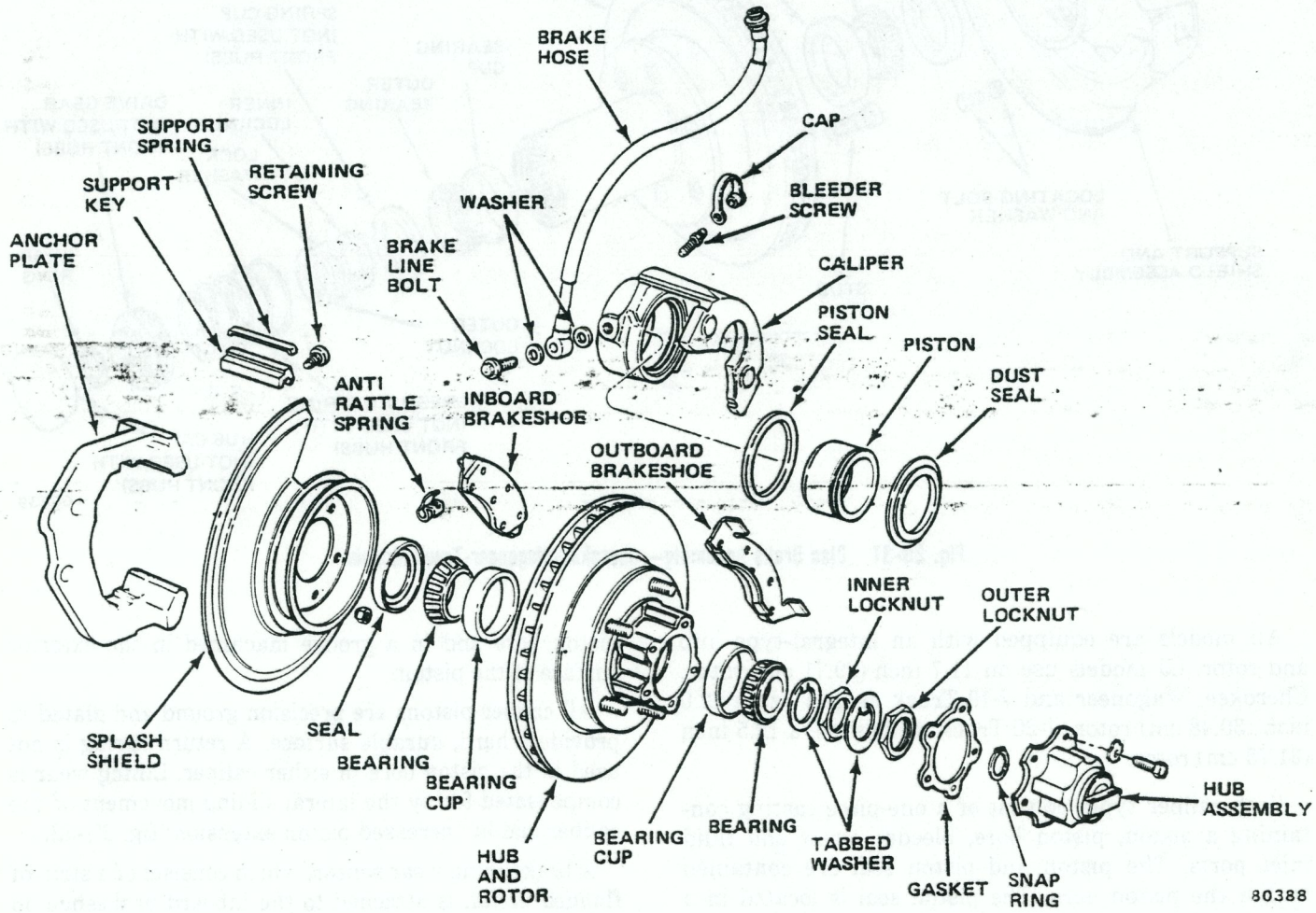

Fig. 2G-30 Disc Brake Assembly—CJ Models

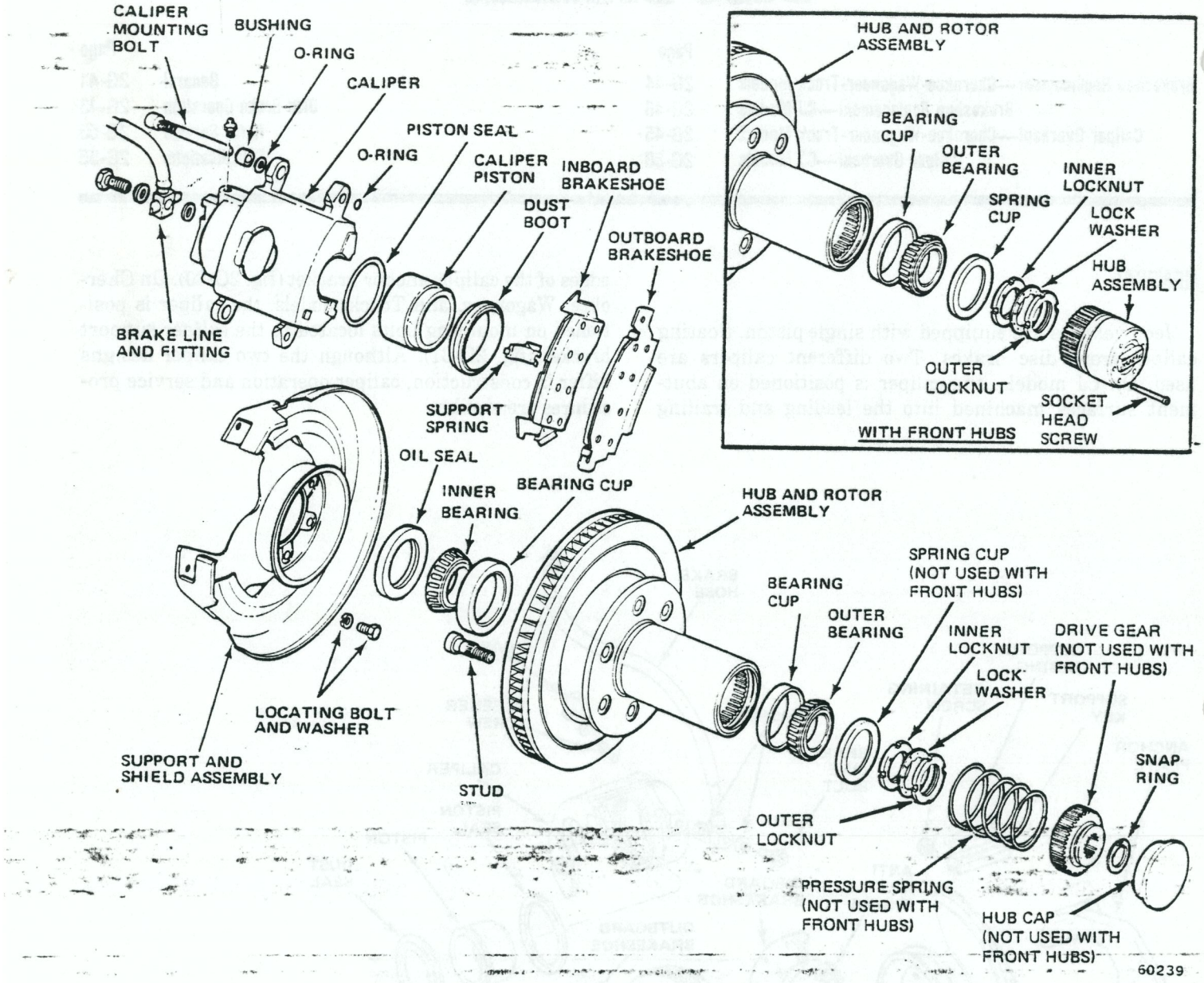

Fig. 2G-31 Disc Brake Assembly—Cherokee-Wagoneer-Truck Models

All models are equipped with an integral-type hub and rotor. CJ models use an 11.7 inch (29.71 cm) rotor. Cherokee, Wagoneer and J-10 Truck models use a 12.0 inch (30.48 cm) rotor. J-20 Truck models use a 12.5 inch (31.75 cm) rotor.

Both caliper types consist of a one-piece casting containing a piston, piston bore, bleeder screw and fluid inlet ports. The piston and piston seal are contained within the piston bore. The piston seal is located in a groove machined in the bore wall. An all-rubber dust boot is used on CJ models while a combination rubber boot with integral metal retainer is used on Cherokee, Wagoneer, and Truck models. The boot is located in a counterbore or groove machined in the upper edge of the piston bore and in a groove machined in the exterior surface of the piston.

All caliper pistons are precision ground and plated to provide a hard, durable surface. A return spring is not used in the piston bore in either caliper. Lining wear is compensated for by the lateral sliding movement of the caliper and by increased piston extension (fig. 2G-32).

A brakelining wear sensor, which consists of a strip of flanged metal, is attached to the inboard brakeshoe on Cherokee, Wagoneer and Truck models (a sensor is not used on CJ model lining). When the brakelining wears to the point of replacement, the sensor contacts the rotor surface making a high-pitched noise to alert the driver (fig. 2G-33).

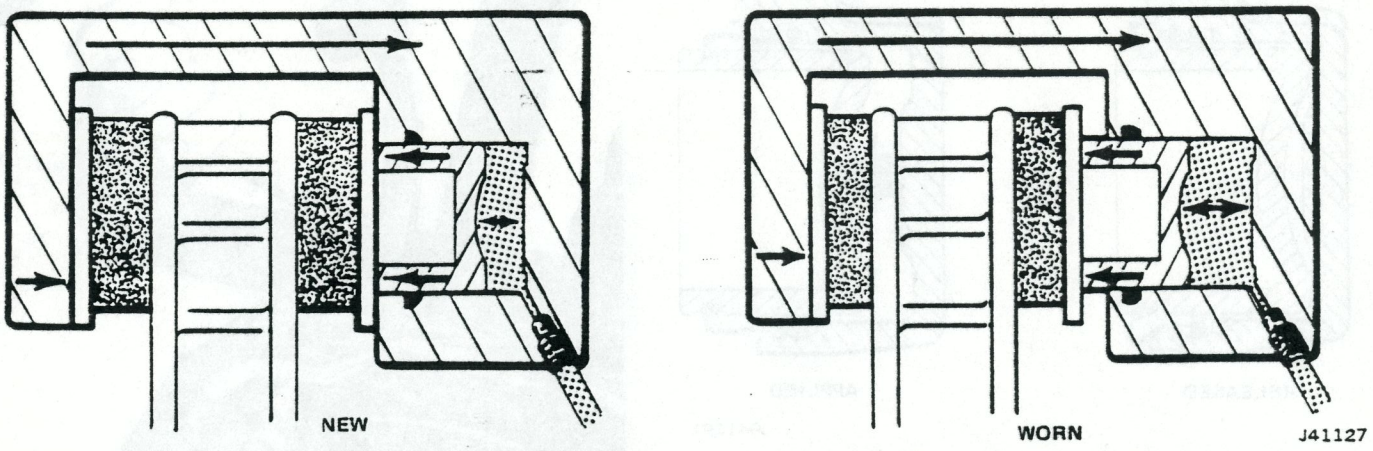

Fig. 2G-32 Piston Extension—New and Worn Linings

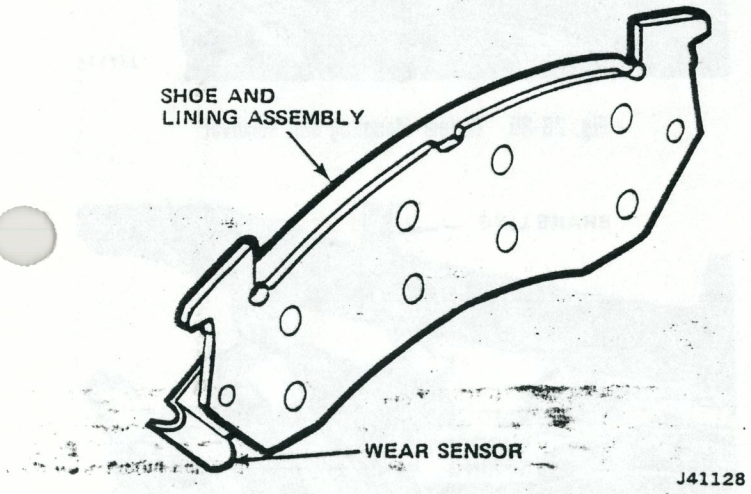

Fig. 2G-33 Brakelining Wear Sensor Location—Cherokee-Wagoneer-Truck Models

DISC BRAKE OPERATION

Operation

The significant feature of disc brake operation is that the caliper is free to slide laterally on the mounting bolts or anchor plate abutment surfaces.

When the brakes are applied, fluid pressure is exerted equally against the piston and piston bore surfaces. Pressure applied to the piston is transmitted to the inboard shoe and lining pressing the lining against the rotor inboard surface. At the same time, pressure applied to the piston bore forces the caliper to slide inboard. This movement causes the outboard portion of the caliper to press the outboard shoe and lining assembly against the rotor outboard surface.

Any application or release of brake apply pressure produces very slight piston and caliper movement. At release, the piston and caliper return to a neutral position. Cherokee, Wagoneer and J-10 Truck models are equipped with low drag calipers. The caliper piston seal in this caliper design retracts each caliper piston more fully than in previous designs. The result is less vehicle rolling resistance because brake lining drag on each brake rotor is reduced.

As the linings wear, the piston extends farther out of the caliper bore causing the caliper to reposition itself to maintain lining-to-rotor clearance. When the piston extends, additional brake fluid flows into the bore to compensate for the increase in bore volume caused by piston extension (fig. 2G-32).

Wear Compensation

The piston seal maintains operating clearance between the rotor and lining and adjusts for wear during each brake application. When the brakes are applied, the seal is deflected by hydraulic pressure and by friction between the piston and seal. When hydraulic pressure is released, the seal reverts to its original shape and retracts the piston just enough to provide the necessary operating clearance.

As the linings wear, piston travel begins to exceed the seal deflection limit. The piston then moves outward through the seal just far enough to compensate for lining wear and reestablish normal seal deflection (fig. 2G-34).

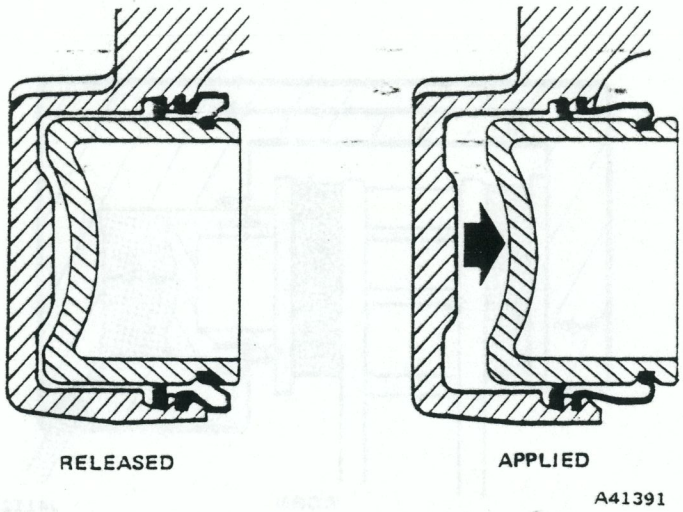

Fig. 2G-34 Piston and Seal Movement

BRAKESHOE REPLACEMENT—CHEROKEE-WAGONEER-TRUCK MODELS

WARNING: *When servicing wheel brake parts, do not create dust by grinding or sanding brakelinings or by cleaning wheel brake parts with a dry brush or with compressed air. Use water dampened shop cloths only to remove dirt and dust from brake parts prior to disassembly. Many wheel brake parts contain asbestos fibers which can become airborne if dust is created during servicing operations. Breathing dust containing asbestos fibers may cause serious bodily harm.*

(1) Remove two-thirds of brake fluid from master cylinder front reservoir.

(2) Raise vehicle.

(3) Remove front wheel and tire.

(4) Bottom caliper piston in bore. Insert screwdriver between piston and inboard shoe and press piston into bore. If piston is difficult to move using screwdriver, use large C-clamp.

(5) Remove caliper mounting bolts using hex wrench (fig. 2G-35).

(6) Remove caliper by lifting it upward and out of shield and support (fig. 2G-36). Place caliper on front spring or other suitable support. Do not allow brake hose to support weight of caliper.

(7) Remove brakeshoes from caliper.

(8) Remove support spring from inboard shoe. Note spring position for assembly reference (fig. 2G-36).

(9) Remove sleeves and rubber bushings from mounting bolt bores in caliper mounting ears (fig. 2G-30).

(10) Clean mounting bolts, bolt bores, and bushing grooves in caliper mounting ears with brake cleaning solvent. Replace mounting bolts if corroded or if threads are damaged.

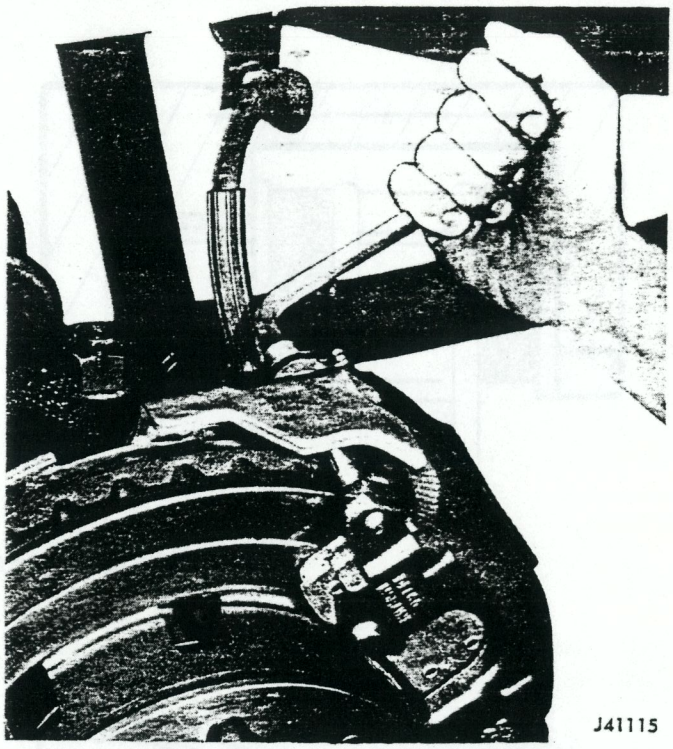

Fig. 2G-35 Caliper Mounting Bolt Removal

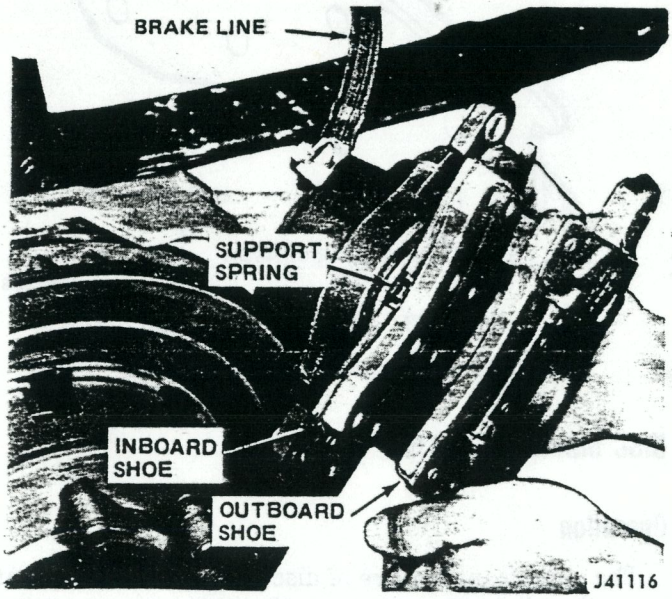

Fig. 2G-36 Caliper Removal

NOTE: *Do not use abrasives to clean or polish the mounting bolts. Abrasives will destroy the protective plating on the bolts.*

(11) Clean caliper interior and dust boot using shop cloths only. Inspect dust boot for cuts, cracks, and for proper seating in piston bore. If evidence of fluid leakage is noted during inspection, overhaul caliper.

CAUTION: *Do not use compressed air to clean the caliper interior or dust boot. The force of compressed air will unseat the boot. Use shop cloths only.*

(12) Lubricate replacement bushings, sleeves, bushing grooves, and small ends of mounting bolts with silicone lubricant.

(13) Install rubber bushings in caliper mounting ears.

CAUTION: *Do not use the original old bushings or sleeves. Use replacement parts only.*

(14) Install sleeves in inboard mounting ears of caliper. Position sleeves with sleeve end facing shoe and lining flush with machined surface of mounting ear.

(15) Install support spring on inboard shoe. Place single tang end of spring over notch in shoe (fig. 2G-37).

(16) Install inboard shoe in caliper (fig. 2G-38). Be sure shoe is flush against piston and that support spring is fully seated in piston (fig. 2G-38).

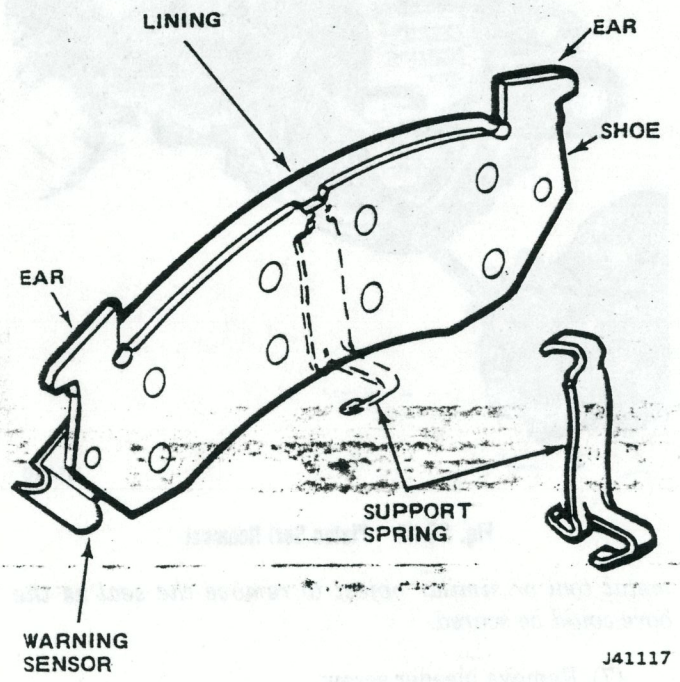

Fig. 2G-37 Support Spring Installation

(17) Install outboard shoe. Shoe ears should rest on upper surface of caliper mounting ears and lower shoe tab should fit into cutout in caliper. Be sure shoe is fully seated.

(18) Position caliper over rotor and in support shield and bracket. Align mounting holes in caliper and bracket.

(19) Install caliper mounting bolts. Be sure bolts pass under inboard shoe retaining ears and insert bolts until they enter bores in outboard shoe and caliper mounting ears. Thread bolts into support bracket and tighten to 35 foot-pounds (47 N•m) torque.

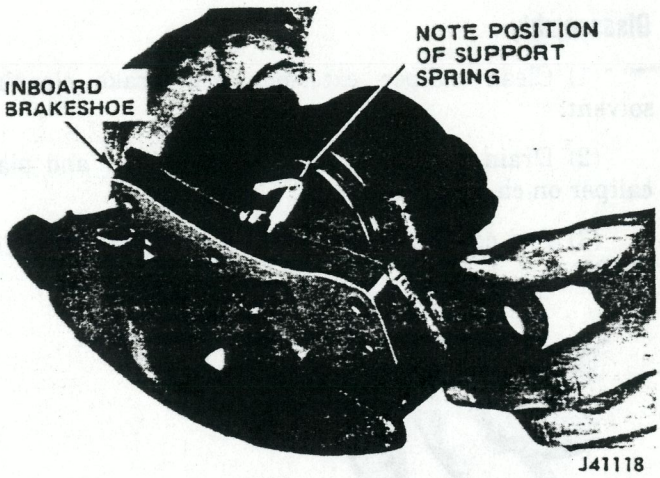

Fig. 2G-38 Inboard Brakeshoe Installation

(20) Fill master cylinder with brake fluid and pump brake pedal to seat shoes.

(21) Clinch upper ears of outboard shoe until radial clearance between shoe and caliper is eliminated.

NOTE: *Outboard shoes with formed ears are designed for original installation only and are fitted to the caliper. These shoes should never be relined or reconditioned for future installation.*

(22) Install wheel and tire.

(23) Lower vehicle.

(24) Check master cylinder fluid level. Add fluid as required to within 1/4 inch (6.35 mm) of reservoir rim.

(25) Apply brakes several times to seat brakeshoes.

(26) Check and correct master cylinder fluid level as necessary.

(27) Test brake operation before moving vehicle.

CALIPER OVERHAUL—CHEROKEE-WAGONEER-TRUCK MODELS

Removal

(1) Remove two-thirds of brake fluid from master cylinder front reservoir.

(2) Raise vehicle.

(3) Remove wheel and tire.

(4) Bottom caliper piston using screwdriver or large C-clamp.

(5) Clean brake line hose connection thoroughly using shop cloth.

(6) Disconnect brake line at caliper. Remove brake line bolt and copper gaskets. Discard copper gaskets.

(7) Cap or tape open end of brake hose to prevent dirt entry.

(8) Remove caliper and remove brakeshoes from caliper.

NOTE: *Work on one caliper at a time only. If shoes are to be reused, mark their location for assembly reference.*

Disassembly

(1) Clean caliper exterior with brake cleaning solvent.

(2) Drain remaining fluid from caliper and place caliper on clean work surface.

(3) Pad caliper interior with clean shop cloths (fig. 2G-39).

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Fig. 2G-39 Piston Removal

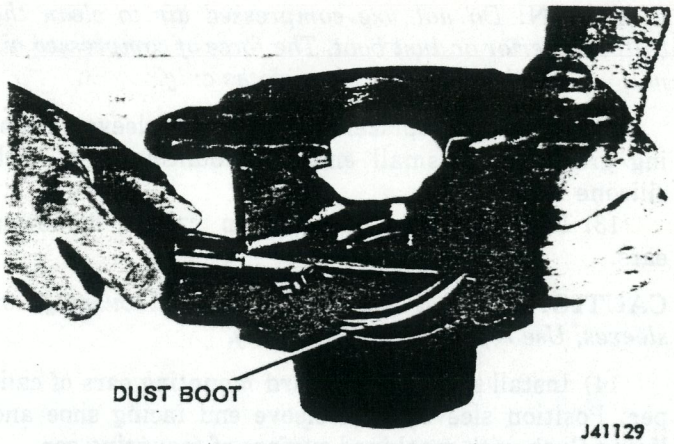

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Fig. 2G-40 Dust Boot Removal

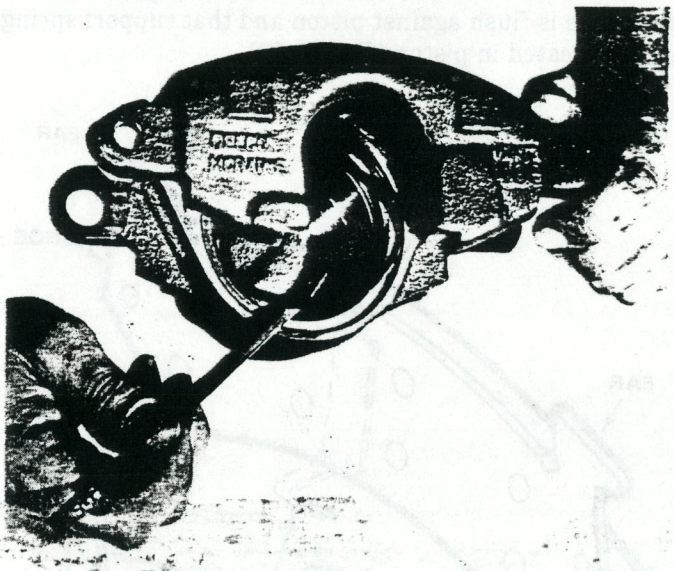

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Fig. 2G-41 Piston Seal Removal

WARNING: *Do not, under any circumstances, place fingers in front of the piston in an attempt to catch or protect it. In addition, use only enough air pressure to ease the piston out of the bore. Excessive air pressure can eject the piston with enough force to cause damage or injury.*

(4) Insert air nozzle into caliper fluid inlet hole and slowly apply just enough air pressure to ease piston out of bore (fig. 2G-39).

(5) Remove and discard dust boot. Use screwdriver to pry boot from bore (fig. 2G-40). Do not scratch piston bore during boot removal.

(6) Remove and discard piston seal. Use pencil or similar wood implement to remove seal (fig. 2G-41).

CAUTION: *Remove the seal using a pencil, wooden stick, piece of plastic, or similar tool only. Do not use a metal tool or similar object to remove the seal as the bore could be scored.*

(7) Remove bleeder screw.

(8) Remove and discard sleeves and rubber bushings from caliper mounting ears.

Cleaning and Inspection

Clean all parts in brake cleaning solvent or clean brake fluid only. Blow out all caliper passages using filtered compressed air only.

Replace the mounting bolts if corroded or if the threads are damaged. Do not attempt to clean or polish the mounting bolts with abrasives as the protective plating will be removed.

Inspect the caliper piston. Replace the piston if nicked, scratched, corroded, or if the protective plating has worn off.

CAUTION: *Do not attempt to refinish the piston in any way. The outside diameter is the sealing surface and is manufactured to very close tolerances. Removal of the nickel-chrome protective plating will lead to pitting, rusting, and eventual piston seizure.*

Inspect the piston bore. Replace the caliper if the bore is nicked, scratched, worn, cracked, or badly corroded. However, minor stains or corrosion can be removed using crocus cloth.

CAUTION: *Do not use emery cloth or similar abrasives on the piston bore. If the bore does not clean up with crocus cloth, replace the caliper. Clean the caliper thoroughly with brake fluid or brake cleaning solvent if the bore was polished.*

Assembly

(1) Lubricate piston bore and replacement seal with brake fluid.

(2) Install seal in bore groove. Work seal into groove using fingers only.

(3) Lubricate piston with brake fluid.

(4) Install replacement dust boot on piston. Slide metal retainer portion of boot over open end of piston and pull boot rearward until rubber boot lip seats in piston groove (fig. 2G-42).

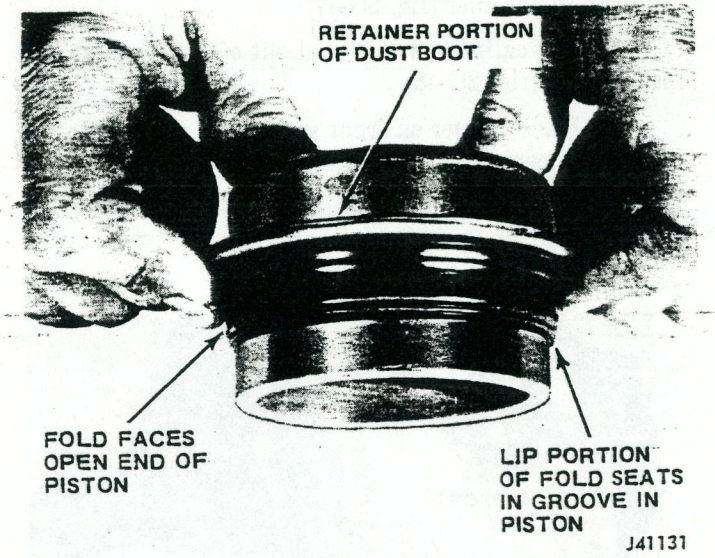

Fig. 2G-42 Installing Dust Boot on Piston

(5) Push metal retainer portion of boot forward until retainer is flush with rim at open end of piston and boot fold snaps into place (fig. 2G-43).

(6) Insert piston into bore and into piston seal. Do not unseat seal.

(7) Press piston to bottom of bore using hammer handle. Approximately 50 to 100 pounds (23 to 45 kg) of force is required to bottom piston in bore.

(8) Seat metal retainer portion of dust boot in counterbore at upper end of piston bore using tool J-22904 (fig. 2G-44).

CAUTION: *The metal portion of the dust boot must be seated evenly and below the face of the caliper.*

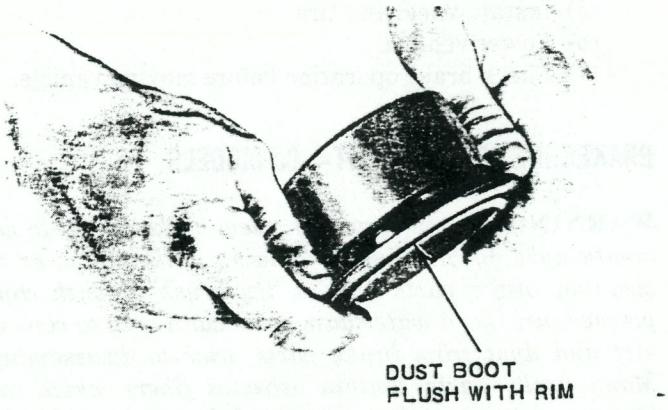

Fig. 2G-43 Snapping Dust Boot Fold in Place

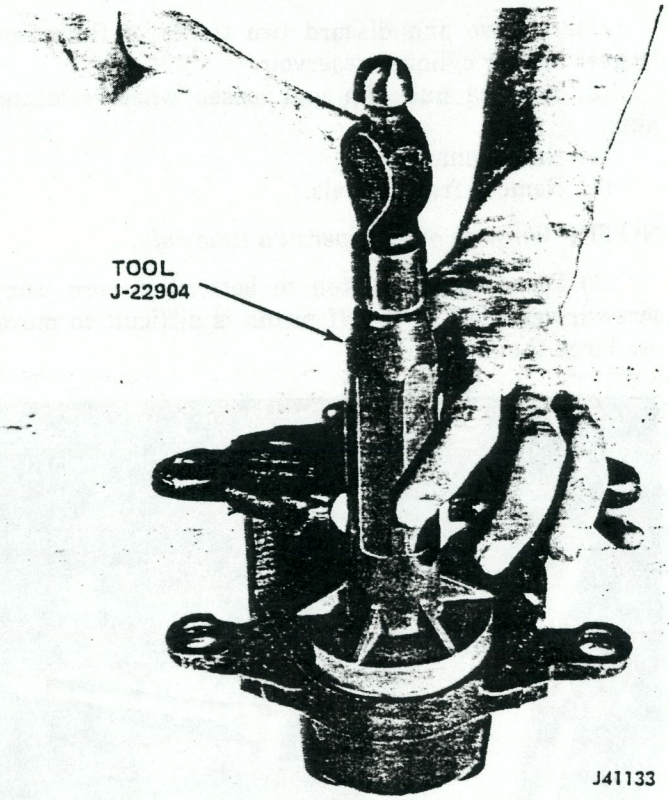

Fig. 2G-44 Seating Dust Boot in Counterbore

(9) Install bleeder screw. Tighten screw securely but not to required torque until brakes have been bled.

Installation

(1) Install replacement copper gaskets on brake line and connect line to caliper. Tighten brake line bolt to 160 inch-pounds (18 N•m) torque.

(2) Install brakeshoes, and replacement sleeves and bushings as outlined in Brakeshoe Replacement.

(3) Position caliper on rotor and support bracket and install caliper mounting bolts. Tighten bolts to 35 foot-pounds (47 N•m) torque.

(4) Bleed brakes as outlined in Brake Bleeding.

(5) Install wheel and tire.

(6) Lower vehicle.

(7) Check brake operation before moving vehicle.

BRAKESHOE REPLACEMENT—CJ MODELS

WARNING: *When servicing wheel brake parts, do not create dust by grinding or sanding brakelinings or by cleaning brake parts with a dry brush or with compressed air. Use a water dampened cloth only to remove dirt and dust from brake parts prior to disassembly. Many brake parts contain asbestos fibers which can become airborne if dust is created during service operations. Breathing dust containing asbestos fibers may cause serious bodily harm.*

(1) Remove and discard two thirds of fluid from largest master cylinder reservoir.

(2) Remove hub cap and loosen wheel retaining nuts.

(3) Raise vehicle.

(4) Remove front wheels.

NOTE: *Work on one caliper at a time only.*

(5) Press caliper piston to bottom of bore using screwdriver (fig. 2G-45). If piston is difficult to move, use large C-clamp.

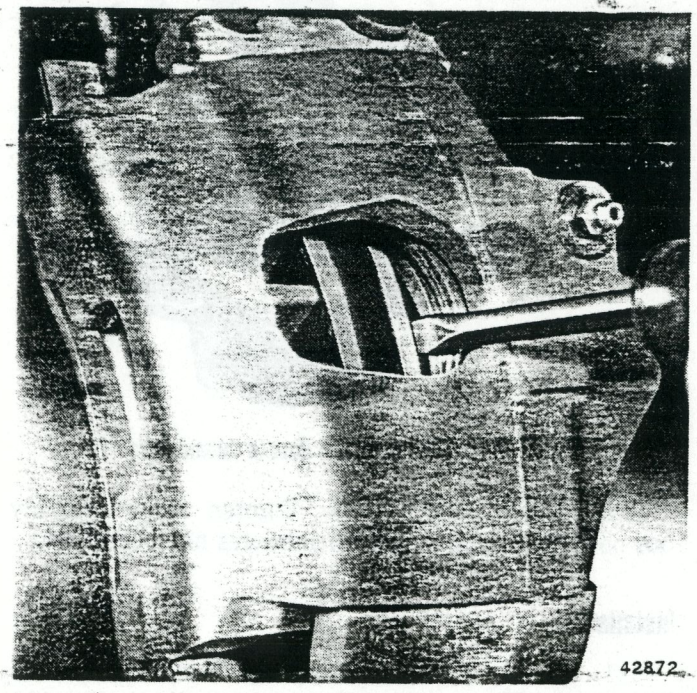

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Fig. 2G-45 Bottoming Caliper Piston

(6) Remove caliper support key retaining screw using 1/4 hex wrench (fig. 2G-46).

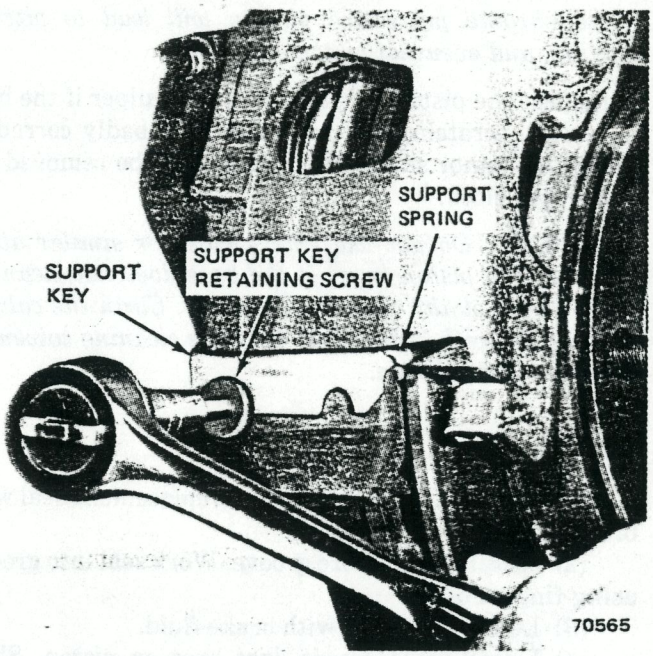

Fig. 2G-46 Support Key Retaining Screw Removal

(7) Remove caliper support key and spring using punch and hammer (fig. 2G-47).

(8) Lift caliper upward and out of anchor plate and off of rotor (fig. 2G-48).

(9) Place caliper on front suspension spring. Do not let brake hose support weight of caliper.

(10) Remove inboard brakeshoe from anchor plate (fig. 2G-49).

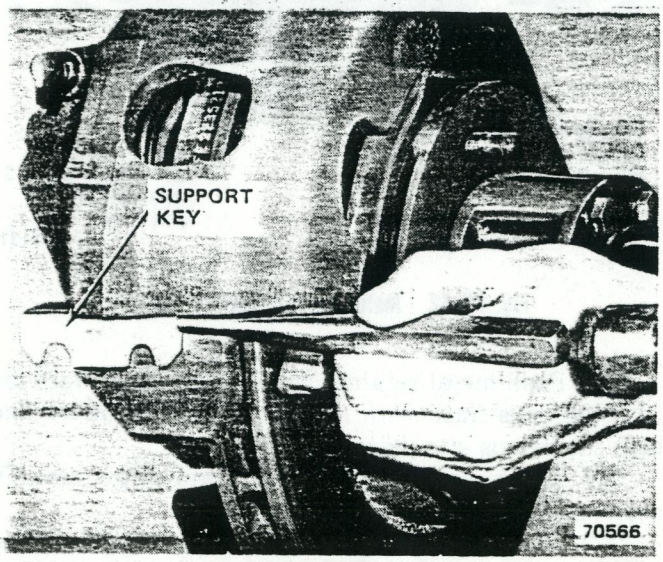

Fig. 2G-47 Support Key and Spring Removal

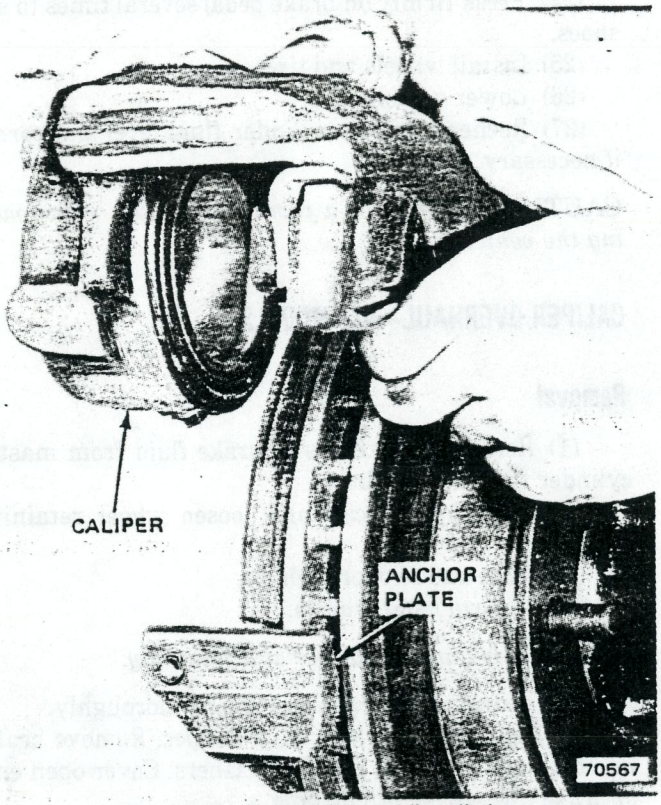

Fig. 2G-48 Caliper Removal/Installation

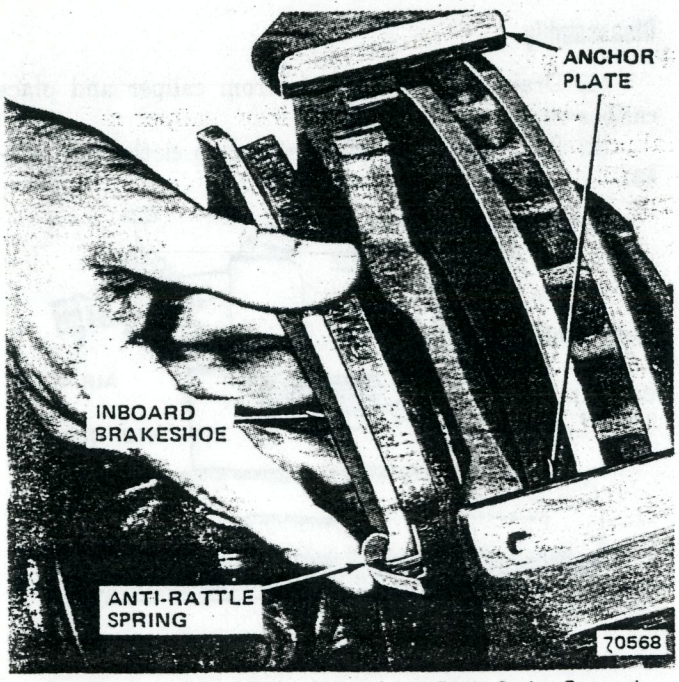

Fig. 2G-49 Inboard Brakeshoe and Anti-Rattle Spring Removal

(11) Remove anti-rattle spring from inboard brakeshoe (fig. 2G-49). Note spring position for assembly reference.

(12) Remove outboard brakeshoe from caliper.

(13) Clean caliper interior using shop cloths only.

CAUTION: *Do not use compressed air to clean the caliper interior. The force of compressed air is enough to dislodge or damage the dust boot.*

(14) Inspect caliper for evidence of leakage from piston bore. If leakage is evident, overhaul caliper. Refer to Caliper Overhaul—CJ Models.

(15) Inspect abutment (sliding) surfaces of caliper and anchor plate for rust or corrosion (fig. 2G-50). Clean these surfaces using stiff wire brush and fine grit sandpaper and lubricate them with molydisulphide grease.

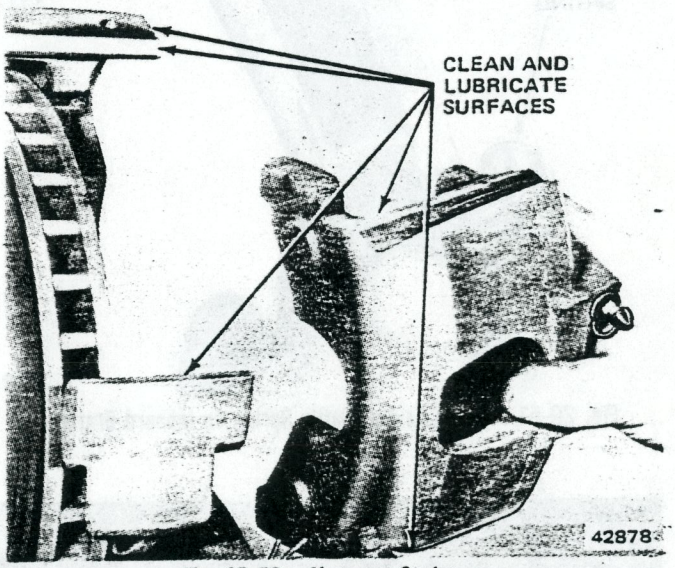

Fig. 2G-50 Abutment Surfaces

CAUTION: *It is important that the abutment surfaces be clean, smooth, and lubricated with molydisulphide grease. Rust, corrosion, or foreign material on these surfaces will impair the sliding action of the caliper in the anchor plate.*

(16) Install inboard brakeshoe anti-rattle spring on rear flange of inboard brakeshoe. Be sure looped section of spring faces away from rotor (fig. 2G-51).

(17) Install assembled inboard brakeshoe and anti-rattle spring in caliper anchor plate (fig. 2G-49). Do not dislodge anti-rattle spring during shoe installation.

(18) Install outboard brakeshoe in caliper (fig. 2G-52).

(19) Install caliper over rotor and in anchor plate (fig. 2G-48).

CAUTION: *Be very careful to avoid tearing or dislodging the dust boot when installing the caliper. A damaged or displaced boot will expose the caliper piston to road splash resulting in corrosion and eventual piston seizure.*

(20) Align caliper and anchor plate and insert support key and spring between abutment surfaces at trailing end of caliper (fig. 2G-46).

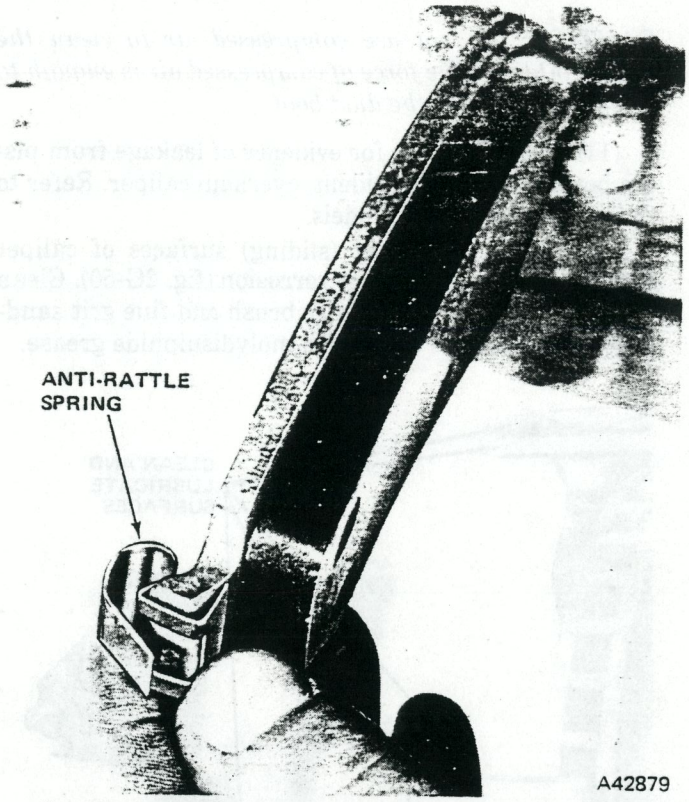

Fig. 2G-51 Installing Anti-Rattle Spring on Inboard Brakeshoe

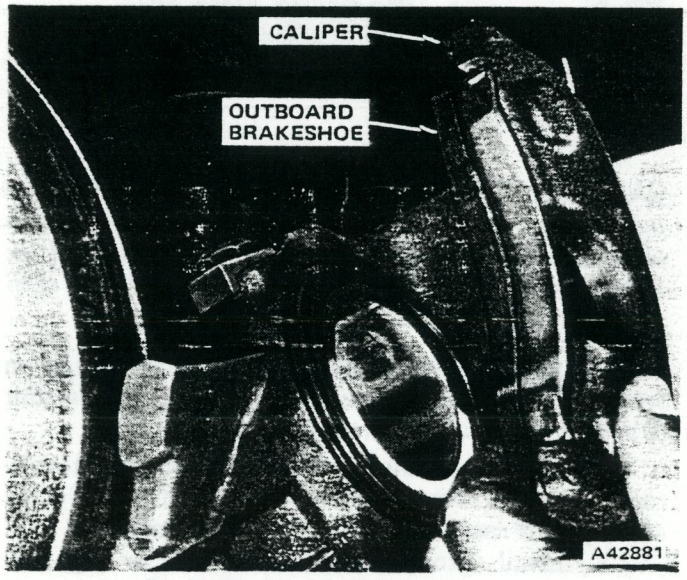

Fig. 2G-52 Inboard Brakeshoe Installation

(21) Complete installation of support key and spring using hammer and punch.

(22) Install support key retaining screw and tighten screw to 15 foot-pounds (20 N•m) torque. Be sure screw is properly seated in support key notch before tightening.

(23) Fill master cylinder reservoir to within 1/4 inch (6.35 mm) of reservoir rim.

(24) Press firmly on brake pedal several times to seat shoes.

(25) Install wheels and tires.

(26) Lower vehicle.

(27) Recheck master cylinder fluid level and correct if necessary.

CAUTION: *Check for a firm brake pedal before moving the vehicle.*

CALIPER OVERHAUL—CJ MODELS

Removal

(1) Remove two-thirds of brake fluid from master cylinder front reservoir.

(2) Remove hub cap and loosen wheel retaining nuts.

(3) Raise and support vehicle.

(4) Remove front wheels.

NOTE: *Work on one caliper at a time only.*

(5) Clean caliper brake line fitting thoroughly.

(6) Disconnect brake line at caliper. Remove brake line bolt and washers. Discard washers. Cover open end of brake line with cloth or tape.

(7) Remove caliper and brakeshoes as outlined in Brakeshoe Replacement—CJ Models.

Disassembly

(1) Drain remaining fluid from caliper and place caliper on clean work surface.

(2) Pad caliper interior with shop cloths (fig. 2G-53).

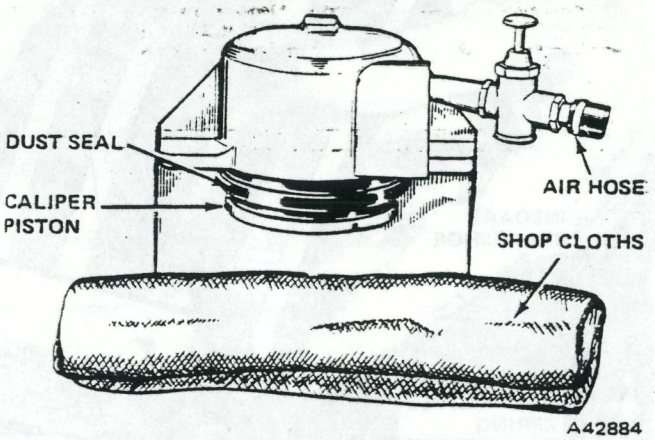

Fig. 2G-53 Caliper Piston Removal

(3) Insert air nozzle in caliper fluid inlet port and slowly apply just enough air pressure to ease piston out of bore.

WARNING: *Do not, under any circumstances, place fingers in front of the piston in an attempt to catch or protect it. In addition, use only enough air pressure to*

ease the piston out of the bore. Excessive air pressure can eject the piston with enough force to cause damage or personal injury.

(4) Remove and discard dust boot (fig. 2G-54).

(5) Remove piston seal from bore using plastic or wood tool only. Discard piston seal.

CAUTION: *Do not use metal tools to remove the piston seal. Metal tools may damage the piston bore.*

(6) Remove bleeder screw protective cap and bleeder screw.

Cleaning and Inspection

Remove rust and corrosion from the caliper and anchor plate abutment surfaces using a wire brush and fine grit sandpaper and lubricate these surfaces with molydisulphide grease (fig. 2G-50).

Clean the caliper and piston with brake cleaning solvent and dry both parts using filtered compressed air. Be sure to blow out all passages in the caliper.

Inspect the caliper piston for damage. Replace the piston if worn, scored, pitted, or corroded.

Inspect the caliper for damage. Replace the caliper if the bore or seal grooves are worn, nicked, pitted, or badly corroded. Minor corrosion in the bore can be removed using a fiber brush only.

Inspect the anti-rattle spring, support key, support key spring, and support key retaining screw. Replace any parts that are damaged or worn. Replace the support spring and anti-rattle springs if they are flattened, distorted, or lack tension.

Assembly

(1) Lubricate piston bore and replacement piston seal with brake fluid.

(2) Install piston seal in bore. Work seal into groove using fingers only.

(3) Install bleeder screw and protective cap.

(4) Install caliper piston and replacement dust boot using Installer Tool J-24837. Refer to Piston and Boot Replacement with Installer Tool J-24837.

NOTE: *If a boot installer tool is not available, refer to Piston and Boot Installation without Installer Tool.*

(1) Lubricate piston and replacement dust boot with brake fluid.

(2) Mount dust boot on Installer Tool J-24837 (fig. 2G-55). Allow approximately 1/4 inch (6.35 mm) of tool to extend beyond small lip of dust boot.

(3) Position assembled boot and installer tool over piston bore. Reach through installer tool and work large lip of boot into boot groove in upper edge of piston bore (fig. 2G-56). Be sure boot is completely seated in groove.

(4) Lubricate caliper piston with brake fluid.

(5) Insert piston through installer tool and center piston in bore.

(6) Press piston half-way into bore. Use hammer handle and steady pressure to install piston (fig. 2G-57). Do not strike hammer handle or piston to install. Piston must be pressed into bore only.

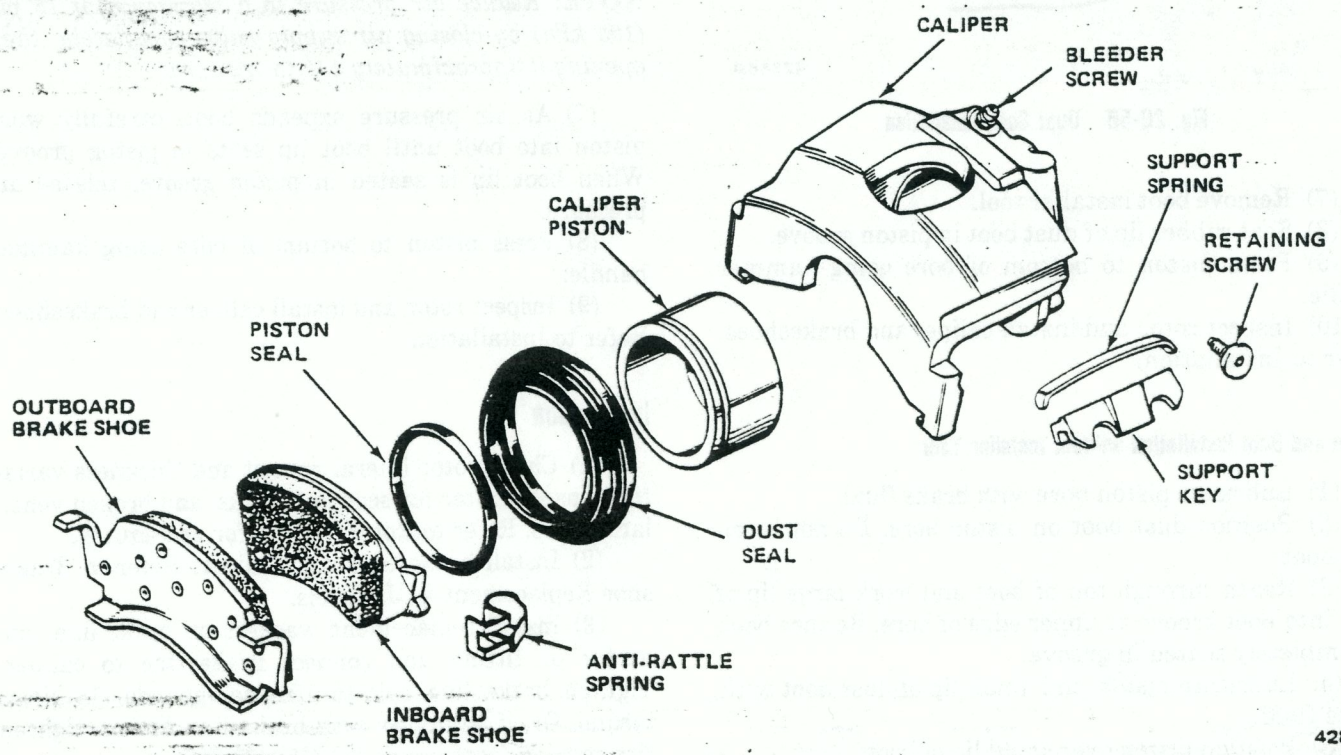

Fig. 2G-54 Caliper Assembly—CJ Models

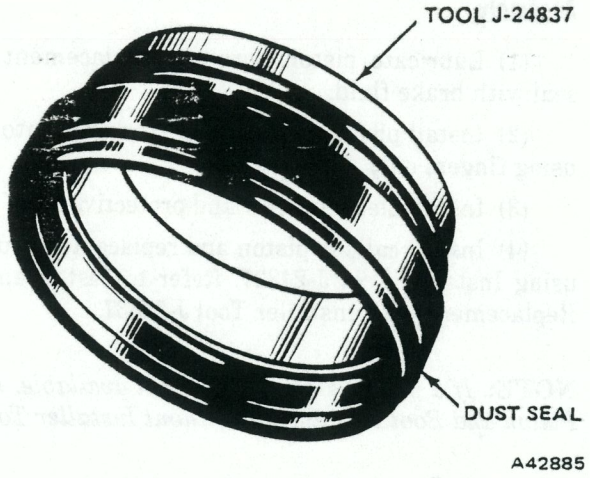

Fig. 2G-55 Positioning Dust Seal on Installer Tool

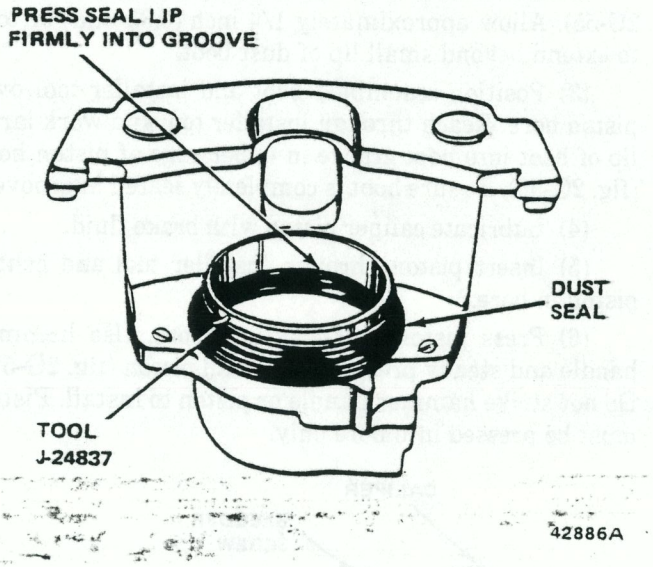

Fig. 2G-56 Dust Seal Installation

(7) Remove boot installer tool.

(8) Seat rubber lip of dust boot in piston groove.

(9) Press piston to bottom of bore using hammer handle.

(10) Inspect rotor and install caliper and brakeshoes. Refer to Installation.

Piston and Boot Installation without Installer Tool

(1) Lubricate piston bore with brake fluid.

(2) Position dust boot on piston bore. Do not lubricate boot.

(3) Reach through top of boot and work large lip of boot into boot groove at upper edge of bore. Be sure boot is completely seated in groove.

(4) Lubricate piston and small lip of dust boot with brake fluid.

(5) Position piston over small lip of boot.

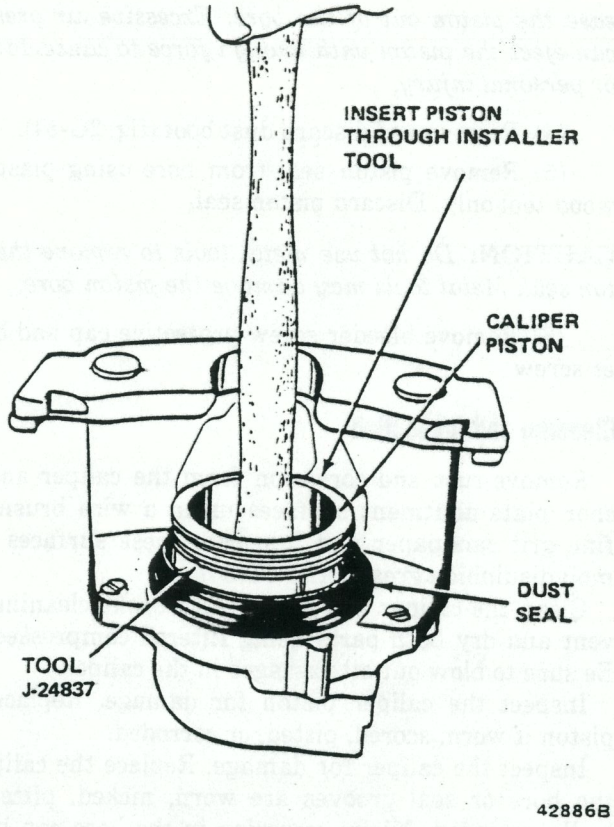

Fig. 2G-57 Caliper Piston Installation

(6) Hold piston in position over boot lip and direct reduced air pressure of approximately 15 psi (103 kPa) compressed air into caliper fluid inlet port.

NOTE: *Reduce air pressure to a maximum of 15 psi (103 kPa) by closing air supply valve completely; then opening it approximately 1/4 to 1/2 turn.*

(7) As air pressure expends boot, carefully work piston into boot until boot lip seats in piston groove. When boot lip is seated in piston groove, release air pressure.

(8) Press piston to bottom of bore using hammer handle.

(9) Inspect rotor and install caliper and brakeshoes. Refer to Installation.

Installation

(1) Check rotor lateral runout and thickness variation. Inspect rotor for scoring, cracks, and broken ventilating ribs. Refer to Rotor Service for procedures.

(2) Install brakeshoes and caliper. Refer to Brakeshoe Replacement—CJ Models.

(3) Install replacement washers on brake line connector or fitting and connect brake line to caliper. Tighten brake line bolt to 160 inch-pounds (18 N•m) torque. Or, if equipped with brake line fitting, tighten fitting to 25 foot-pounds (34 N•m) torque.

(4) Fill master cylinder to within 1/4 inch (6.35 mm) of reservoir rims.

(5) Press brake pedal firmly several times to seat brakeshoes.

(6) Refill master cylinder if necessary and bleed brakes. Refer to Brake Bleeding.

(7) Install wheels.

(8) Lower vehicle.

(9) Check brake operation before moving vehicle.

ROTOR SERVICE

Rotor Inspection

(1) Raise and support front of vehicle.

(2) Remove front wheels.

(3) Remove caliper (do not disconnect brake line).

(4) Inspect rotor braking surfaces. If surfaces are only lightly rusted or scored, proceed to step (5). If surfaces are severely scored, cracked, chipped, excessively worn, or have hard spots (a series of shiny or dark colored spots), replace rotor.

(5) If rotor surfaces are only lightly scaled, rusted or scored, remove rotor, bearings and seal from rotor. Clean rotor hub bearing surfaces and mount rotor in brake lathe. Clean surfaces using flat sanding discs while rotor is turning in lathe.

(6) Remove rotor from lathe.

(7) Check rotor thickness at center of lining contact area. Thickness must be larger than minumum (replacement) specification and provide sufficient stock for refinishing if necessary. If rotor is within limits, proceed to next step. If rotor is less than minimum thickness specification or refinishing would leave it below minimum thickness specification, replace rotor.

(8) Install bearings and seal in rotor.

(9) Install rotor on steering spindle and check runout and thickness variation. Refer to Specifications for Tolerances.

Rotor Measurement

(1) Measure rotor lateral (face) runout (fig. 2G-58).

(a) Mount dial indicator on support stand or steering spindle.

(b) Position indicator stylus so it contacts center of rotor lining contact area and zero indicator.

(c) Turn rotor 360 degrees and note indicator reading. Runout must not exceed limit stated in Rotor Specifications.

(d) Refinish rotor if runout exceeds stated limit. Replace rotor if runout is so severe that machining would cause rotor to fall below minimum (replacement) thickness specification. Refer to Rotor Specifications.

(e) If runout is within limits, proceed to step (2).

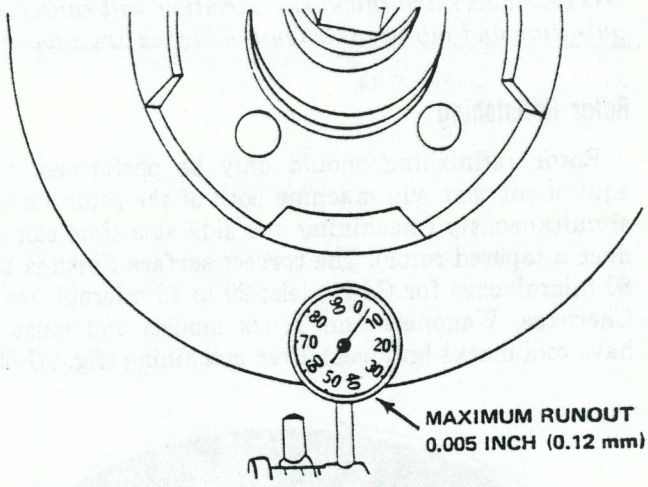

Fig. 2G-58 Checking Lateral Runout

NOTE: *Excessive lateral runout will cause rotor wobble resulting in chatter, vibration and pedal pulsation.*

(2) Measure rotor thickness variation (fig. 2G-59).

(a) Measure variation using micrometer or two dial indicators.

(b) Take readings at four or more equally spaced points around rotor circumference and one inch (25 mm) inward from outer edge of rotor.

(c) Thickness variation, from point-to-point, must not vary by more than limit stated in Rotor Specifications.

(d) Refinish rotor if thickness variation exceeds stated limit. Replace rotor if machining will not correct variation or if machining would cause rotor to fall below minimum thickness specification.

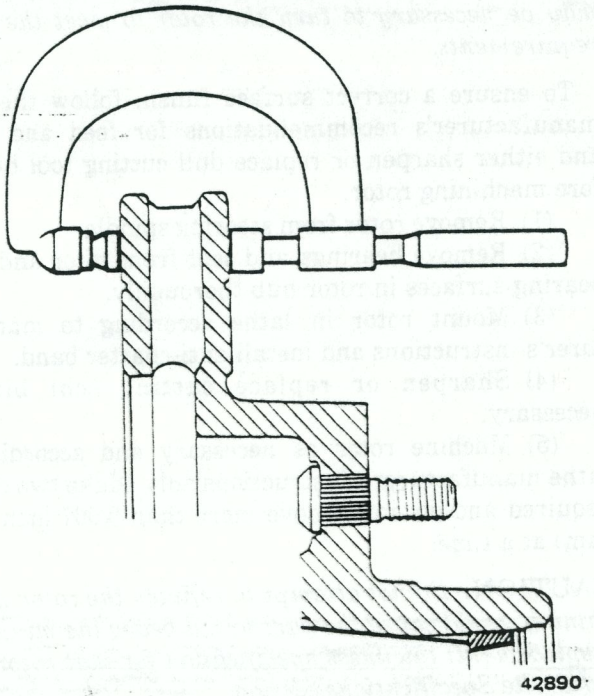

Fig. 2G-59 Checking Thickness Variation

NOTE: *Excessive thickness variation will cause pedal pulsation and vibration when the brakes are applied.*

Rotor Refinishing

Rotor refinishing should only be performed using equipment that will machine both of the rotor surfaces simultaneously (machining one side at a time can produce a tapered rotor). The correct surface finish is 15 to 80 microinches for CJ models; 20 to 60 microinches for Cherokee, Wagoneer and Truck models and must not have tool marks (grooves) after machining (fig. 2G-60).

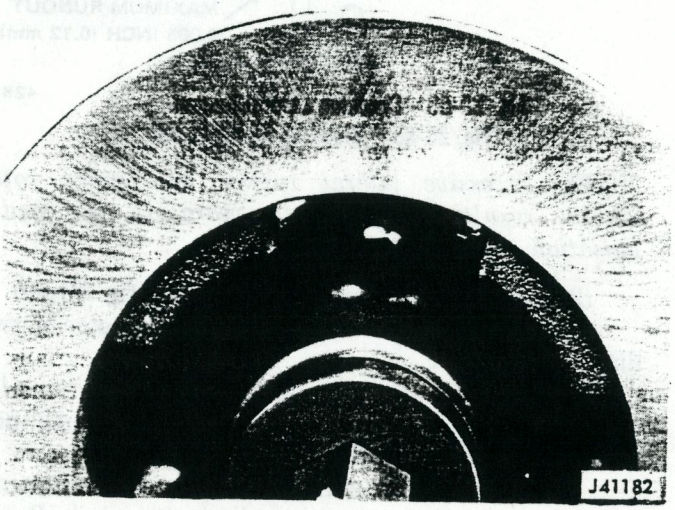

Fig. 2G-60 Correct Rotor Finish (Nondirectional Crosshatch Pattern)

NOTE: *If a rotor is glazed or highly polished, sanding the rotor may not produce the required rotor finish. It may be necessary to turn the rotor to meet the finish requirements.*

To ensure a correct surface finish, follow the lathe manufacturer's recommendations for feed and speed and either sharpen or replace dull cutting tool bits before machining rotor.

(1) Remove rotor from steering spindle.

(2) Remove bearings and seal from rotor and clean bearing surfaces in rotor hub thoroughly.

(3) Mount rotor in lathe according to manufacturer's instructions and install anti-chatter band.

(4) Sharpen or replace cutting tool bits as necessary.

(5) Machine rotor as necessary and according to lathe manufacturer's instructions only. Make two cuts if required and do not remove more than 0.007 inch (0.18 mm) at a time.

CAUTION: *Do not attempt to refinish the rotor if machining would cause the part to fall below the minimum (replacement) thickness specification for that rotor. Refer to the Specifications section.*

NOTE: *If one disc brake assembly requires a new set of brakeshoes, the shoes on the other assembly must also be replaced to ensure even braking.*

Rotor Replacement—CJ Models

Removal

(1) Raise and support vehicle.

(2) Remove wheel.

(3) Remove caliper. Refer to Brakeshoe Replacement—CJ Models.

(4) Remove bolts attaching hub body to hub clutch and remove hub body.

(5) Remove retaining ring from axle shaft and remove hub clutch and bearing assembly.

(6) Straighten lip of outer locknut retaining washer.

(7) Remove outer locknut and retaining washer and remove inner locknut and retaining washer.

(8) Remove hub and rotor.

(9) Remove wheel bearings from rotor.

Installation

(1) Lubricate wheel bearings with EP-type, waterproof wheel bearing lubricant.

(2) Install wheel bearings and replacement grease seal in rotor.

(3) Install rotor.

(4) Install tabbed inner washer and inner locknut.

(5) Install wheel but do not tighten wheel nuts completely.

(6) Tighten inner locknut to 50 foot-pounds (68 N•m) torque using tool J-25103. Rotate wheel while tightening locknut to seat bearings uniformly.

(7) Back off inner locknut 1/6 turn (45°-65°).

(8) Install outer tabbed washer and outer locknut. Tighten outer locknut to minimum of 50 foot-pounds (68 N•m) torque and bend lip of tabbed washer over locknut.

(9) Install hub clutch and bearing assembly on axle shaft.

(10) Install retaining ring on axle shaft.

(11) Install new gasket on hub body and install body on clutch and bearing assembly.

(12) Align bolt holes in hub body and rotor hub and install hub attaching bolts and tabbed lockwashers. Tighten bolts to 30 foot-pounds (41 N•m) torque.

(13) Install caliper. Refer to Brakeshoe Replacement—CJ Models.

(14) Lower vehicle.

Rotor Replacement—Cherokee-Wagoneer-Truck Models

Removal

(1) Remove wheel cover, if equipped, and loosen wheel retaining nuts.

(2) Raise vehicle.
(3) Remove wheels.
(4) Remove caliper. Refer to Brakeshoe Replacement—Cherokee-Wagoneer-Truck Models.
(5) On models without front hubs:
(a) Remove rotor hub cap.
(b) Remove drive gear snap ring and remove drive gear, pressure spring, and spring cup.
(6) On models with front hubs:
(a) Remove socket head screws attaching hub body to hub clutch and remove hub body from clutch.
(b) Remove large and small hub retaining rings.
(c) Remove hub clutch from axle shaft.
(7) Straighten lip of outer locknut retaining washer.
(8) Remove wheel bearing outer and inner locknuts and retaining washers using tool J-6893.
(9) Remove rotor.
(10) Remove wheel bearings from rotor.

Installation

(1) Lubricate wheel bearings with EP-type, waterproof wheel bearing lubricant.
(2) Install wheel bearings and replacement grease seal in rotor.
(3) Install rotor.
(4) Install inner locknut using tool J-6893.

NOTE: *The bearing adjuster inner locknut has a locating peg on one side. When installed, this peg must face away from the bearing.*

(5) Install wheel on rotor but do not tighten wheel nuts completely at this time.
(6) Tighten inner locknut to 50 foot-pounds (68 N•m) torque using tool J-6893. Rotate wheel while tightening locknut to seat bearings uniformly.
(7) Back off inner locknut 1/6 turn (45°-65°) while rotating wheel.
(8) Install retaining washer and outer locknut.

NOTE: *Be sure the inner locknut locating peg is engaged in one of the retaining washer holes before installing the outer locknut.*

(9) Tighten outer locknut to minimum of 50 foot-pounds torque (68 N•m) using tool J-6893.
(10) On models without front hub:
(a) Install pressure spring cup.

CAUTION: *The spring cup must be installed so the recessed side of the cup faces the outboard bearing and the flat side of the cup faces the pressure spring.*

(b) Install pressure spring, drive gear and snap ring.
(c) Coat rim of chrome hub cap with Permatex Form-A-Gasket number 3 (or equivalent) and install cap in rotor hub.
(11) On models with front hubs:
(a) Install hub clutch on axle.
(b) Install large and small hub retaining rings.
(c) Install hub body on clutch and install socket head screws. Tighten screws to 30 inch-pounds (3 N•m) torque.
(12) Remove wheel and install caliper. Refer to Brakeshoe Replacement—Cherokee-Wagonner-Truck models.
(13) Reinstall wheel but do not tighten wheel nuts completely.
(14) Lower vehicle.
(15) Tighten wheel nuts to 75 foot-pounds (102 N•m) torque on Cherokee, Wagoneer and Truck. On 8400 GVW J-20 Truck, tighten nuts to 130 foot-pounds (176 N•m) torque.
(16) Install wheel cover, if equipped.

SPECIFICATIONS

General Specifications

Caliper Piston Diameter:	
CJ Models	2.6 inches (6.60 cm)
Cherokee-Wagoneer-Truck	2.94 inches (7.45 cm)
Minimum Rotor Thickness:	
CJ Models	.815 inches (20.7 mm)
Cherokee-Wagoneer-Truck	1.215 inches (30.86 mm)
Rotor Diameter:	
CJ Models	11.7 inches (29.7 cm)
Cherokee-Wagoneer-J10 Truck	12.0 inches (30.48 cm)
J-20 Truck	12.5 inches (31.75 cm)
Rotor Hub-To-Bore Runout Limit	0.010 inches (0.25 mm)
Rotor Lateral Runout Limit	0.005 inches (0.12 mm)
Rotor Thickness Variation	0.001 inches (0.02 mm)

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Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft-lbs)		Metric (N-m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Caliper Mounting Bolts (Cke-Wag-Trk)	35	30-40	47	41-54
Caliper Support Key Retaining Screw (CJ)	15	15-18	20	20-24
Caliper Brake Line Fitting	160 in-lbs.	150-170 in-lbs.	18	17-19
Disc Brake Shield Bolts (Cke-Wag-Trk)	8	5-10	11	7-14
Disc Brake Shield Nuts (Cke-Wag-Trk)	35	30-40	47	41-54
Front Wheel Bearing Adjusting Locknuts	50	50-55	68	68-75
Wheel Retaining Lugnuts:				
CJ Models	75	65-80	102	88-108
Cherokee—Wagoneer—J-10 Truck	75	65-80	102	88-108
J-20 Truck (8400 GVW)	130	110-150	176	149-203

All torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

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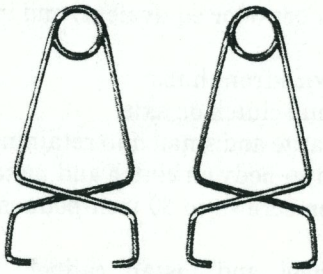
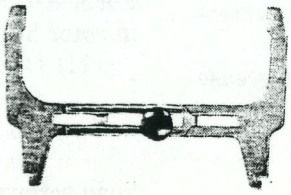
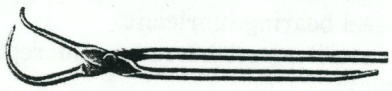
Tools



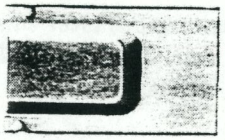
J-8002
WHEEL CYLINDER CLAMPS



J-21177
DRUM BRAKE
CLEARANCE GAUGE



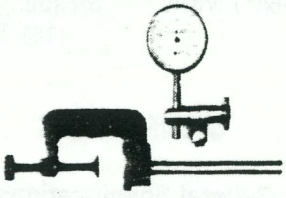
J-8057
BRAKE SPRING TOOL



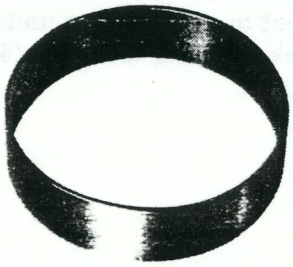
J-26869
METERING VALVE TOOL
(TYPE-W VALVE)

J-23709
METERING VALVE TOOL
(TYPE-D VALVE)

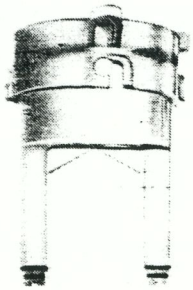
J-22904
DUST BOOT INSTALLER



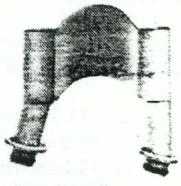
J-8001
DIAL INDICATOR SET



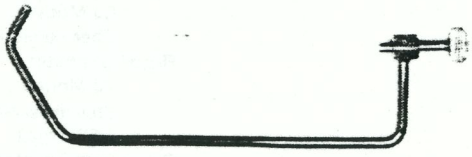
J-24837
CALIPER PISTON
INSTALLER



J-26819-24
BRAKE BLEEDER
ADAPTER



J-26819-30
BRAKE BLEEDER
EXTENSION



J-26819-25
BLEEDER ADAPTER
CLAMP

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WHEELS AND TIRES 2H

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GENERAL

Jeep vehicles are equipped with American and metric size, tubeless-type, pneumatic tires available in load ranges SL, B, C, and D. Standard equipment tires are of bias-ply or bias-belted construction. Radial-ply tires are available as an option on most models.

Standard equipment wheels are safety rim, drop center-types constructed entirely of steel. Optional wheels, which are available on most models, consist of forged aluminum wheels, wide rim spoke-type sport wheels, and chrome plated styled steel wheels.

Original equipment wheels and tires are tested and selected to provide the best all around performance for normal operation. To obtain optimum wheel/tire performance, tire inflation pressures must be maintained at recommended levels and wheel/tire condition should be checked regularly. This is especially important on vehicles equipped with the Quadra-Trac full-time four wheel drive transfer case.

TIRE CONSTRUCTION

Three types of tire construction are currently in use. They are referred to as bias-ply, bias-belted, and radial-ply construction. The description for each construction-type is derived from the method used to position the tire cord plies in relation to the tread centerline.

Bias-Ply Construction

Bias-ply tires are constructed with the body cord plies extending from bead-to-bead and at an angle to the tread centerline (fig. 2H-1). Alternate plies overlap one another at opposing angles.

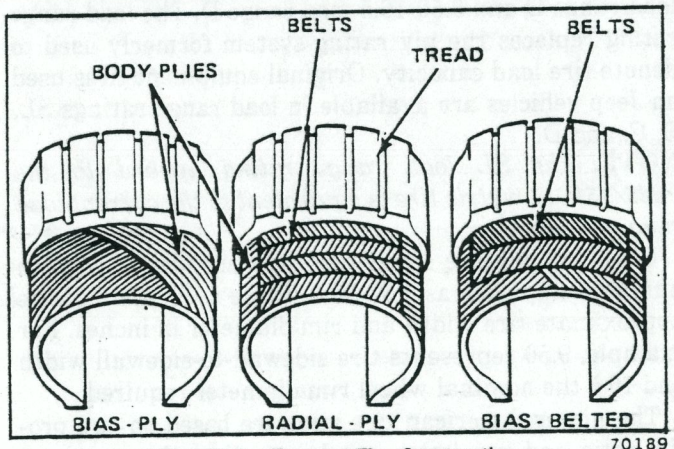


Fig. 2H-1 Types of Tire Construction

Bias-Belted Construction

Bias-belted tires are constructed basically the same as bias-ply tires. However, in addition to the angled body cord plies, they also have belts that encircle the tire. These belts are located under the tire tread and extend from tread shoulder to tread shoulder (fig. 2H-1).

Radial-Ply Construction

Radial-ply tires, like bias-belted tires, also have belts under the tread which encircle the tire and extend from tread shoulder to tread shoulder. However, these tires are constructed with the body cord plies at right angles to the tread centerline. The plies cross the tread centerline at an angle of approximately 90 degrees (fig. 2H-1). Because the body cord plies radiate from the tread centerline, this type of construction is designated radial-ply.

Identifying Tire-Types

Radial tires are identified by the code letter R which appears in the size description imprinted on the tire sidewall. Bias-ply and bias-belted tires do not have such a code letter. For example, P225/75R-15 or HR78-15 for radial tires as compared to H78-15 for similar size bias-ply or bias-belted tires.

NOTE: *As a result of their unique construction, radial tires have a highly flexible sidewall. This flexibility is responsible for the characteristic sidewall "bulge" which makes the tire appear to be underinflated. This is a normal condition for radial tires. Do not attempt to reduce this bulge by overinflating the tire. The only way to be sure a tire is properly inflated is to use an accurate and reliable tire pressure gauge. Check and adjust inflation pressures in accordance with the information provided in the Tire Inflation Pressure Chart at the end of this chapter.*

TIRE SIZE AND LOAD RATING

American and metric tire sizes and tire load range ratings are indicated in the combination of letters and numbers imprinted on the tire sidewall such as: P225/75R-15 load range SL, H78-15 load range B, G78-15 load range D and 9.50-16.5 load range D. The load range rating replaces the ply rating system formerly used to denote tire load capacity. Original equipment tires used on Jeep vehicles are available in load range ratings SL, B, C, and D.

NOTE: *The SL load range rating applied to the P225/75R-15 metric tire is equivalent to the current load range B rating.*

Conventional size American tires are identified with numbers only such as 9.50-16.5. These numbers indicate approximate tire width and rim diameter in inches. For example, 9.50 represents tire sidewall-to-sidewall width and 16.5 the nominal wheel rim diameter required.

The newer American tire sizes are based on tire profile ratio and use letter-number combinations such as H78-15. In this case, letter H represents tire industry specifications for the load and inflation schedule for tires in this letter classification. The number 78 indicates tire section height as determined by the ratio of section height to sidewall-to-sidewall width. Or, height divided by width equals size or profile ratio. In this case, the height of an H78 tire is equal to 78 percent of the width. This formula applies to all profile series tires (fig. 2H-2). The number 15 denotes the wheel rim diameter required.

Metric size tires also use letter-number combinations to indicate size and type. For example, with the P225/75R-15 tire, letter P indicates tire use is for passenger vehicle applications, 225 is the sidewall-to-sidewall width in millimeters, 75 is the profile ratio (height equals 75% of width), R indicates radial-ply construction and 15 the wheel rim diameter required stated in inches.

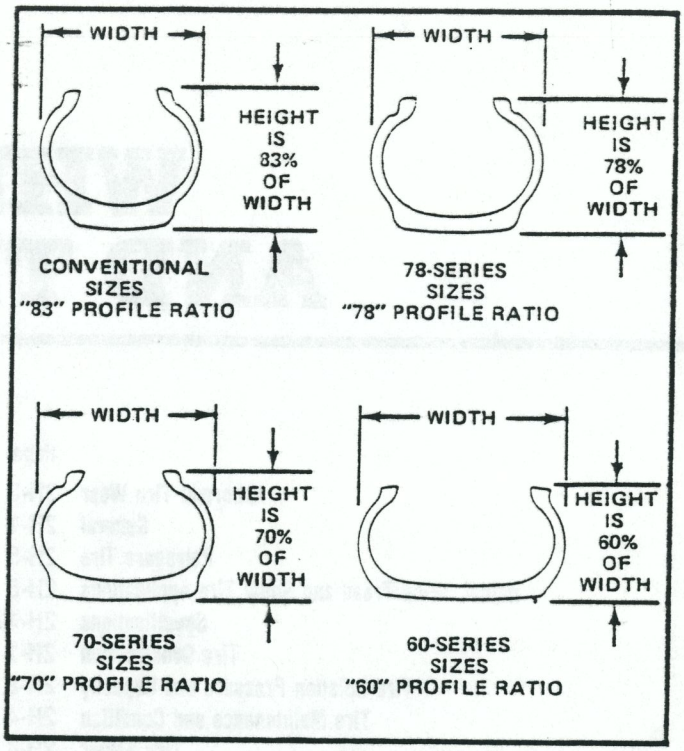


Fig. 2H-2 Tire Size and Profile Ratio

TIRE INFLATION PRESSURE AND CAPACITY

Original equipment tires used on Jeep vehicles are selected and tested to meet operating requirements within tire capacity. The recommended load capacities and inflation pressures for full or reduced load operation are listed in the Tire Inflation Pressure Chart at the end of this chapter. This information is also provided in the owners manual and on a label attached to the interior surface of the glove box door.

Tire inflation pressures are selected to be compatible with the load capacity, ride, and handling characteristics of a specific vehicle. In cases where a slightly softer ride is preferred, the driver may use reduced load pressures but must not exceed 55 mph (88 km/h) or reduced load vehicle capacity.

When sustained high speed operation is anticipated, tires may be inflated to recommended full load inflation pressures plus an additional 2 psi (14 kPa). However, inflation pressures must not exceed maximum recommended pressures.

Tire pressures should be checked and adjusted to recommended levels on a weekly basis. This is especially important when extreme changes of 20 degrees or more in average seasonal temperatures occur and is especially important on vehicles with Quadra-Trac.

Adjusting Inflation Pressures

Check and adjust inflation pressures only when the tires are cold, or driven for less than two miles at speeds below 40 mph (64 km/h), or after the vehicle has been parked for three hours or more.

Do not reduce inflation pressures if the tires are hot, or driven over two miles at speeds above 40 mph (64 km/h). At this stage, tire pressures may increase as much as 6 psi over cold inflation pressures due to air expansion caused by heat buildup in the tire.

When checking and adjusting inflation pressures, always use a reliable and accurate gauge to ensure proper inflation levels.

ABNORMAL TIRE WEAR

Abnormal tire wear may be caused by incorrect inflation pressures, tire-wheel unbalance, worn suspension components, improper brake operation, bent wheels, front wheel alignment, or excessive speed on turns.

In most cases, inspection of tire wear patterns will reveal the cause of abnormal wear. The various types of wear patterns and necessary corrective action are illustrated in figure 2H-3.

Rapid wear of the tread shoulders is usually caused by underinflation or lack of rotation or a combination of both. If this type of wear occurs and the tires are serviceable, rotate the tires and inflate them to recommended levels when they are cool.

Rapid wear at the tread center is usually caused by overinflation or lack of rotation or a combination of both. If this type of wear occurs and the tires are still serviceable, rotate the tires and inflate them to recommended levels when they are cool.

Cracked treads are usually caused by underinflation or excessive high speed operation or a combination of both. Tires with cracked treads should be replaced and the replacement tires properly maintained to avoid a recurrence.

Excessive wear of one tread shoulder may be caused by excessive speed on turns or by incorrect camber. Incorrect negative camber will wear the inboard tire shoulder while incorrect positive camber will wear the outboard shoulder. If this type of wear occurs, check camber. If camber is incorrect, the front axle housing may need to be replaced. If camber is within specified limits, caution the owner about excessive speed on turns. If the tires are serviceable, rotate them and adjust inflation pressures to recommended levels.

Incorrect toe-in will cause the tire tread surface to develop a feathered edge. One side of the tread will be rounded while the opposite side develops a feathered edge. This type of wear indicates that the tire is side slipping and scuffing as it moves over the road surface.

A feathered edge that faces toward the vehicle indicates excessive toe-in. A feathered edge that faces away from the vehicle indicates excessive toe-out. The direction in which a feathered edge has developed can be determined by passing a hand over the tire tread surface. Bent steering knuckle arms can also cause this type of wear.

If a feathered edge develops, check and correct toe-in as necessary and rotate the tires if they are serviceable.

Wide Tread Bias-Belted Tire Wear

Bias-belted wide tread tires have an initial wear characteristic that is unique to this type of tire. It occurs as a fairly rapid but even wear of the second and sixth tread ribs (fig. 2H-4). Wear may occur at only one of the ribs or at both ribs simultaneously. In some cases, a slight cupping of these ribs may also develop in addition to wear. Although wear develops rapidly, the degree of wear is relatively light.

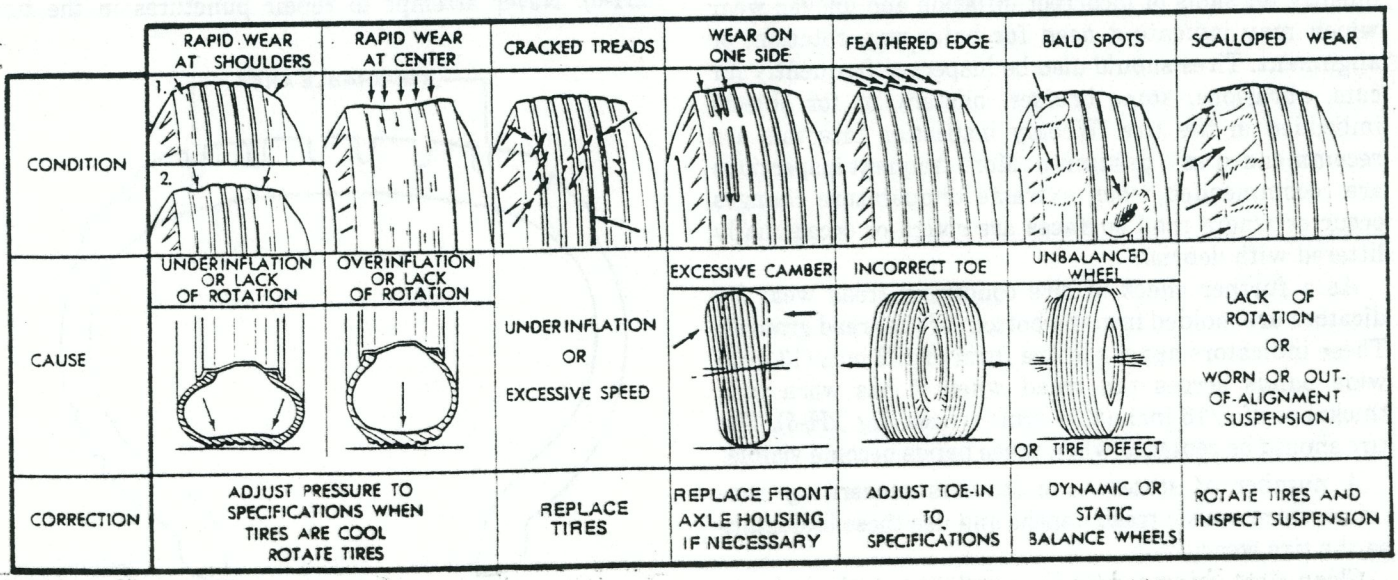


Fig. 2H-3 Tire Wear Patterns

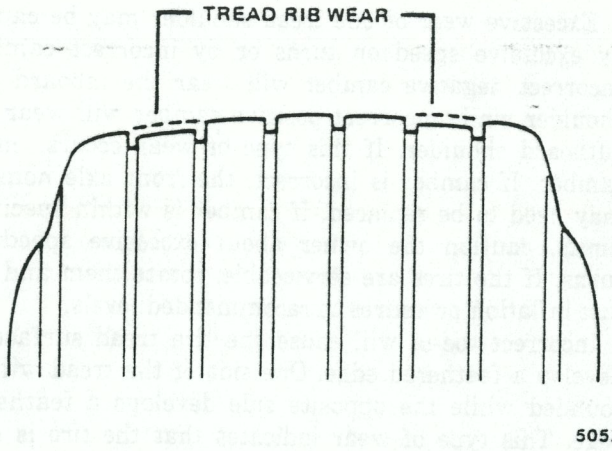


Fig. 2H-4 Wide Tread Bias-Belted Tire Wear

This wear characteristic is a normal condition with wide tread bias-belted tires and is related to the tread deflection properties of these tires. When the tread is pressed against the road surface, all tread ribs do not support equal portions of weight. The outer and center ribs support the most weight while the second and sixth ribs support the least. Because of the lighter load on the second and sixth ribs, they are able to deflect more and tend to slip and scrub slightly as the tire rotates. This action causes more wear on these ribs.

Wear on the second and sixth ribs cannot be reduced by over or underinflating the tires. Maximum benefit in minimizing wear is obtained only by adhering to the specifications recommended for tire inflation pressures, tire rotation, and front wheel alignment.

TIRE MAINTENANCE AND CONDITION

To maximize tire performance, inspect tires frequently for signs of incorrect inflation and uneven wear which may indicate a need for balancing, rotation, or alignment. Tires should also be inspected frequently for cuts, abrasions, stone bruises, blisters, or for objects imbedded in the tire. Weekly inspection intervals are recommended as a minimum. More frequent inspections are recommended when extreme temperature changes occur or where road surfaces are rough or occasionally littered with debris.

As a further check of tire condition, tread wear indicators are molded into the bottom of the tread grooves. These indicators appear in the form of 1/2 inch (13 mm) wide bands across the tread when it has worn to a thickness of 1/16 inch (1.58 mm) or less (fig. 2H-5). The tire should be replaced when these bands become visible.

A number of states have statutes concerning minimum permissable tread depths and use these indicators as the tire wear limit.

Clean tires using a mild soap and water solution only and rinse thoroughly with water. Do not use caustic solutions or abrasive materials. To clean white sidewalls and raised letters and numbers, use an approved whitewall cleaner only. Do not use steel wool, wire brushes, or materials having a mineral oil base such as gasoline, paint thinner, or turpentine. These materials are harmful to the tires and will also discolor the white sidewalls and raised figures.

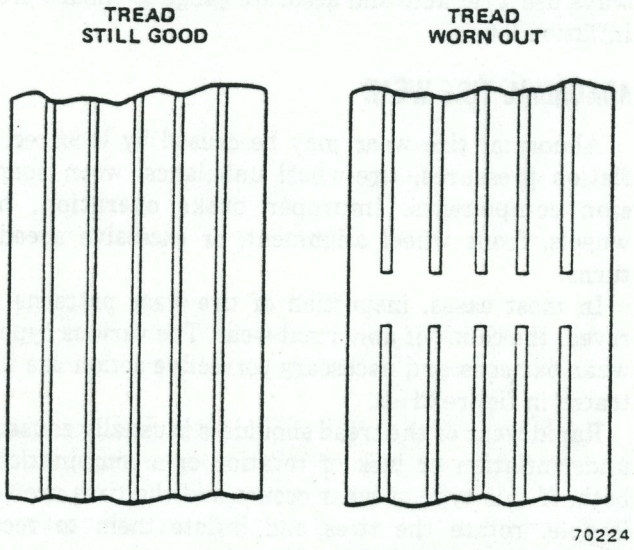


Fig. 2H-5 Tread Wear Indicators

TIRE REPAIR

Punctured tires should be removed from the wheel and permanently repaired from the inside using a combination repair plug and vulcanized patch. When repairing punctures, always follow the manufacturers instructions for repair kit installation.

Punctures in the tread area only are repairable (fig. 2H-6). Never attempt to repair punctures in the tire

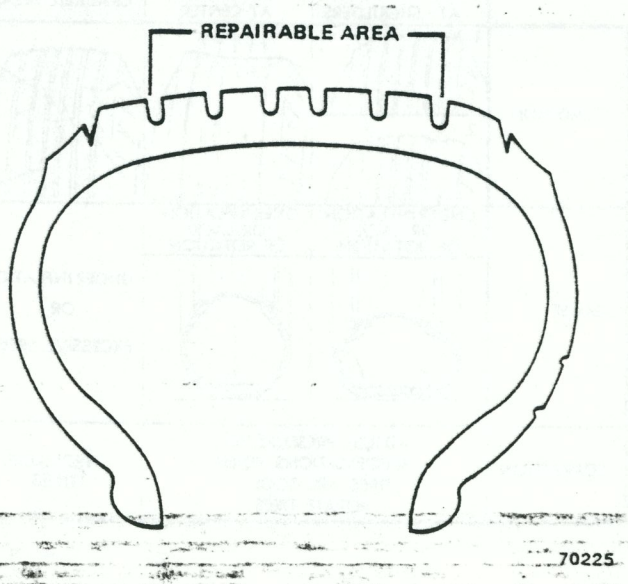


Fig. 2H-6 Tire Repair Area

shoulders or sidewalls. In addition, never attempt to repair any tire that has sustained the following damage:

- Bulges or blisters
- Ply separations
- Broken, cut, or cracked beads
- Fabric cracks or cuts
- Tires worn to the fabric or if wear indicators are visible
- Punctures larger than 1/4 inch (6 mm) in diameter

Externally applied repair plugs, blowout patches, and aerosol sealants should be considered as emergency-type repairs only. Tires repaired in this fashion should not be driven at speeds over 40 mph (64 km/h) or for more than 75 miles (121 kilometers) before permanent repair is made.

TIRE ROTATION

To equalize wear, tires should be rotated at the intervals specified in the Mechanical Maintenance Schedule. The first rotation is the most important in setting the stage for even tread wear. After rotation, adjust tire inflation pressures to the levels recommended in the Tire Inflation Pressure Chart.

Radial tires are not rotated in the same manner as conventional tires. Conventional tires are rotated in a crossing pattern. Radial tires are rotated on the same side, front-to-rear (fig. 2H-7).

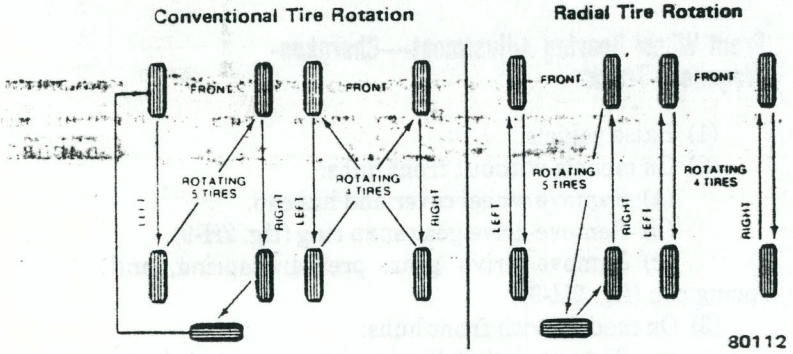


Fig. 2H-7 Tire Rotation

RADIAL, WIDE TREAD AND SNOW TIRE APPLICATIONS

Radial, wide tread, mud and snow, or conventional tires must be installed in **complete sets** only. This is especially important on vehicles with Quadra-Trac. Different tire types must not be intermixed at any time.

CAUTION: *Tires installed on Jeep four-wheel drive vehicles must all be of equal circumference to maintain satisfactory operation. They must also be the same size, tread pattern, make, construction, and inflation pressure. Intermixing tires of different size or construction will cause unusual handling, noisy operation, and accelerated wear of driveline components.*

Wide tread tires must be installed in complete sets and only when there is adequate clearance for the tire in the wheel well. Refer to the Tire Inflation Pressure Chart for tire sizes allowable on each model.

Radial tires must never be intermixed with bias-ply or bias-belted tires on any vehicle. Intermixing these tires will produce an adverse effect on vehicle handling and cornering stability. In an emergency situation, tires may be intermixed but only for the duration of the emergency and only if vehicle speed is kept below 40 mph (64 km/h).

Mud and snow tires must not be intermixed with conventional tread tires on any vehicle. These tires must also be of the same size, tread pattern, make, construction, and inflation pressure. In addition, never mix bias-ply or bias-belted snow tires with radial-ply mud or snow tires.

POLYSPARE TIRE

The Polyspare lightweight spare tire furnished with Cherokee and Wagoneer models and J-10 trucks is designed for emergency use only. Operation of the tire at speeds over 50 mph (80 km/h) and travel in excess of 100 continuous miles (160 km) is not recommended.

The Polyspare tire is mounted on a standard type 15 x 6-inch steel wheel. Correct inflation pressure is 32 psi (221 kPa) and the tire can be inflated with conventional inflation equipment. Installation and removal of Polyspare does not require special tools and the anticipated tread life is approximately 3,000 miles (4 800 km).

WHEELS

The standard equipment wheels used on Jeep vehicles are safety rim, drop center, J-type wheels of all-steel construction. Optional wheels include chrome-plated styled steel wheels, wide rim spoke-type steel wheels, and forged aluminum wheels.

Steel wheels are of two-piece construction consisting of a rim and center section (spider). The two sections are welded together to form a seamless, air-tight assembly.

WHEEL MAINTENANCE AND CONDITION

Wheel condition should be checked frequently. Replace any wheel that is cracked, bent, severely dented, has excessive runout, or has broken welds. The tire inflation valve should also be inspected frequently for wear, leaks, cuts, or looseness and should be replaced if damaged or worn.

Clean all wheels with a mild soap and water solution only and rinse thoroughly with water. Never use abrasive or caustic materials, especially on aluminum or chrome plated wheels as the surface will be etched or the plating severely damaged. After cleaning aluminum or chrome plated wheels, apply a coating of protective wax to preserve the finish and lustre.

WHEEL BALANCING

Wheel balancing may be performed using on or off-vehicle equipment. However, when using on-vehicle balancing equipment, observe the following precautions:

- On vehicles with a Trac-Lok rear axle, do not use on-vehicle equipment to balance the rear wheels. Instead, remove the wheels and balance them off the vehicle using a two-plane, dynamic balancer.
- On vehicles with front hubs, place the hubs in the 4 x 2 or Free position before balancing front wheels.
- Before balancing wheels on a vehicle equipped with a Model 208 or 300 transfer case, shift the transmission and transfer case into neutral.
- Before balancing wheels on a vehicle equipped with a Quadra-Trac Model 219 transfer case, disconnect the front or rear propeller shafts as required.

Because of their unique construction, radial tires are sometimes less responsive to certain balancing techniques. In some cases, dynamic two-plane, off-vehicle type balancing equipment will provide the most satisfactory results with radial tires.

When balancing aluminum or chrome plated wheels, take care to avoid damaging the wheel surface when installing balance weights. Use self-adhering type weights on aluminum wheels only and install them on the back side of the wheel whenever possible.

WHEEL BEARING ADJUSTMENT

Wheel bearing adjustment is very important because it establishes the operating clearance of the wheel bearings. A tight adjustment preloads the bearings excessively causing them to overheat. A loose adjustment allows the hub to shift position as bearing load varies during acceleration, braking, and cornering. A loose bearing adjustment can produce shimmy, vibration, and low brake pedal heights as a result of disc brakeshoe knock back caused by rotor wobble.

Front Wheel Bearing Adjustment—CJ Models

(1) Raise vehicle.

(2) Remove bolts attaching front hub to rotor hub and remove hub body and gasket.

(3) Remove snap ring from axle shaft and remove hub clutch assembly.

(4) Straighten lip of outer locknut tabbed washer (fig. 2H-8).

(5) Remove outer locknut and tabbed washer.

(6) Loosen, then tighten inner locknut to 50 foot-pounds (68 N•m) torque using tool J-25103. Rotate wheel while tightening nut to seat bearing properly.

(7) Back off inner locknut 1/6 turn (45°-65°) while rotating wheel. Wheel must rotate freely and not display any lateral movement.

(8) Install tabbed washer and outer locknut.

(9) Tighten outer locknut to 50 foot-pounds (68 N•m) torque using tool J-25103 and bend lip of tabbed washer over locknut.

(10) Recheck bearing adjustment. Wheel must rotate freely and not display any lateral movement.

(11) Install hub clutch assembly on axle shaft.

(12) Install snap ring on axle shaft.

(13) Install gasket and hub body. Tighten hub bolts to 30 foot-pounds (41 N•m) torque.

(14) Lower vehicle.

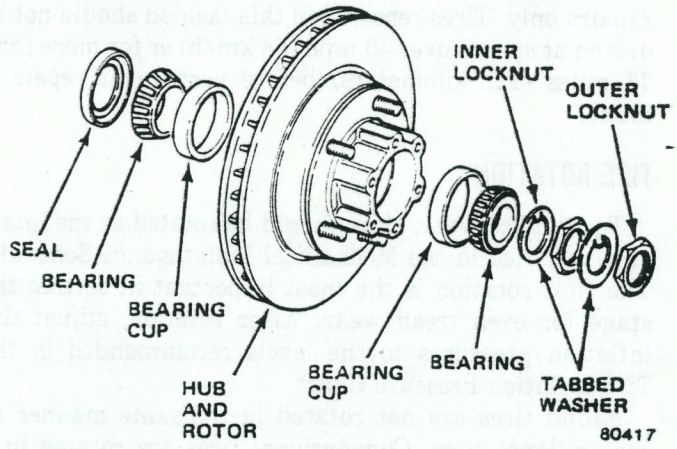


Fig. 2H-8 Rotor and Wheel Bearings—CJ Models

Front Wheel Bearing Adjustment—Cherokee-Wagoneer-Truck

(1) Raise vehicle.

(2) On models without front hubs:

(a) Remove wheel cover and hubcap.

(b) Remove drive gear snap ring (fig. 2H-9).

(c) Remove drive gear, pressure spring, and spring cup (fig. 2H-9).

(3) On models with front hubs:

(a) Remove socket head screws from hub body and remove body from hub clutch assembly.

(b) Remove large retaining ring from hub. Remove small retaining ring from axle shaft.

(c) Remove hub clutch assembly.

(4) Remove outer locknut and lockwasher (fig. 2H-9).

(5) Seat bearings by loosening, then tightening inner locknut to 50 foot-pounds (68 N•m) torque using tool J-6893. Rotate wheel while tightening locknut to seat bearings uniformly.

(6) Back off inner locknut 1/6 turn (45°-65°) while rotating wheel.

(7) Install lockwasher. Align one of lockwasher holes with peg on inner locknut and install washer on nut.

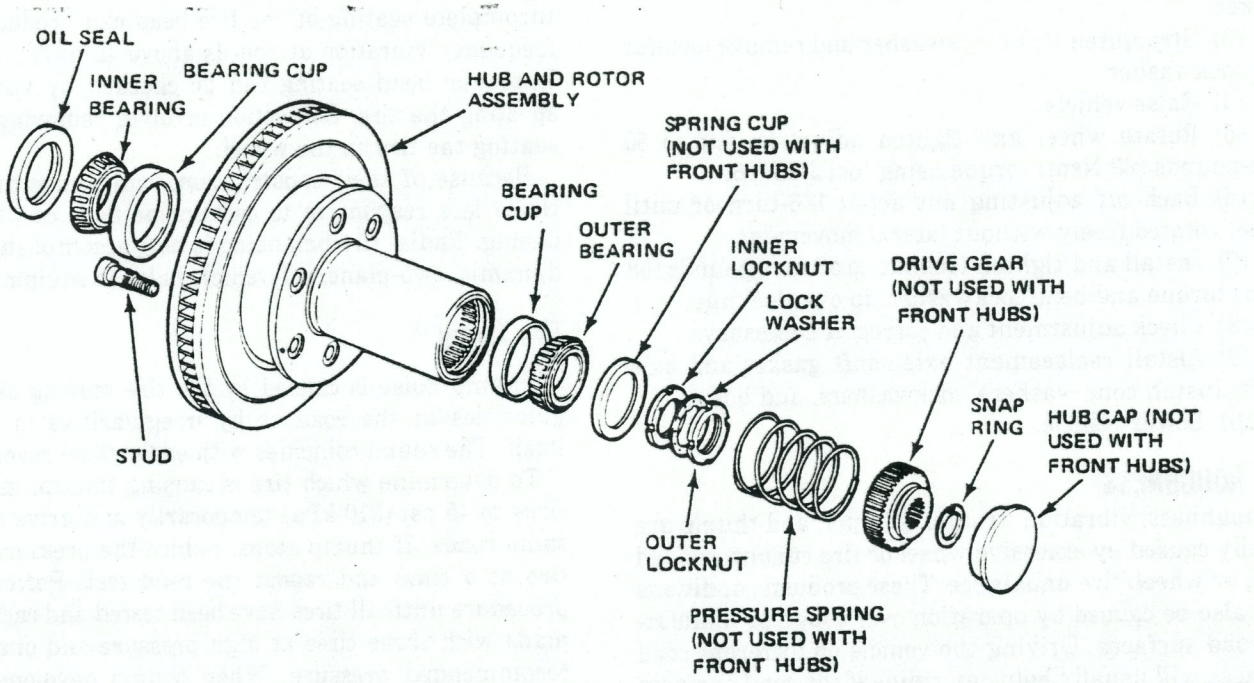


Fig. 2H-9 Rotor and Wheel Bearings—Cherokee-Wagoneer-Truck

(8) Install outer locknut. Tighten outer locknut to minimum of 50 foot-pounds (68 N•m) torque using tool J-6893.

(9) Recheck bearing adjustment. Wheel must rotate freely and not display any lateral movement.

(10) On models without front hubs:

(a) Install spring cup and pressure spring.

CAUTION: *The spring cup must be installed so the recessed side faces the bearing and the flat side faces the pressure spring. The pressure spring should contact the flat side of the cup only.*

(b) Install drive gear and drive gear snap ring.

(c) Coat hubcap rim with Permatex Form-A-Gasket No. 3 or equivalent and install hubcap.

(11) On models with front hubs:

(a) Install hub clutch assembly.

(b) Install small retaining ring on axle shaft. Install large retaining ring on hub.

(c) Install hub body on hub clutch.

(d) Install socket head screws in hub. Tighten screws to 30 inch-pounds (3 N•m) torque.

(12) Lower vehicle.

Rear Wheel Bearing Adjustment

AMC/Jeep Rear Axle

The wheel bearings used in Cherokee, Wagoneer and J-10 Truck models do not require adjustment. The shafts used in these axle models are equipped with tapered roller bearings which are capable of accepting lateral thrust in either direction. However, the tapered axle shafts used in CJ models (AMC/Jeep axle) do require correct axle shaft end play to maintain proper bearing operating clearances. Refer to Chapter 2F—Axles for end play measurement and adjustment procedures.

Model 60 Full-Floating Rear Axle

(1) Remove axle shaft attaching bolts, lockwashers, and cone washers (fig. 2H-10).

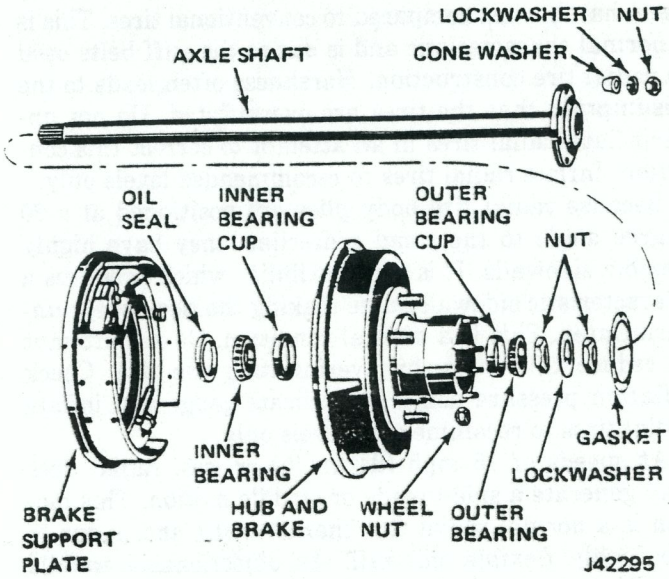


Fig. 2H-10 Model 60 Rear Axle Hub and Bearings

(2) Remove axle shaft and shaft gasket. Discard gasket.

(3) Straighten lip of lockwasher and remove locknut and lockwasher.

(4) Raise vehicle.

(5) Rotate wheel and tighten adjusting nut to 50 foot-pounds (68 N•m) torque using tool J-25106.

(6) Back off adjusting nut about 1/6-turn or until wheel rotates freely without lateral movement.

(7) Install and tighten locknut to 50 foot-pounds (68 N•m) torque and bend lockwasher lip over locknut.

(8) Check adjustment and correct if necessary.

(9) Install replacement axle shaft gasket and axle shaft. Install cone washers, lockwashers, and bolts.

(10) Lower vehicle.

TIRE ROUGHNESS

Roughness, vibration, tramp, shimmy, and thump are usually caused by excessive wheel or tire runout, cupped tires, or wheel/tire unbalance. These problem conditions may also be caused by operation over rough or undulating road surfaces. Driving the vehicle on different road surfaces will usually help determine if the road surfaces or tires are causing the problem.

Always road test the vehicle to determine the exact nature of the problem. Drive the vehicle for at least seven miles (11 km) to warm the tires and remove temporary flat spots that may have formed while the vehicle was parked. Note tire condition and wear and check and adjust inflation pressures to recommended levels before road testing.

Radial Tire Performance Characteristics

As a result of their unique construction, radial tires produce ride, handling and appearance characteristics that are noticeably different from conventional tires.

The low speed ride quality or feel of radial tires may seem harsh when compared to conventional tires. This is a normal characteristic and is due to the stiff belts used in radial tire construction. Harshness often leads to the assumption that the tires are overinflated. Do not underinflate radial tires in an attempt to correct this condition. Inflate radial tires to recommended levels only.

Because radial tire body plies are positioned at a 90 degree angle to the tread centerline, they have highly flexible sidewalls. It is this flexibility which produces a characteristic sidewall bulge making the tire appear underinflated. This is a normal condition. Do not attempt to reduce this bulge by overinflating the tire. Check inflation pressure using an accurate gauge and inflate radial tires to recommended levels only.

At speeds of 15 mph (24 km/h) or less, radial tires may generate a side-to-side or waddle motion. This motion is a normal radial tire characteristic and is due to the highly flexible sidewall. An objectionable waddle condition can be reduced only by rotating the tires. Wheel balancing will not alleviate this condition.

Proper mounting of radial tires is very important. Incomplete seating of the tire bead can produce a high frequency vibration at speeds above 45 mph (72 km/h). Improper bead seating can be checked by visually inspecting the tire. Correction involves removing and reseating the tire on the wheel.

Because of their construction, radial tires are sometimes less responsive to certain methods of wheel balancing. Radial tire balancing is best accomplished using dynamic, two-plane, off-vehicle balance equipment.

Tire Thump

Thump noise is caused by the tire moving over irregularities in the road or by irregularities in the tire itself. The sound coincides with each wheel revolution.

To determine which tire is causing thump, inflate all tires to 45 psi (310 kPa) temporarily and drive over the same roads. If thump stops, reduce the pressure in one tire at a time and repeat the road test. Perform this procedure until all tires have been tested and each test is made with three tires at high pressure and one tire at recommended pressure. When thump develops again, the tire just reduced to normal inflation pressure is the problem tire.

NOTE: *Although the procedure for diagnosing thump is usually effective with conventional tires, it is considerably less effective with radial tires.*

Tire Tramp

Tramp is caused by wheel/tire static unbalance or by excessive lateral runout of the tire or wheel.

The most effective method for checking static balance is by using off-vehicle balancing equipment.

Static balance is the result of an equal distribution of wheel and tire weight about the circumference of the tire. In this case, weight is distributed about the spindle in such a manner that the assembly lacks the tendency to rotate by itself when mounted on the arbor of a balancing machine.

Static unbalance occurs when an unequal portion of weight is concentrated at one point on the tire and wheel (fig. 2H-11). It causes a vibratory-type pounding action which is referred to as tramp or hop.

Dynamic balance is the result of an equal distribution of wheel/tire weight around the plane of rotation (fig. 2H-12). This causes the wheel to rotate smoothly about the axis that bisects the wheel and tire centerline.

Dynamic unbalance occurs when unequal forces are concentrated at opposing points on the tire circumference. It will cause shimmy and vibration at medium and high speeds (fig. 2H-12).

The most effective method for balancing wheels and tires is by using equipment that will correct both static and dynamic balance. Dynamic, two-plane balancing equipment is preferable.

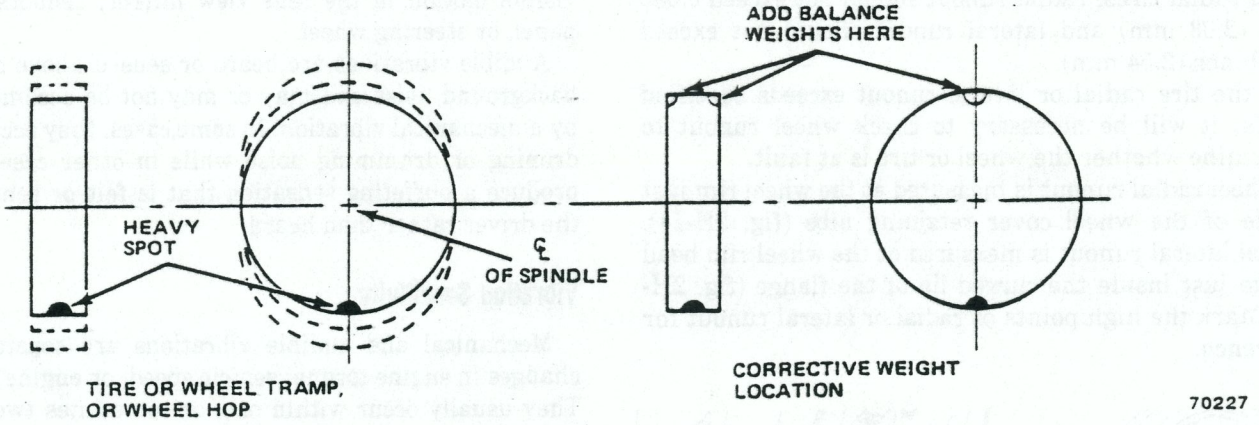


Fig. 2H-11 Static Unbalance

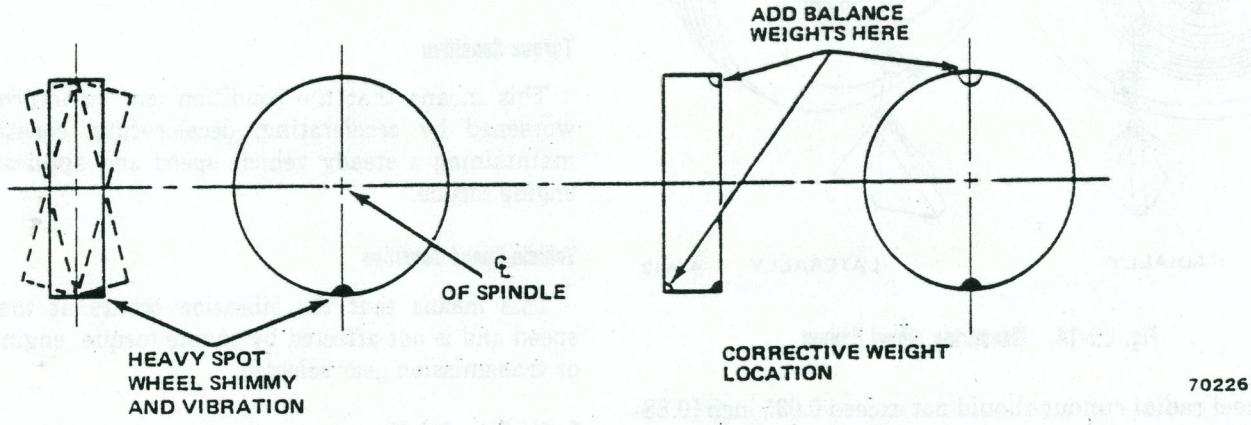


Fig. 2H-12 Dynamic Unbalance

Since procedures vary with different machines, follow the equipment manufacturers operating instructions explicitly to obtain satisfactory results.

WARNING: *On-vehicle type wheel balancers may be used on the rear wheels of vehicles equipped with a Trac-Lok differential, but only after raising the rear end and removing the wheel opposite the one being balanced. In addition, do not exceed 35 mph (56 km/h) on the speedometer when spinning wheels. As a result of differential action, actual wheel speed is double the speed indicated on the vehicle speedometer. The centrifugal force generated by a tire spinning at high speed could cause damage and personal injury.*

Wheel and Tire Runout

Excessive radial or lateral runout of a wheel or tire can cause roughness, vibration, tramp, tire wear, and steering wheel tremor.

Before checking runout, drive the vehicle for at least seven miles to remove temporary flat spots that may have formed in the tires. Flat spots must be removed to avoid false readings when measuring runout.

Measure runout using a dial indicator. All measurements should be made on the vehicle with the tires inflated to recommended levels and with the wheel bearings adjusted to specifications.

Measure radial runout at the center and outside ribs of the tread face (fig. 2H-13). Measure lateral runout at the tire sidewall just above the buffing rib on the sidewall (fig. 2H-13).

On conventional tires, radial runout should not exceed 0.105 inch (2.66 mm) and lateral runout should not exceed 0.080 inch (2.03 mm). Mark the high points of lateral or radial runout for reference.

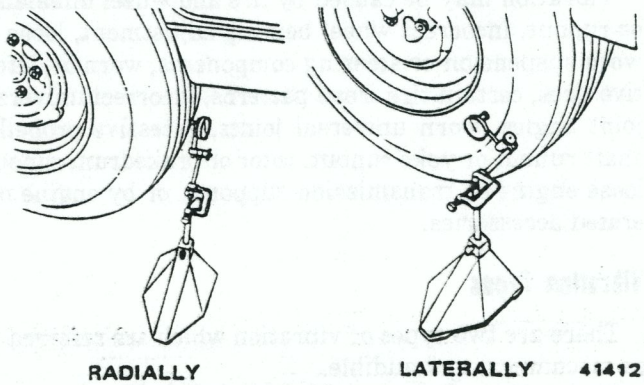


Fig. 2H-13 Measuring Tire Runout

On radial tires, radial runout should not exceed 0.080 inch (2.03 mm) and lateral runout should not exceed 0.100 inch (2.54 mm).

If the tire radial or lateral runout exceeds specified limits, it will be necessary to check wheel runout to determine whether the wheel or tire is at fault.

Wheel radial runout is measured at the wheel rim just inside of the wheel cover retaining nibs (fig. 2H-14). Wheel lateral runout is measured at the wheel rim bead flange just inside the curved lip of the flange (fig. 2H-14). Mark the high points of radial or lateral runout for reference.

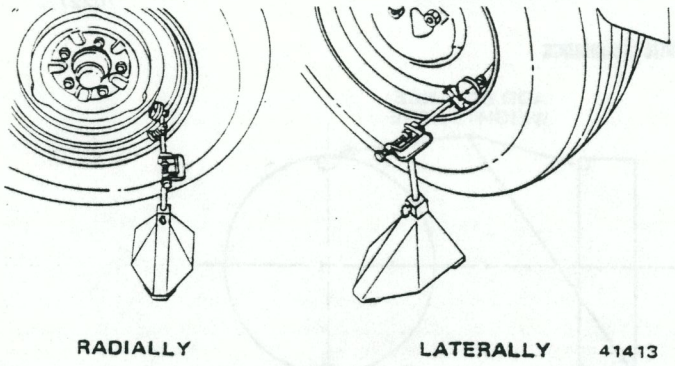


Fig. 2H-14 Measuring Wheel Runout

Wheel radial runout should not exceed 0.035 inch (0.88 mm). Wheel lateral runout should not exceed 0.045 inch (1.14 mm).

If tire runout exceeds specified limits but wheel runout is within limits, runout may be reduced to an acceptable level by changing tire position on the wheel so that the previously marked high points are 180 degrees apart.

NOTE: *On vehicles with disc brakes, excessive wheel lateral runout may be caused by excessive rotor hub-to-bore runout. Refer to the Rotor Inspection procedure in Chapter 2G.*

VIBRATION

Vibration may be caused by tire and wheel unbalance or runout, incorrect wheel bearing adjustment, loose or worn suspension or steering components, worn or defective tires, certain tire tread patterns, incorrect universal joint angles, worn universal joints, excessive propeller shaft runout or yoke runout, rotor or brakedrum runout, loose engine or transmission supports, or by engine operated accessories.

Vibration Types

There are two types of vibration which are referred to as mechanical and audible.

Mechanical vibrations are felt through the seats, floorpan, or steering wheel and usually produce some visible motion in the rear view mirror, fenders, dash panel, or steering wheel.

Audible vibrations are heard or sensed above normal background noise and may or may not be accompanied by a mechanical vibration. In some cases, they occur as a droning or drumming noise while in other cases they produce a buffeting sensation that is felt or sensed by the driver rather than heard.

Vibration Sensitivity

Mechanical and audible vibrations are sensitive to changes in engine torque, vehicle speed, or engine speed. They usually occur within one, or sometimes two well-defined ranges in terms of vehicle speed, engine rpm, and torque application.

Torque Sensitive

This means that the condition can be improved or worsened by accelerating, decelerating, coasting, or maintaining a steady vehicle speed and application of engine torque.

Vehicle Speed Sensitive

This means that the vibration occurs at the same speed and is not affected by engine torque, engine rpm, or transmission gear selected.

Engine Speed Sensitive

This means that the vibration occurs at varying vehicle speeds when a different transmission gear is selected. It can sometimes be isolated by increasing or decreasing engine speed with the transmission in neutral.

Vibration Diagnosis

A proper vibration diagnosis should always begin with a road test. Corrective measures should not be attempted until the vibration type, magnitude, and speed range have been established by a road test.

Road Test

During the road test, drive the vehicle on a road that is smooth and free of undulations. If vibration is apparent, note and record the following:

- The speed range in which vibration occurs
- The type of vibration—mechanical or audible
- If the vibration is affected by changes in vehicle speed, engine rpm, or engine torque
- Determine the vibration sensitivity—torque sensitive, engine speed sensitive, or vehicle speed sensitive

Diagnosis Procedure

When the vibration type, sensitivity, and range has been determined, refer to the Vibration Diagnosis Chart for probable causes.

Consider correcting only those items coded on the charts that are related to the problem condition.

Refer to the following correction codes for a description of the various corrective procedures.

Vibration Diagnosis Chart Codes

TRR—Tire and Wheel Radial Runout. Vehicle speed sensitive mechanical vibration. Not a cause of vibration below 20 mph. Speed required to cause vibration increases as runout decreases.

WH—Wheel Hop. Vehicle speed sensitive mechanical vibration. Not a cause of vibration below 20 mph (32 km/h). Generates rapid up-down movement in steering wheel and dash panel. Most noticeable in 20-40 mph (32-64 km/h) speed range. Caused by tires having radial runout of more than 0.045 inch (1.14 mm). Balancing ineffective, faulty tire should be replaced.

TB—Tire Balance. Vehicle speed sensitive mechanical vibration. Static unbalance not a cause of vibration below 30 mph (46 km/h). Dynamic unbalance not a cause of vibration below 40 mph (64 km/h).

TLR—Tire and Wheel Lateral Runout. Vehicle speed sensitive mechanical vibration. Not a cause of vibration below 50-55 mph (80-88 km/h) unless runout is extreme. Generates front end shimmy if extreme.

TW—Tire Wear. Vehicle speed sensitive mechanical vibration. Abnormal wear causes vibration in 30-55 mph (50-88 km/h) range and may generate whine noise at high speed changing to growl noise at low speed.

W—Radial Tire Waddle. Normal condition with radial tires. Construction causes side-to-side motion at speeds up to 15 mph. Rotate tires to reduce condition. Replace tires if condition is extremely severe.

UJA—Universal Joint Angles. Incorrect angles cause mechanical vibration below 20 mph (32 km/h) changing to mechanical and/or audible vibration at 35 to 55 mph (56 to 88 km/h). Torque sensitive vibration.

UJ—Universal Joints. If needle bearings, bearing cups, or bearing ends of spiders are worn, damaged, overtightened, or loose, they will cause mechanical vibration at almost any speed. Torque and vehicle speed sensitive vibration.

PSY—Propeller Shaft and Yokes. Not a cause of vibration below 35 mph (56 km/h). Excessive runout, unbalance, missing balance weights, undercoating on shaft tube, dents or bends in tube will cause mechanical vibration at 35 mph (56 km/h) and above. Torque and vehicle speed sensitive vibration.

WB—Wheel Bearings. Loose bearings cause shimmy-like vehicle speed sensitive mechanical vibration at 35 mph (56 km/h) and above. Rough or damaged bearings will also generate growl noise at low speed or whine noise at high speed.

AN—Axle Noise. Axle not a cause of vibration unless axle shaft is bent or front axle shaft U-Joint is damaged. Worn or damaged axle gears or bearings will cause noise in varying speed ranges in relation to amount of engine torque applied.

SSC—Suspension and Steering Components. Worn, damaged, or loose suspension components (steering damper, steering knuckles, pitman arm, springs, spring U-bolts or center bolts, shocks, tie rod ends, etc.) can cause mechanical or audible vibrations at many speeds. Can be torque and vehicle speed sensitive.

EA—Engine Driven Accessories. Loose or broken AC compressor, power steering pump, water pump, air pump, alternator, etc. can cause engine speed sensitive mechanical vibration. Usually apparent when transmission is shifted into neutral and engine rpm increased.

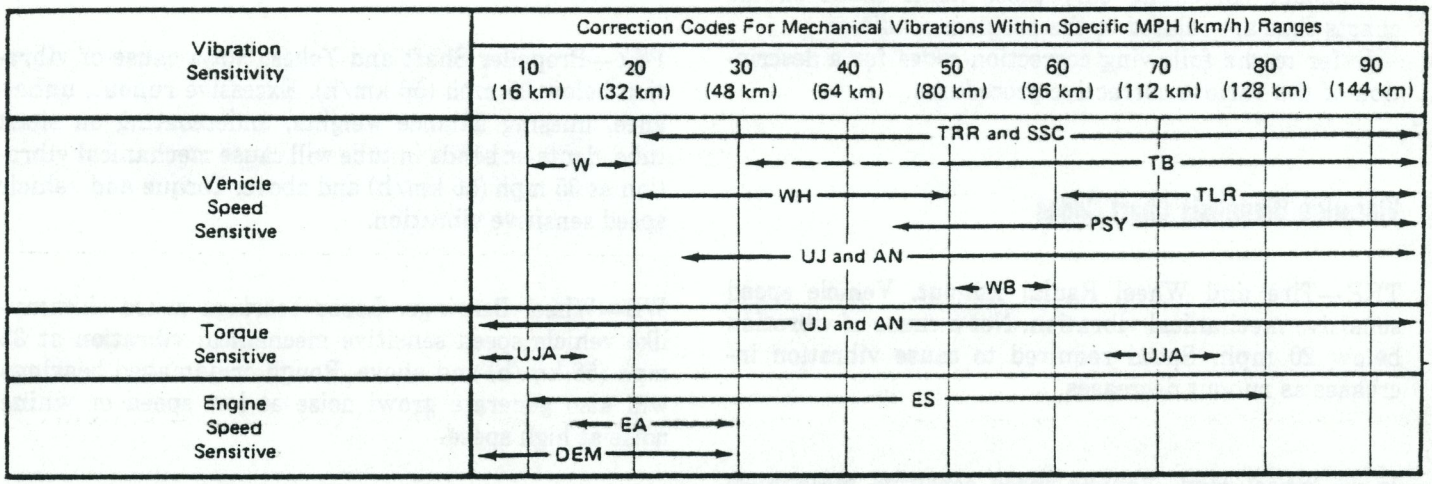
ADB—Accessory Drive Belts. Loose, worn belts can cause engine speed sensitive audible vibration that sounds like droning, fluttering, or rumbling noise.

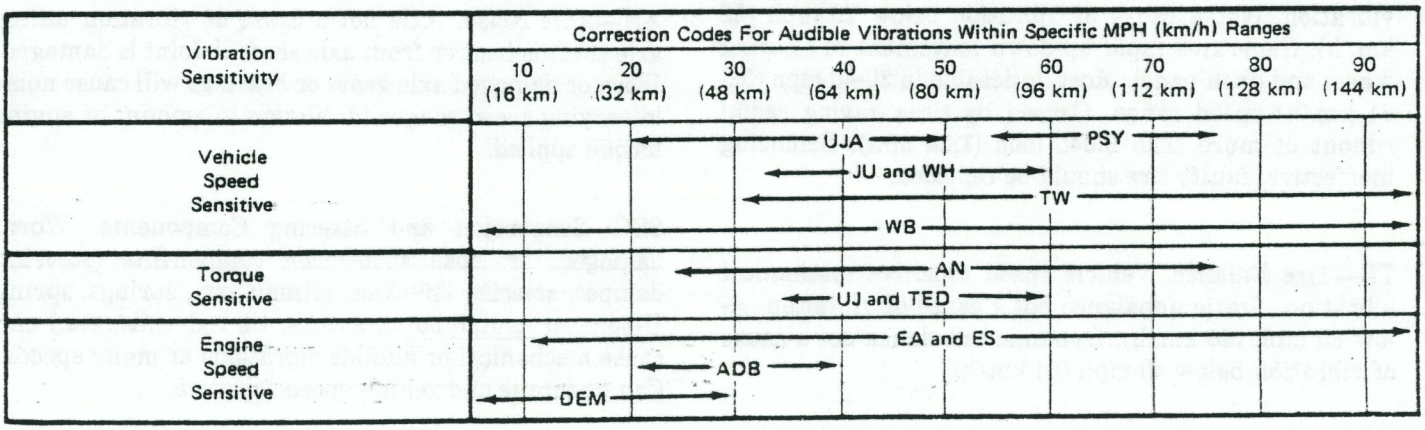
DEM—Damaged Engine or Transmission Mounts. If loose, worn, or broken can allow engine, transmission, or engine accessories to contact body causing noise and vibration.

ES—Exhaust System. Loose or broken components may contact body causing noise. In addition, mispositioned components (e.g., muffler, converter, pipes, hangers) may also contact body or driveline components causing noise.

SPECIFICATIONS

Vibration Diagnosis Chart





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Tire Inflation Pressure Chart

Model	GVW Rating		Tire Size	Load Range	Normal Load ①				Maximum Load ②				Wheel Size	
					Sustained Driving Over 65 mph (105 km/h) ④		Under 65 mph (105 km/h)		Sustained Driving Over 65 mph (105 km/h) ④		Under 65 mph (105 km/h)			
	lbs	kg			Front	Rear	Front	Rear	Front	Rear	Front	Rear		
CJ-5 & CJ-7	3750 & 4150	1700 & 1882	9-15LT	B	35	35	25	25	40	40	30	30	15 x 8	
			H78-15	B & D	24	24	20	20	28	28	24	24	15 x 5.50	
			L78-15	B & C	24	24	20	20	24	24	20	20	15 x 8	
Cherokee & Wagoneer	6200	2812	L78-15	B	24	24	20	20	32	32	28	28	15 x 8	Aluminum
			P225/75R-15	SL ③	31	31	28	28	35*	35*	32	32	15 x 7	Wheel
			P235/75R-15	SL ③	31	31	28	28	35*	35*	32	32	15 x 7	is
			10R-15LT	B	35	35	25	25	45*	45*	35	35	15 x 8	15 x 7
J-10 Truck	6200	2812	H78-15	B	28	28	24	24	32*	32*	32	32	15 x 6	
			H78-15	D	28	28	24	24	36	36	32	32	15 x 6	Aluminum
			L78-15	B	24	24	20	20	32	32	28	28	15 x 8	Wheel
			P225/75R-15	SL ③	31	31	28	28	35*	35*	32	32	15 x 6	is
			10R-15LT	B	35	35	25	25	45*	45*	35	35	15 x 8	15 x 7
J-20 Truck	6800	3084	8.75-16.5	C	40	40	30	30	50*	55*	40	45	16.5 x 6	
			9.50-16.5	D	45	45	35	35	55*	70*	45	60	16.5 x 6.75	
	7600	3447	9.50-16.5	D	45	45	35	35	55*	70*	45	60	16.5 x 6.75	
	8400	3810	9.50-16.5	D	45	45	35	35	55*	70*	45	60	16.5 x 6.75	
Cherokee & Wagoneer with Snow Plow Package	6200	2812	H78-15	D	28	28	24	24	40*	40*	38	38	15 x 6	
			H78-15	D	28	28	24	24	40*	40*	38	38	15 x 7	Aluminum Wheel
J-10 Truck with Snow Plow Package	6200	2812	H78-15	D	28	28	24	24	40*	40*	38	38	15 x 6	is 15 x 7

NOTE: Inflate tires while cold, before running. Do not reduce pressure if tires are warm.

*Speed limited to 74 mph (119 km/h).

① Normal Load: Frequently selected accessories plus driver and two passengers. For CJ models, driver and one passenger.

② Maximum Load: Gross Vehicle Weight Rating (GVWR).

③ SL is approximate metric tire equivalent of load range B.

④ Sustained driving over 74 mph (119 km/h) for Cherokee and Wagoneer except where indicated by asterisk (*).

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Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft-lbs)		Metric (N-m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Caliper Mounting Bolt (Cke-Wag-Trk)	35	30-40	47	41-54
Caliper Support Key Retaining Screw (CJ)	15	15-18	20	20-24
Wheel Retaining Nuts:				
CJ	75	65-80	102	88-108
Cke—Wag—J-10 Trk	75	65-90	102	88-122
J-20 Trk (8400 GVW)	130	110-150	176	149-203
Wheel Bearing Adjustment (CJ):				
Outer Locknut	50	50 min.	68	68 min.
Inner Locknut (Adjusting Nut)	Tighten to 50 foot-pounds (68 N-m) torque and back locknut off 1/6 turn (45°-65° while rotating wheel			
Wheel Bearing Adjustment (Cke-Wag-Trk):				
Outer Locknut	50	50 min.	68	68 min.
Inner Locknut	Tighten to 50 Foot-pounds (68 N-m), and back off locknut 1/6 turn (45°-65°) while rotating wheel			
Tire Radial Runout:				
Conventional Tire	0.105 inch		2.66 mm	
Radial Tire	0.080 inch		2.03 mm	
Tire Lateral Runout (All)	0.100 inch		2.54 mm	
Wheel Radial Runout (All)	0.045 inch		1.14 mm	
Wheel Lateral Runout (All)	0.045 inch		1.14 mm	

All Torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

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STEERING COLUMNS 2J

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GENERAL

Three different steering column designs are used on Jeep vehicles. Models with automatic transmission use a nontilt column with column mounted gearshift mechanism. Models with manual transmission use a nontilt column with ignition key release lever. A six position tilt column is available as an option on all models.

All steering columns used on Jeep vehicles have anti-theft and energy absorbing features. Each column is designed to compress under impact.

The ignition lock cylinder and ignition switch are mounted on the column. When the lock cylinder is turned to LOCK position, the ignition switch and steering shaft cannot be operated. On models with automatic transmission, the lock mechanism also prevents operation of the column mounted gearshift mechanism.

A center slip-type (telescoping) intermediate shaft is used on all models. It is attached to the steering gear with a flexible coupling and to the steering column with a universal joint.

SERVICE DIAGNOSIS

When diagnosing steering column malfunctions, refer to the Service Diagnosis Charts for the probable cause and correction procedures. To simplify chart use, they are divided into the various sub-systems within the column such as ignition system, lock mechanism, turn signal switch and electrical.

Service Diagnosis—Lock System

Condition	Possible Cause	Correction
WILL NOT LOCK	(1) Lockbolt spring broken or defective.	(1) Replace lock bolt spring.
HIGH EFFORT (REQUIRED TO TURN IGNITION KEY AND LOCK CYLINDER)	(1) Lock cylinder defective.	(1) Replace lock cylinder.
	(2) Ignition switch defective.	(2) Replace ignition switch.
	(3) Rack preload spring broken or deformed.	(3) Replace preload spring.

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Service Diagnosis—Lock System

Condition	Possible Cause	Correction
HIGH EFFORT (REQUIRED TO TURN IGNITION KEY AND LOCK CYLINDER) (CON'T)	(4) Burr on lock sector, lock rack, housing, support or remote rod coupling.	(4) Remove burr.
	(5) Bent sector shaft.	(5) Replace shaft.
	(6) Defective lock rack.	(6) Replace lock rack.
	(7) Remote rod bent, deformed.	(7) Replace rod.
	(8) Ignition switch mounting bracket bent.	(8) Straighten or replace.
	(9) Distorted coupling slot in lock rack (tilt column).	(9) Replace lock rack.
WILL STICK IN "START"	(1) Remote rod deformed.	(1) Straighten or replace.
	(2) Ignition switch mounting bracket bent.	(2) Straighten or replace.
KEY CANNOT BE REMOVED IN "OFF-LOCK"	(1) Ignition switch is not adjusted correctly.	(1) Adjust switch.
	(2) Defective lock cylinder.	(2) Replace lock cylinder.
LOCK CYLINDER CAN BE REMOVED WITHOUT DEPRESSING RETAINER	(1) Lock cylinder with defective retainer.	(1) Replace lock cylinder.
	(2) Burr over retainer slot in housing cover or on cylinder retainer.	(2) Remove burr.
HIGH EFFORT ON LOCK CYLINDER BETWEEN "OFF" AND "OFF-LOCK"	(1) Distorted lock rack.	(1) Replace lock rack.
	(2) Burr on tang of shift gate (automatic column).	(2) Remove burr.
	(3) Gearshift linkage not adjusted.	(3) Adjust linkage.

Service Diagnosis—Steering Column

Condition	Possible Cause	Correction
NOISE IN COLUMN	(1) One click when in "off-lock" position and the steering wheel is moved (all except automatic column).	(1) Normal—lock bolt is seating.
	(2) Coupling bolts not tightened.	(2) Tighten pinch bolts.
	(3) Lack of grease on bearings or bearing surfaces.	(3) Lubricate with chassis grease.
	(4) Upper shaft bearing worn or broken.	(4) Replace bearing assembly.
	(5) Lower shaft bearing worn or broken.	(5) Replace bearing. Check shaft and replace if scored.
	(6) Column not correctly aligned.	(6) Align column.
	(7) Coupling pulled apart.	(7) Replace coupling.
	(8) Broken coupling lower joint.	(8) Repair or replace joint and align column.
	(9) Steering shaft snap ring not seated.	(9) Replace snap ring. Check for proper seating in groove.
	(10) Shroud loose on shift bowl. Housing loose on jacket—will be noticed with ignition in "off-lock" and when torque is applied to steering wheel.	(10) Position shroud over lugs on shift bowl. Tighten mounting screws.
HIGH STEERING SHAFT EFFORT	(1) Column misaligned.	(1) Align column.
	(2) Defective upper or lower bearing.	(2) Replace as required.
	(3) Tight steering shaft universal joint.	(3) Repair or replace.
	(4) Flash on I.D. of shift tube at plastic joint (tilt column only).	(4) Replace shift tube.
	(5) Upper or lower bearings siezed.	(5) Replace bearings.
LASH IN MOUNTED COLUMN ASSEMBLY	(1) Column mounting bracket bolts loose.	(1) Tighten bolts.
	(2) Broken weld nuts on column jacket.	(2) Replace column jacket.
	(3) Column capsule bracket sheared.	(3) Replace bracket assembly.
	(4) Column bracket to column jacket mounting bolts loose.	(4) Tighten to specified torque.
	(5) Loose lock shoes in housing (tilt column only).	(5) Replace shoes.

Service Diagnosis—Steering Column (Continued)

Condition	Possible Cause	Correction
	(6) Loose pivot pins (tilt column only).	(6) Replace pivot pins and support.
	(7) Loose lock shoe pin (tilt column only).	(7) Replace pin and housing.
	(8) Loose support screws (tilt column only).	(8) Tighten screws.
HOUSING LOOSE (TILT COLUMN ONLY)	(1) Excessive clearance between holes in support or housing and pivot pin diameters.	(1) Replace pivot pins and support.
	(2) Housing support-screws loose.	(2) Tighten screws.
STEERING WHEEL LOOSE—EVERY OTHER TILT POSITION (TILT COLUMN ONLY)	(1) Loose fit between lock shoe and lock shoe pivot pin.	(1) Replace lock shoes and pivot pin.
STEERING COLUMN NOT LOCKING IN ANY TILT POSITION (TILT COLUMN ONLY)	(1) Lock shoe siezed on pivot pin.	(1) Replace lock shoes and pin.
	(2) Lock shoe grooves have burrs or are filled with foriegn material.	(2) Clean or replace lock shoes.
	(3) Lock shoe springs weak or broken.	(3) Replace springs.
NOISE WHEN TILTING COLUMN (TILT COLUMN ONLY)	(1) Upper tilt bumpers worn.	(1) Replace tilt bumper.
	(2) Tilt spring rubbing in housing.	(2) Lubricate with chassis grease.
ONE CLICK WHEN IN "OFF-LOCK" POSITION AND THE STEERING WHEEL IS MOVED	(1) Seating of lock bolt.	(1) None. Click is normal characteristic sound produced by lock bolt as it seats.
HIGH SHIFT EFFORT (AUTOMATIC AND TILT COLUMN ONLY)	(1) Column not correctly aligned.	(1) Align column.
	(2) Lower bearing not aligned correctly.	(2) Assemble correctly.
	(3) Lack of grease on seal or lower bearing areas.	(3) Lubricate with chassis grease.
IMPROPER TRANSMISSION SHIFTING—AUTOMATIC AND TILT COLUMN ONLY	(1) Sheared shift tube joint.	(1) Replace shift tube.
	(2) Improper transmission gearshift linkage adjustment.	(2) Adjust linkage.
	(3) Loose lower shift lever.	(3) Replace shift tube.

Service Diagnosis—Ignition System

Condition	Possible Cause	Correction
IGNITION SWITCH ELECTRICALLY INOPERATIVE	(1) Loose or defective switch connector.	(1) Tighten or replace connector.
	(2) Feed wire open (fusible link).	(2) Repair or replace.
	(3) Defective ignition switch.	(3) Replace ignition switch.
ENGINE WILL NOT CRANK	(1) Ignition switch not adjusted properly.	(1) Adjust switch.
IGNITION SWITCH WILL NOT ACTUATE MECHANICALLY	(1) Defective ignition switch.	(1) Replace switch.
	(2) Defective lock sector.	(2) Replace lock sector.
	(3) Defective remote rod.	(3) Replace remote rod.
IGNITION SWITCH CANNOT BE ADJUSTED CORRECTLY	(1) Remote rod deformed.	(1) Repair, straighten or replace.

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Service Diagnosis—Turn Signal

Condition	Possible Cause	Correction
TURN SIGNAL WILL NOT CANCEL	(1) Loose switch mounting screws.	(1) Tighten screws.
	(2) Switch or anchor bosses broken.	(2) Replace switch.
	(3) Broken, missing or out of position detent, or cancelling spring.	(3) Reposition springs or replace switch as required.

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Service Diagnosis — Turn Signal (Continued)

Condition	Possible Cause	Correction
TURN SIGNAL DIFFICULT TO OPERATE	(1) Turn signal lever loose.	(1) Tighten mounting screw.
	(2) Switch yoke broken or distorted.	(2) Replace switch.
	(3) Loose or misplaced springs.	(3) Reposition springs or replace switch.
	(4) Foreign parts and/or materials in switch.	(4) Remove foreign parts and/or material.
	(5) Switch mounted loosely.	(5) Tighten mounting screws.
TURN SIGNAL WILL NOT INDICATE LANE CHANGE	(1) Broken lane change pressure pad or spring hanger.	(1) Replace switch.
	(2) Broken, missing or misplaced lane change spring.	(2) Replace or reposition as required.
	(3) Jammed wires.	(3) Loosen mounting screws, reposition wires and retighten screws.
TURN SIGNAL WILL NOT STAY IN TURN POSITION	(1) Foreign material or loose parts impeding movement of switch yoke.	(1) Remove material and/or parts.
	(2) Defective switch.	(2) Replace switch.
HAZARD SWITCH CANNOT BE PULLED OUT	(1) Foreign material between hazard support cancelling leg and yoke.	(1) Remove foreign material. (a) No foreign material impeding function of hazard switch—replace turn signal switch.

Service Diagnosis — Turn Signal (Continued)

Condition	Possible Cause	Correction
NO TURN SIGNAL LIGHTS	(1) Inoperative turn signal flasher.	(1) Replace turn signal flasher.
	(2) Defective or blown fuse.	(2) Replace fuse.
	(3) Loose chassis to column harness connector.	(3) Connect securely.
	(4) Disconnect column to chassis connector. Connect new switch to chassis and operate switch by hand. If vehicle lights now operate normally, signal switch is inoperative.	(4) Replace signal switch.
	(5) If vehicle lights do not operate check chassis wiring for opens, grounds, etc.	(5) Repair chassis wiring as required.
INSTRUMENT PANEL TURN INDICATOR LIGHTS ON BUT NOT FLASHING	(1) Burned out or damaged front or rear turn signal bulb.	(1) Replace bulb.
	(2) If vehicle lights do not operate, check light sockets for high resistance connections, the chassis wiring for opens, grounds, etc.	(2) Repair chassis wiring as required.
	(3) Inoperative flasher.	(3) Replace flasher.
	(4) Loose chassis to column harness connection.	(4) Connect securely.
	(5) Inoperative turn signal switch.	(5) Replace turn signal switch.
	(6) To determine if turn signal switch is defective, substitute new switch into circuit and operate switch by hand. If the vehicle's lights operate normally, signal switch is inoperative.	(6) Replace turn signal switch.

Service Diagnosis—Turn Signal (Continued)

Condition	Possible Cause	Correction
STOP LIGHT NOT ON WHEN TURN INDICATED	(1) Loose column to chassis connection.	(1) Connect securely.
	(2) Disconnect column to chassis connector. Connect new switch into system without removing old. Operate switch by hand. If brake lights work with switch in the turn position, signal switch is defective.	(2) Replace signal switch.
	(3) If brake lights do not work check connector to stop light sockets for grounds, opens, etc.	(3) Repair connector to stop light circuits using service manual as guide.
TURN INDICATIOR PANEL LIGHTS NOT FLASHING	(1) Burned out bulbs.	(1) Replace bulbs.
	(2) High resistance to ground at bulb socket.	(2) Replace socket.
	(3) Opens, grounds in wiring harness from front turn signal bulb socket to indicator lights.	(3) Locate and repair as required.
TURN SIGNAL LIGHTS FLASH VERY SLOWLY	(1) High resistance ground at light sockets.	(1) Repair high resistance grounds at light sockets.
	(2) Incorrect capacity turn signal flasher or bulb.	(2) Replace turn signal flasher or bulb.
	(3) If flashing rate is still extremely slow, check chassis wiring harness from the connector to light sockets for high resistance.	(3) Locate and repair as required.

Service Diagnosis — Turn Signal (Continued)

Condition	Possible Cause	Correction
TURN SIGNAL LIGHTS FLASH VERY SLOWLY (CON'T.)	(4) Loose chassis to column harness connection.	(4) Connect securely.
	(5) Disconnect column to chassis connector. Connect new switch into system without removing old. Operate switch by hand. If flashing occurs at normal rate, the signal switch is defective.	(5) Replace turn signal switch.
HAZARD SIGNAL LIGHTS WILL NOT FLASH—TURN SIGNAL FUNCTIONS NORMALLY	(1) Blown fuse.	(1) Replace fuse.
	(2) Inoperative hazard warning flasher.	(2) Replace hazard warning flasher in fuse panel.
	(3) Loose chassis-to-column harness connection.	(3) Connect securely.
	(4) Disconnect column to chassis connector. Connect new switch into system without removing old. Depress the hazard warning lights. If they now work normally, turn signal switch is defective.	(4) Replace turn signal switch.
	(5) If lights do not flash, check wiring harness "K" lead for open between hazard flasher and connector. If open, fuse block is defective.	(5) Repair or replace brown wire or connector as required.

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STEERING COLUMN ALIGNMENT

(1) Loosen all toe plate screws.

(2) Remove instrument panel lower trim.

(3) Loosen column mounting bracket-to-instrument-panel attaching bolts.

(4) Pull steering column upward. Maintain upward pressure and tighten instrument panel-to-column mounting bracket bolts to 20 foot-pounds (27 N•m) torque.

(5) Install lower clamp bracket and tighten bolts to 20 foot-pounds (27 N•m) torque.

(6) Tighten toe plate screws to 10 foot-pounds (14 N•m) torque.

(7) Install instrument panel lower trim.

(8) On vehicles with automatic transmission, check gearshift manual linkage for proper operation. Refer to Chapter 2C—Automatic Transmission.

STEERING WHEEL REMOVAL

CJ Models

(1) Disconnect battery negative cable.

(2) Place front wheels in straight ahead position.

(3) Remove horn button. Pull button straight up to remove.

(4) Remove steering wheel nut and washer.

(5) Remove receiver bushing attaching screws and remove bushing.

(6) Remove horn button receiver and contact plate.

(7) Paint or scribe alignment marks on steering wheel and steering shaft for assembly reference.

(8) Remove steering wheel using Puller J-21232 (fig. 2J-1).

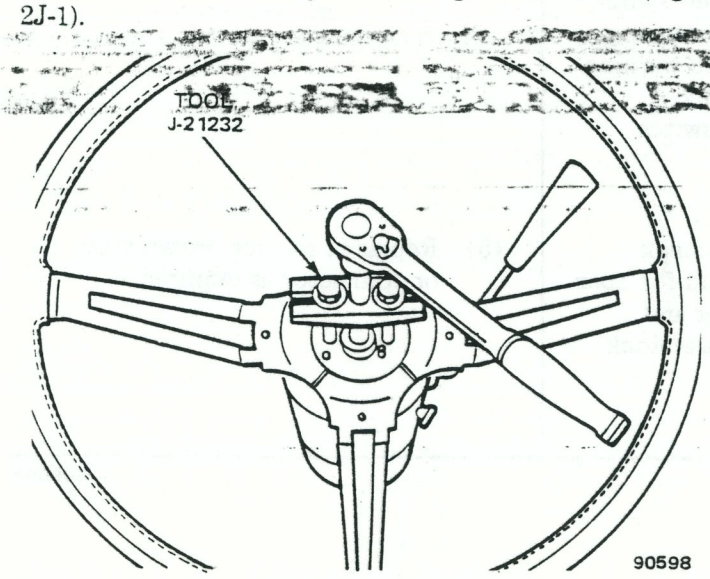


Fig. 2J-1 Steering Wheel Removal

Cherokee-Wagoneer-Truck Models

(1) Disconnect battery negative cable.

(2) Place front wheels in straight ahead position.

(3) On models with standard steering wheel, remove horn cover attaching screws from underside of wheel and remove cover. On models with sport steering wheel, remove horn button by pulling button upward.

(4) On models with standard steering wheel, remove horn wire. Disconnect wire at steering wheel switch. Unseat retainer that holds horn wire and spring in canceling cam yoke and remove wire, retainer, and spring as assembly.

(5) Remove steering wheel nut and washer.

(6) On models with sport steering wheel, remove receiver bushing attaching screws and remove bushing, horn button receiver, and contact plate.

(7) Paint or scribe alignment marks on steering wheel and steering shaft for assembly reference.

(8) Remove steering wheel using Puller J-21232 (fig. 2J-1).

STEERING WHEEL INSTALLATION

CAUTION: *Some steering shafts have metric steering wheel nut threads. Inspect and identify the shaft thread-type before installing a replacement nut. Metric shafts have an identifying groove in the steering wheel splines (fig. 2J-2). American thread shafts do not have this groove.*

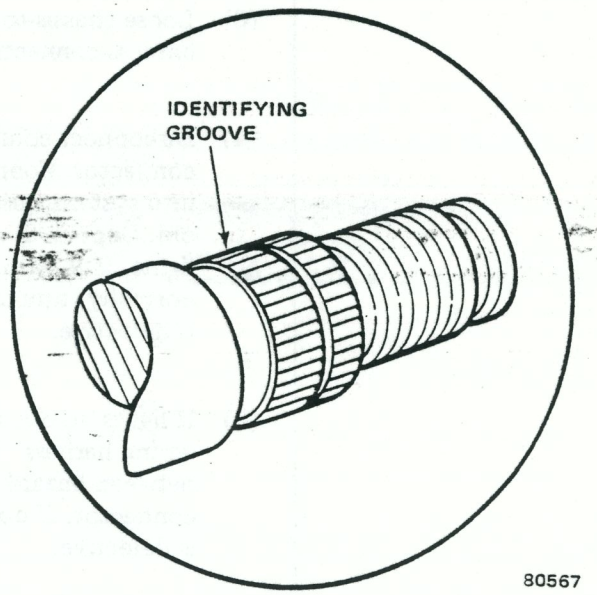


Fig. 2J-2 Metric Steering Shaft Identification

CJ Models

(1) Align reference marks on steering shaft and steering wheel and install wheel.

(2) Install contact plate and horn button receiver. Install receiver so horn button locating notch is at 12 o'clock position.

(3) Install receiver bushing and bushing attaching screws.

(4) Install steering wheel washer and nut. Tighten nut to 30 foot-pounds (41 N•m) torque.

(5) Install horn button.

(6) Connect battery negative cable.

(7) Reset clock, if equipped.

Cherokee-Wagoneer-Truck Models

(1) Align reference marks on steering shaft and steering wheel and install wheel.

(2) On models with sport steering wheel (fig. 2J-3), install contact plate, horn button receiver, and receiver bushing. Be sure to install receiver so horn button locating notch is at 12 o'clock position.

(3) Install steering wheel washer and nut. Tighten nut to 30 foot-pounds (41 N•m) torque.

(4) On models with standard steering wheel, insert spring and horn wire in canceling cam yoke. Seat horn wire retainer in cam yoke and connect opposite end of wire to steering wheel switch.

(5) Install horn button.

(6) Connect battery negative cable.

(7) Reset clock, if equipped.

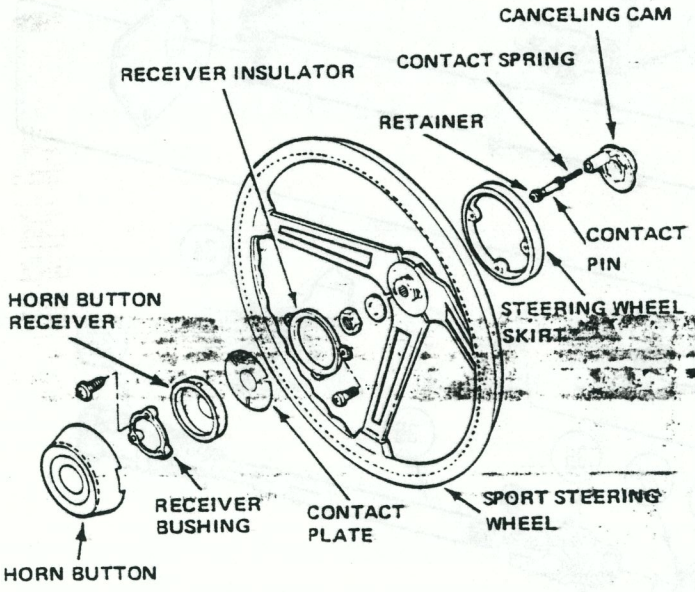


Fig. 2J-3 Sport Steering Wheel Assembly

SPORT STEERING WHEEL SKIRT REPLACEMENT

(1) Disconnect battery negative cable.

(2) Place wheels in straight-ahead position.

(3) Remove horn button. Pull straight up on button to remove.

(4) Remove steering wheel nut and washer.

(5) Remove receiver bushing attaching screws and remove bushing, horn button receiver, and contact plate (fig. 2J-3).

(6) Remove steering wheel using tool J-21232 (fig. 2J-1).

(7) Remove receiver insulator attaching screws and remove insulator and skirt (fig. 2J-3).

(8) Color coat replacement skirt. Refer to Chapter 3B—Metal Repair and Painting for color coat procedure.

(9) Align and install replacement skirt and receiver insulator on steering wheel and install insulator attaching screws.

(10) Align reference marks on steering shaft and wheel and install wheel.

(11) Install contact plate and horn button receiver. Install receiver so horn button locating notch is at 12 o'clock position.

(12) Install receiver bushing and bushing attaching screws.

(13) Install steering wheel washer and nut. Tighten nut to 30 foot-pounds (41 N•m) torque.

(14) Install horn button. Align button tab with receiver notch and press button downward until seated.

(15) Connect battery negative cable.

(16) Reset clock, if equipped.

STEERING COLUMN REMOVAL

CAUTION: *Handle the steering column with special care after it is removed from the vehicle. Sharp blows on the end of the steering shaft or shift lever, leaning on the column assembly, or dropping the assembly could shear or loosen the plastic fasteners that maintain column rigidity.*

(1) Disconnect battery negative cable.

(2) On vehicles with automatic transmission, disconnect transmission shift rod at steering column shift lever.

NOTE: *On Cherokee and Wagoneer models with automatic transmission and power brakes, the gearshift lever must be moved to the "1" range position to gain access to the shift rod-to-shift lever retaining clip.*

(3) Remove steering column-to-intermediate shaft U-joint pinch bolt.

CAUTION: *Do not attempt to separate the intermediate shaft and steering column at this time. If separated, the plastic connector injected into the intermediate shaft could be damaged.*

(4) On Cherokee and Wagoneer models with air conditioning, remove left air duct extension.

(5) Remove steering column-to-instrument panel bezel. On Cherokee, Wagoneer, and Truck models, screws attaching two halves of bezel are located behind lower bezel half.

(6) Remove bolts attaching steering column mounting bracket to instrument panel.

(7) Remove bolts attaching steering column mounting bracket to steering column and remove bracket.

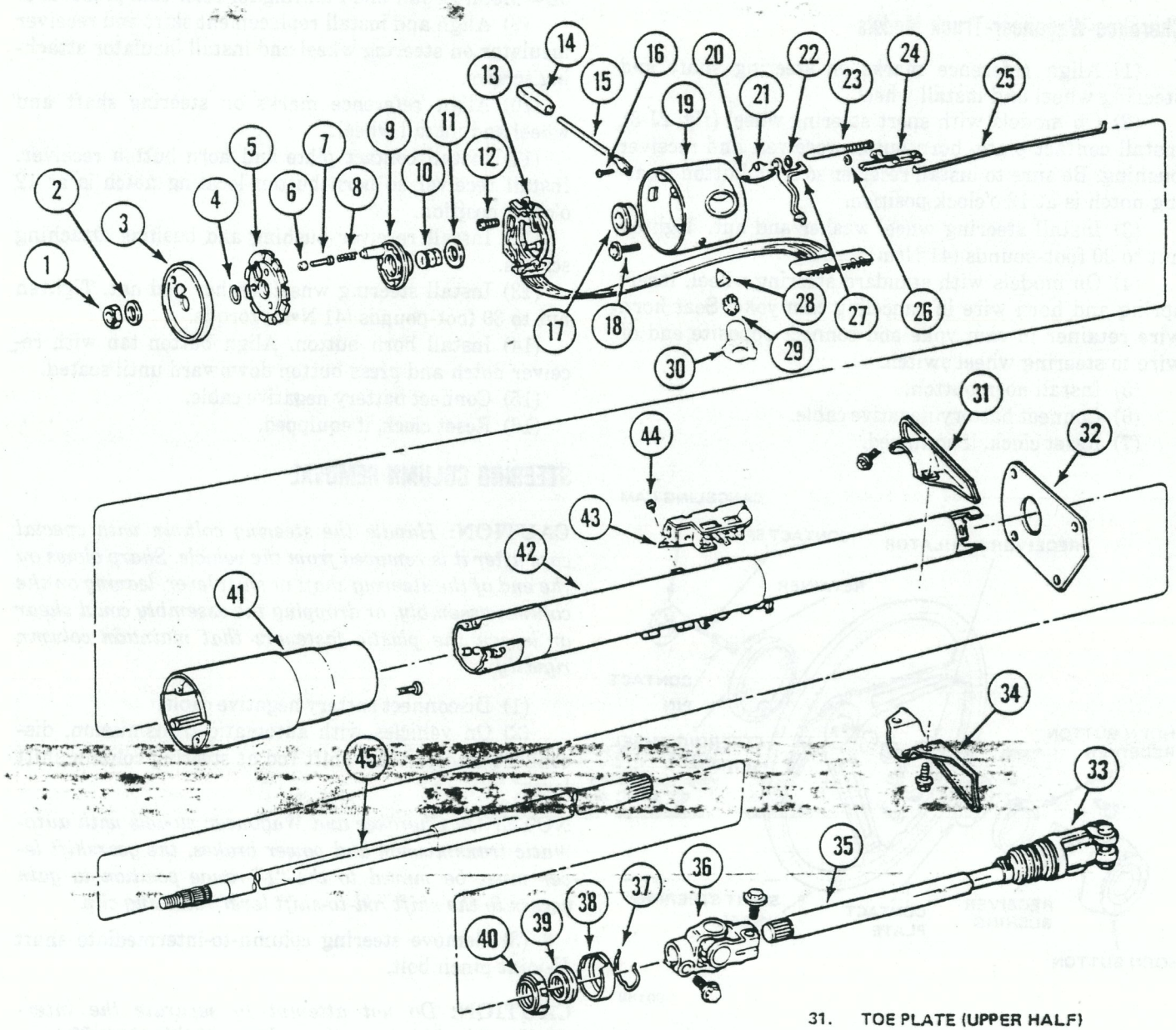
CAUTION: *To avoid damaging the mounting bracket breakaway capsules, store the bracket in a safe place until service operations are completed.*

(8) Remove top and bottom toe plates.

(9) Disconnect wiring harness at ignition switch.

(10) Disconnect Cruise Command wiring harness connector, if equipped.

(11) Separate steering column from intermediate shaft and remove steering column.



1. STEERING WHEEL NUT
2. WASHER
3. LOCK PLATE COVER
4. STEERING SHAFT SNAP RING
5. LOCKPLATE
6. RETAINER
7. HORN CONTACT PIN
8. SPRING
9. CANCELING CAM
10. UPPER BEARING PRELOAD SPRING
11. THRUST WASHER
12. TURN SIGNAL SWITCH SCREW (3)
13. TURN SIGNAL SWITCH
14. TURN SIGNAL LEVER KNOB
15. TURN SIGNAL LEVER
16. TURN SIGNAL LEVER SCREW
17. UPPER BEARING
18. HOUSING RETAINING SCREW (4)
19. HOUSING
20. RACK PRELOAD SPRING
21. KEY RELEASE LEVER SPRING
22. WAVE WASHER
23. LOCK BOLT
24. LOCK RACK
25. REMOTE ROD
26. SPRING WASHER
27. KEY RELEASE LEVER
28. HAZARD WARNING SWITCH KNOB
29. LOCK SECTOR
30. LOCK CYLINDER
31. TOE PLATE (UPPER HALF)
32. SEAL
33. INTERMEDIATE SHAFT COUPLING
34. TOE PLATE (LOWER HALF)
35. INTERMEDIATE SHAFT
36. INTERMEDIATE SHAFT-TO-STEERING SHAFT U-JOINT
37. SNAP RING
38. RETAINER
39. LOWER BEARING
40. LOWER BEARING ADAPTER
41. SHROUD
42. JACKET
43. IGNITION SWITCH
44. IGNITION SWITCH SCREW (2)
45. STEERING SHAFT

60684

Fig. 2J-4 Steering Column—Manual Transmission

STEERING COLUMN INSTALLATION

CAUTION: *Use only the specified screws, bolts, and nuts when servicing the column. Do not use any substitute fasteners. Tighten all fasteners to the specified torque only to maintain the energy-absorbing (compression) action of the column. Bolts and screws longer than specified must not be used as they may prevent the column from compressing under impact. The bolts or nuts securing the column mounting bracket to the instrument panel must be tightened to the proper torque so that the bracket will break away under impact.*

(1) Install steering column in vehicle and connect column to intermediate shaft.

(2) Install intermediate shaft-to-column U-joint pinch bolt. Tighten bolt to 45 foot-pounds (61 N•m) torque.

(3) Connect Cruise Command wire harness connector, if equipped.

(4) Connect wiring harness connectors to ignition switch. Install white connector first—black connector last.

(5) Install top and bottom toe plates but do not tighten attaching bolts completely.

(6) Install mounting bracket on steering column and tighten bracket attaching bolts to 20 foot-pounds (27 N•m) torque.

(7) Align steering column mounting bracket and instrument panel and loosely install mounting bracket-to-instrument panel bolts.

(8) Pull steering column upward and tighten column mounting bracket-to-instrument panel bolts to 20 foot-pounds (27 N•m) torque. Be sure to maintain upward pressure on column when tightening bolts.

(9) Tighten toe plate bolts to 10 foot-pounds (14 N•m) torque.

(10) Install both halves of steering column-to-instrument panel bezel.

(11) On Cherokee, Wagoneer and Truck models with air conditioning, install left air duct extension.

(12) Connect transmission shift rod to steering column shift lever.

(13) On vehicles with automatic transmission, check operation of gearshift manual linkage and adjust linkage if necessary. Refer to Chapter 2C—Automatic Transmission.

(14) Connect all electrical components and check for proper operation.

(15) Install instrument panel trim and left side air conditioning duct, if equipped.

(16) Connect battery negative cable.

(17) Reset clock, if equipped.

STANDARD COLUMN OVERHAUL—MANUAL TRANSMISSION

Column Disassembly

NOTE: *Steering column removal is not necessary if only the lock plate cover, lock plate, steering shaft snap ring, canceling cam, turn signal switch, upper bearing preload spring, or lock cylinder are to be serviced (fig. 2J-4). However, the column must be removed in order to service any of the remaining components. If the column is removed, remove the column-to-instrument panel mounting bracket and install Support Fixture J-23074 (fig. 2J-5). Mount the column in a vise by clamping the support fixture flange in the vise.*

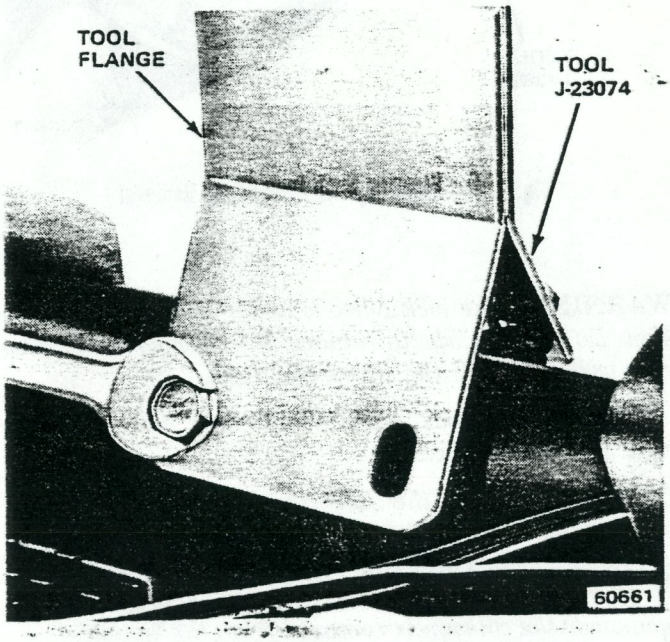


Fig. 2J-5 Steering Column—Manual Transmission

(1) Place front wheels in straight-ahead position.

(2) Disconnect battery negative cable.

(3) Cover painted areas of column.

(4) Remove steering wheel.

(5) Remove lock plate cover. Use two screwdrivers to pry cover off lock plate and out of column.

(6) Compress lock plate and unseat steering shaft snap ring as follows:

(a) Inspect and identify steering shaft nut thread type. Metric shafts have identifying groove in steering wheel locating splines (fig. 2J-2). American thread shafts do not have this groove.

(b) If shaft has American threads, use tool J-23653 as is to compress lock plate and unseat snap ring (fig. 2J-6).

(c) If shaft has metric threads, replace compressor tool standard forcing screw with Metric Forcing Screw J-23653-4 before installing tool on steering shaft.

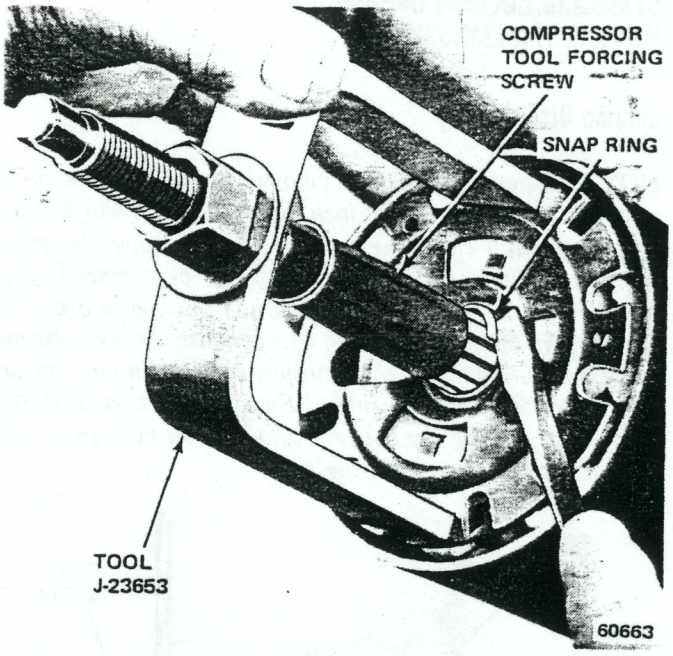


Fig. 2J-6 Steering Shaft Snap Ring Removal

WARNING: *The lock plate is under strong spring tension. Do not attempt to remove the steering shaft snap ring without using the compressor tool.*

(7) Remove lock plate compressor tool and snap ring. Discard snap ring.

CAUTION: *When the steering shaft snap ring is removed, the shaft is free in the column. During bench overhaul, remove the shaft by pulling it out from the lower end of column. Do not allow the shaft to fall out whenever the column is removed from the vehicle.*

(8) Remove lock plate, canceling cam, upper bearing preload spring, and thrust washer from shaft.

(9) Remove hazard warning switch knob. Press knob inward and unthread knob from column.

(10) On vehicles without Cruise Command, remove turn signal lever attaching screw and remove lever.

(11) On vehicles with Cruise Command, disconnect two of four wires at switch connector. Fold wires back along harness. Tape wires to harness and tape length of string to harness to aid removal.

(12) Unhook turn signal switch wire harness connector from bracket at lower end of steering column.

(13) Disconnect instrument panel harness connector from turn signal switch harness connector by lifting plastic lock tab on connector and separating connectors (fig. 2J-7).

(14) Wrap tape around turn signal switch harness connector to prevent snagging during removal.

(15) Remove turn signal switch attaching screws and remove switch. Pull switch and harness straight up and out of housing (fig. 2J-8).

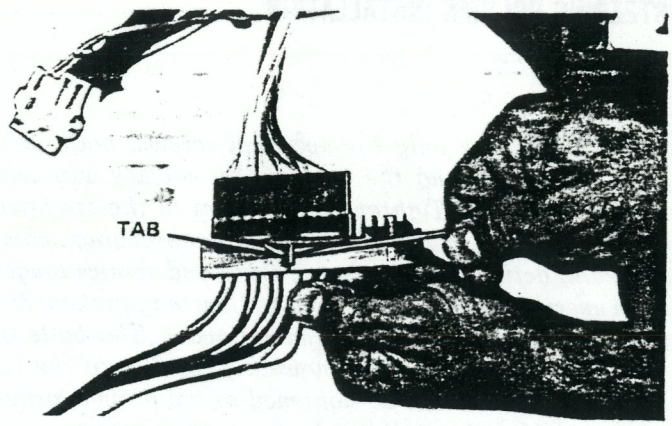


Fig. 2J-7 Turn Signal Switch Removal/Installation

(16) On vehicles with Cruise Command, remove turn signal lever and switch and remove switch harness using string previously taped in place.

(17) Turn ignition lock cylinder (clockwise) two detent positions beyond Off-LOCK position.

(18) Compress lock cylinder retaining tab using thin-bladed screwdriver and remove lock cylinder from column.

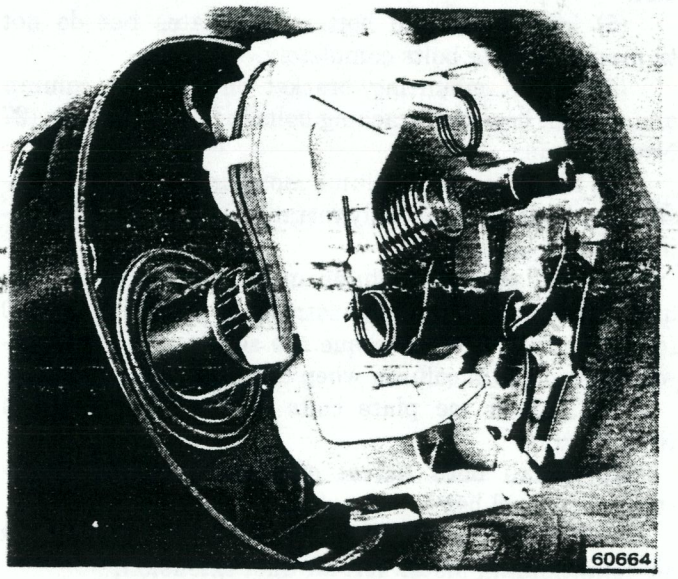


Fig. 2J-8 Disconnecting Turn Signal Switch Harness

NOTE: *The lock cylinder retaining tab is accessible through the slot adjacent to the turn signal switch mounting boss (fig. 2J-9). If the retaining tab is not visible through the slot, scrape or knock any casting flash out of the slot to provide access.*

(19) Remove ignition switch from lower end of column (fig. 2J-10).

(20) Remove screws attaching housing and shroud to column jacket (fig. 2J-11) and remove housing and shroud.

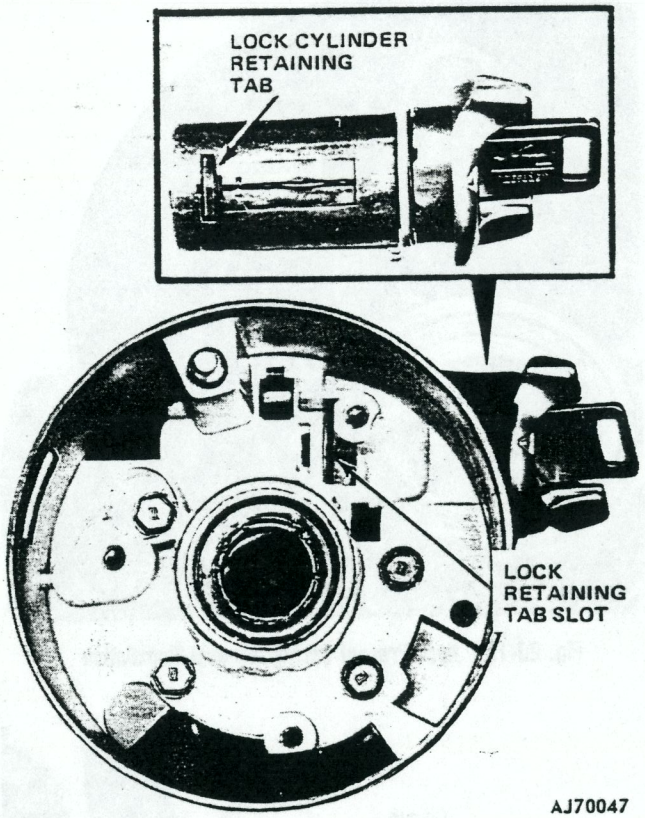


Fig. 2J-9 Lock Cylinder Retaining Tab Location

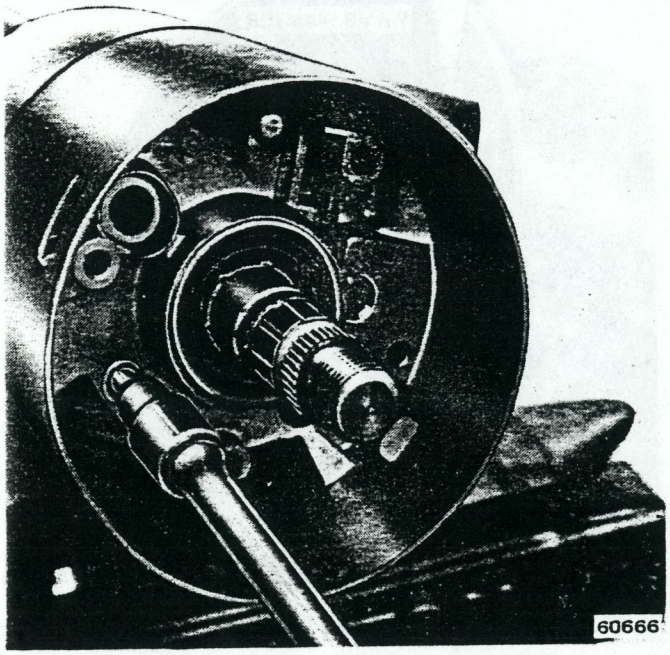


Fig. 2J-11 Housing and Shroud Removal/Installation

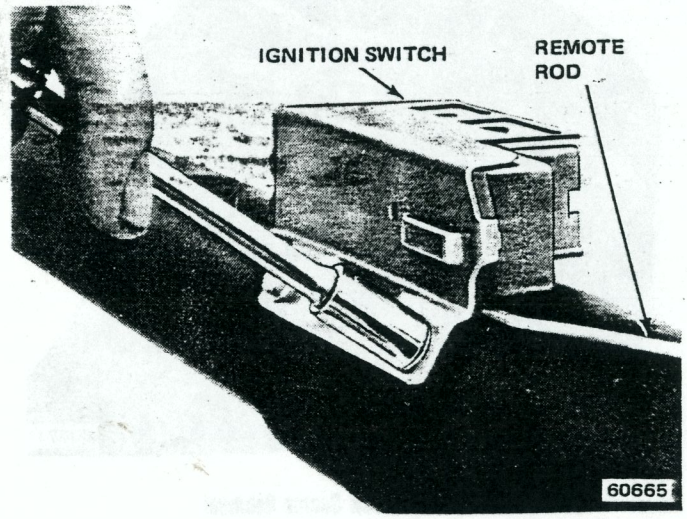


Fig. 2J-10 Ignition Switch Removal/Installation

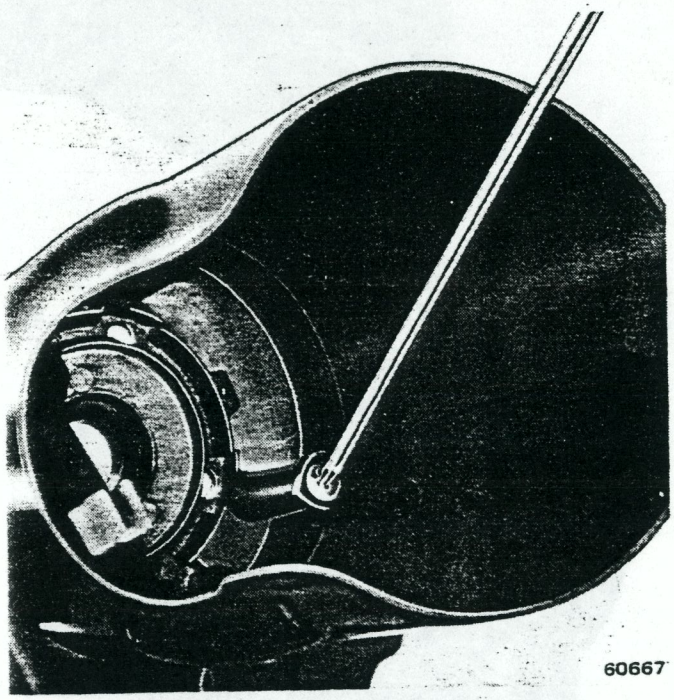


Fig. 2J-12 Removing Shroud From Housing

(21) Disengage remote rod from lock rack.

(22) Remove screws attaching shroud to housing (fig. 2H-12) and remove housing from shroud.

(23) Remove wave washer from key release lever pivot and remove key release lever and spring (fig. 2J-13).

(24) Remove lock rack and lock bolt assembly (fig. 2J-14).

(25) Remove rack preload spring (fig. 2J-15).

(26) Remove lock sector through lock cylinder hole in housing. Push on block tooth of sector with blunt punch to remove (fig. 2J-16).

NOTE: *Although the preceeding steps can be performed with the column mounted in the vehicle, the following steps can be performed only after the column has been removed.*

Fig. 2J-13 Wave Washer Position

Fig. 2J-15 Rack Preload Spring Removal/Installation

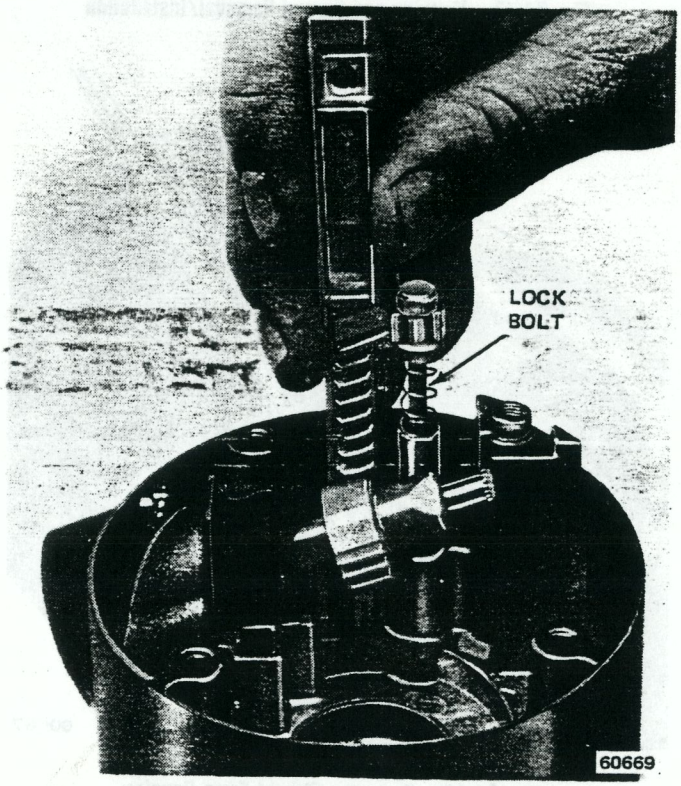


Fig. 2J-14 Lock Rack and Lock Bolt Removal

Fig. 2J-16 Lock Sector Removal

(27) Remove column from vehicle, if necessary, and mount column in vise using Support Fixture Tool J-23074 (fig. 2J-5).

(28) Remove steering shaft if not removed previously.

(29) Remove spring clip from lower bearing retainer and remove retainer, bearing, and adapter.

Column Assembly

CAUTION: *Use only the specified screws, bolts, and nuts when servicing the column and tighten all fasteners to recommended torque values only to maintain the energy-absorbing (compressing) action of the column.*

Incorrect length screws or bolts can prevent the column from compressing under impact. The bolts and nuts that attach the column mounting bracket to the column and instrument panel must also be tightened to the proper torque so that the bracket will break away under impact.

(1) Coat all friction and bearing surfaces with chassis grease before assembly.

(2) Install lock sector on sector shaft. Install sector through lock cylinder hole in housing (fig. 2J-17). Use blunt tool to press sector onto shaft. Be sure sector turns freely after installation.

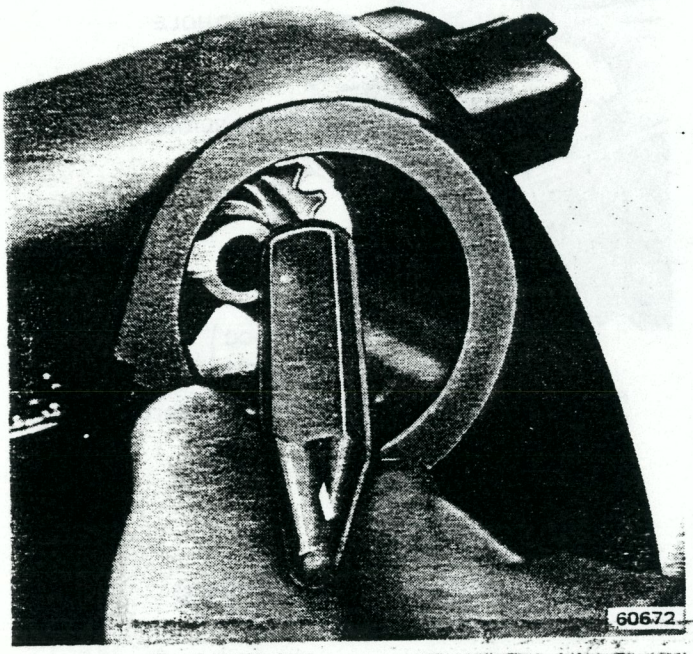


Fig. 2J-17 Sector Installation

(3) Install rack preload spring (fig. 2J-15). Bowed side of spring must bear against lock rack when rack is installed.

(4) Assemble lock bolt and lock rack (fig. 2J-18).

(5) Install assembled lock bolt and lock rack in housing. Mate block tooth of lock rack with block tooth of sector (fig. 2J-19).

(6) Install key-release lever return spring over post in housing (fig. 2J-20). Insert release lever finger in lock rack slot and position hole in lever over threaded hole in housing post (fig. 2J-21). Be sure inner end of spring contacts release lever.

(7) Raise key-release lever slightly and install end of release lever spring between lever and housing boss (fig. 2J-22).

(8) Coat wave washer with chassis grease and install washer on post and over release lever (fig. 2J-13).

(9) Position shroud on housing and install attaching screws. Tighten screws to 18 inch-pounds (2 N•m) torque. Do not displace release lever wave washer when assembling shroud and housing.

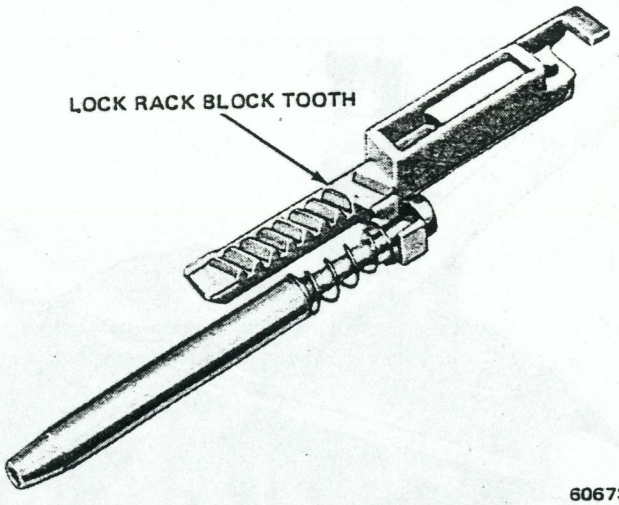


Fig. 2J-18 Assembling Lock Bolt and Lock Rack

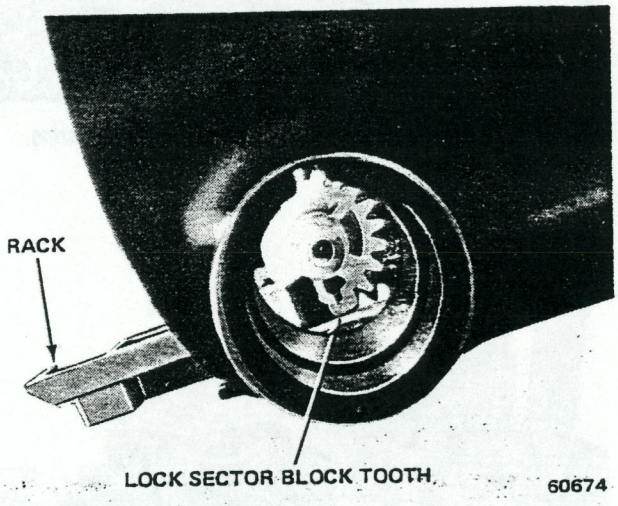


Fig. 2J-19 Lock Bolt and Lock Rack Installation

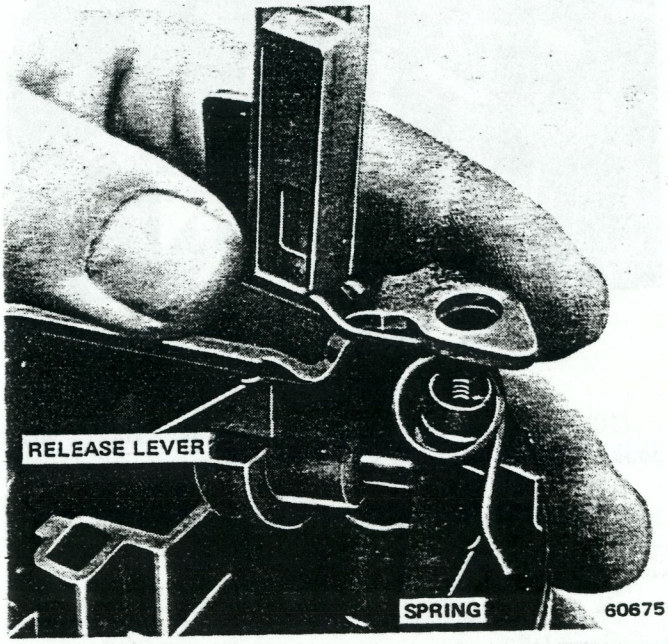


Fig. 2J-20 Key Release Lever and Spring Installation

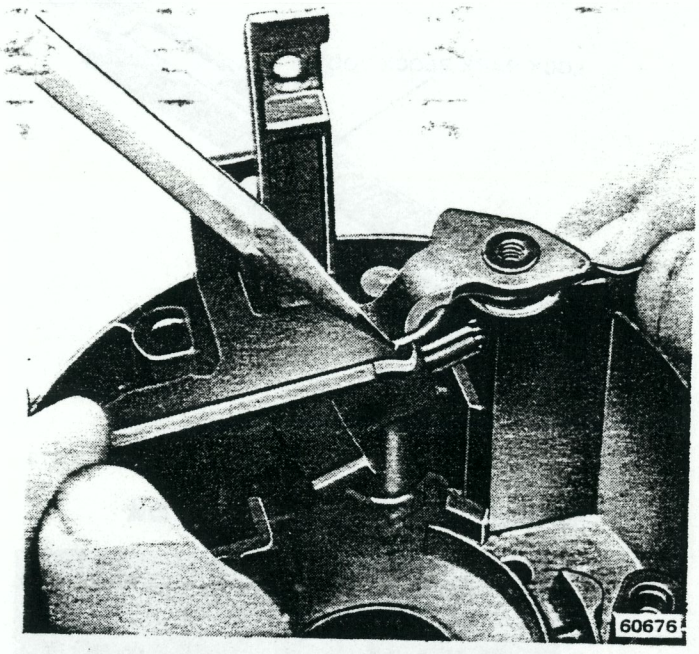


Fig. 2J-21 Positioning Key Release Lever Spring

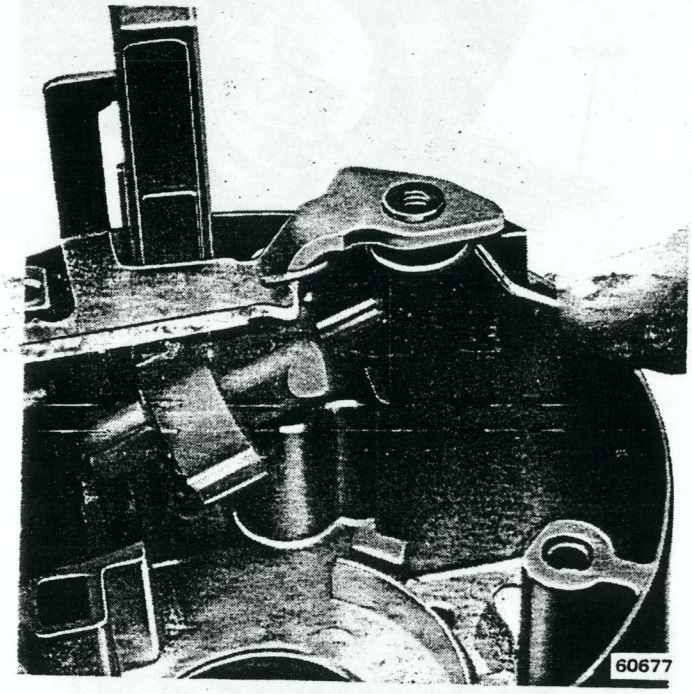


Fig. 2J-22 Securing Key Release Lever Spring

(10) Install remote rod on lock rack. Insert short hooked end of rod in lock rack.

(11) Install assembled shroud and housing on column and install attaching screws (fig. 2J-11). Tighten screws to 60 inch-pounds (7 N•m) torque.

(12) Install lock cylinder in housing. Insert key in lock, hold cylinder sleeve, and rotate key clockwise until key stops (this retracts actuator).

(13) Insert lock cylinder in housing bore with cylinder tab aligned with keyway in housing. Push cylinder inward until it bottoms. Rotate key counterclockwise until drive section of cylinder mates with sector. Push cylinder in fully until tab engages in housing groove.

(14) Turn lock cylinder clockwise to stop, then counterclockwise to Off-Unlock position.

(15) Install ignition switch as follows:

(a) Position switch on column jacket (fig. 2J-23).

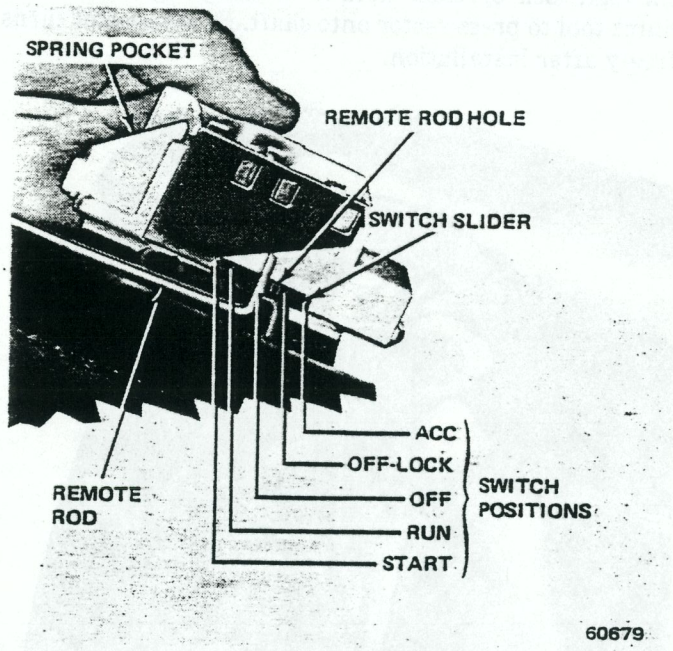


Fig. 2J-23 Positioning Ignition Switch

(b) Move switch slider to extreme left to Accessory position.

(c) Move slider two positions to right from Accessory position to Off-Unlock position.

(d) Insert remote rod into hole in switch slider.

(e) Position switch on column and install attaching screws. Tighten screws to 35 inch-pounds (4 N•m) torque.

(16) Install lower bearing, bearing adapter, retainer, and snap ring in lower end of column.

(17) Install steering shaft through lower end of column and into upper bearing in housing.

(18) Install turn signal switch and wire harness. Fold wires against connector, and feed connector through housing and shroud.

(19) Align turn signal switch in housing and install switch attaching screws. Tighten screws to 35 inch-pounds (4 N•m) torque.

(20) On vehicles without Cruise Command, install turn signal lever. Tighten lever attaching screw to 35 inch-pounds (4 N•m) torque.

(21) On vehicles with Cruise Command, install lever and switch assembly. Use string previously taped in

place to guide wires into housing. Remove string and tape. Connect wires to switch terminal and install lever attaching screw. Tighten screw to 35 inch-pounds (4 N•m) torque.

(22) Install thrust washer, upper bearing preload spring, and canceling cam on steering shaft. Position canceling cam as shown in figure 2J-24.

(23) Place turn signal switch in neutral position and install hazard warning switch knob.

(24) Position lock plate on steering shaft.

(25) Install replacement steering shaft snap ring on sleeve of Compressor Tool J-23653 and install tool on steering shaft (fig. 2J-25).

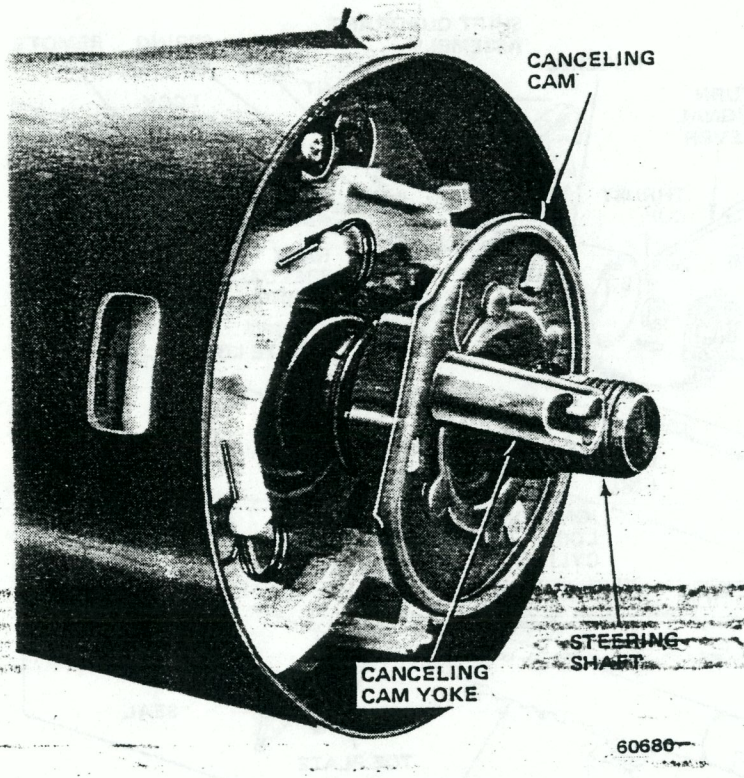


Fig. 2J-24 Positioning Canceling Cam

CAUTION: *Identify the steering shaft nut thread type before using the compressor tool. If the shaft has American threads, use the compressor tool as is. However, if the shaft has metric threads (fig. 2J-2), replace the compressor tool forcing screw with Metric Forcing Screw J-23653-4 before using the tool.*

(26) Compress lock plate and install snap ring in steering shaft groove (fig. 2J-25).

(27) Remove compressor tool. Be sure snap ring is fully seated before removing tool.

(28) Install lock plate cover.

(29) Remove Support Fixture Tool J-23074 if installed.

(30) Install column mounting bracket. Tighten bracket attaching bolts to 20 foot-pounds (27 N•m) torque.

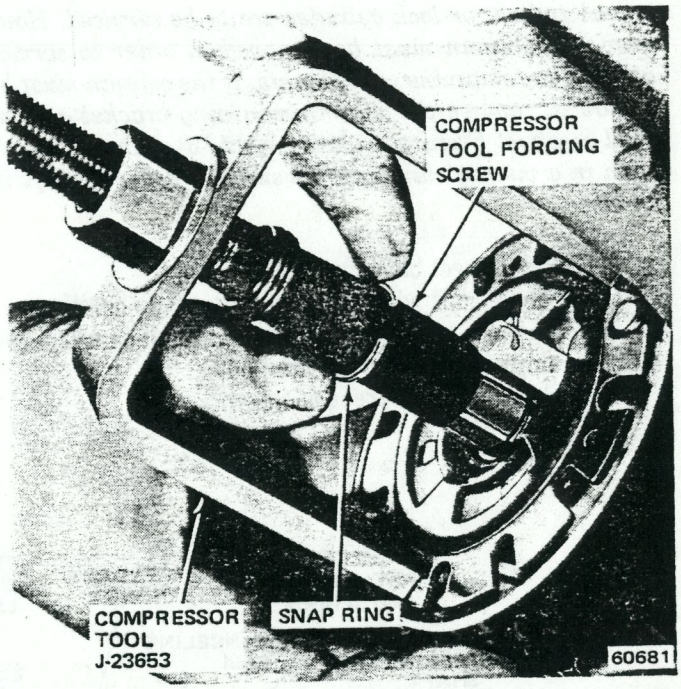


Fig. 2J-25 Steering Shaft Snap Ring Installation

(31) Connect column wiring harness connectors and install harness protector.

(32) Install steering wheel.

(33) Install and tighten steering wheel nut to 30 foot-pounds (41 N•m) torque.

CAUTION: *Some steering shafts have metric size steering wheel nut threads. If a replacement nut is being installed, identify the shaft thread-type before installation. Metric shafts have an identifying groove in the steering wheel locating splines (fig. 2J-2). American thread shafts do not have this groove.*

(34) Install column bezel.

(35) Install and tighten column bracket-to-instrument panel bolts to 20 foot-pounds (27 N•m) torque.

(36) Tighten toe plate bolts to 10 foot-pounds (14 N•m) torque.

(37) Remove protective covering from column painted areas.

(38) Connect battery negative cable.

STANDARD COLUMN OVERHAUL—AUTOMATIC TRANSMISSION

Column Disassembly

NOTE: *Steering column removal is not necessary if only the lock plate cover, lock plate, steering shaft snap ring, upper bearing preload spring, canceling cam, turn*

signal switch, or lock cylinder are to be serviced. However, the column must be removed in order to service any of the remaining components. If the column must be removed, remove the column mounting bracket and install Support Fixture J-23074 (fig. 2J-5). Mount the column in a vise by clamping the support fixture flange in the vise.

(1) Disconnect battery negative cable.

(2) Place front wheels in straight-ahead position.

(3) Remove column-to-instrument panel bezel and left air conditioning duct, if equipped.

(4) Cover painted areas of column.

(5) Remove steering wheel (fig. 2J-1).

(6) Remove lock plate cover (fig. 2J-26). Use two screwdrivers to pry cover off lock plate and out of housing.

(7) Compress lock plate and unseat steering shaft snap ring as follows:

(a) Inspect and identify steering shaft nut thread type. Metric shafts have identifying groove in steering wheel locating splines (fig. 2J-2). American thread shafts do not have this groove.

(b) If shaft has American threads, use Compressor Tool J-23653, as is, to compress lock plate and unseat snap ring (fig. 2J-6).

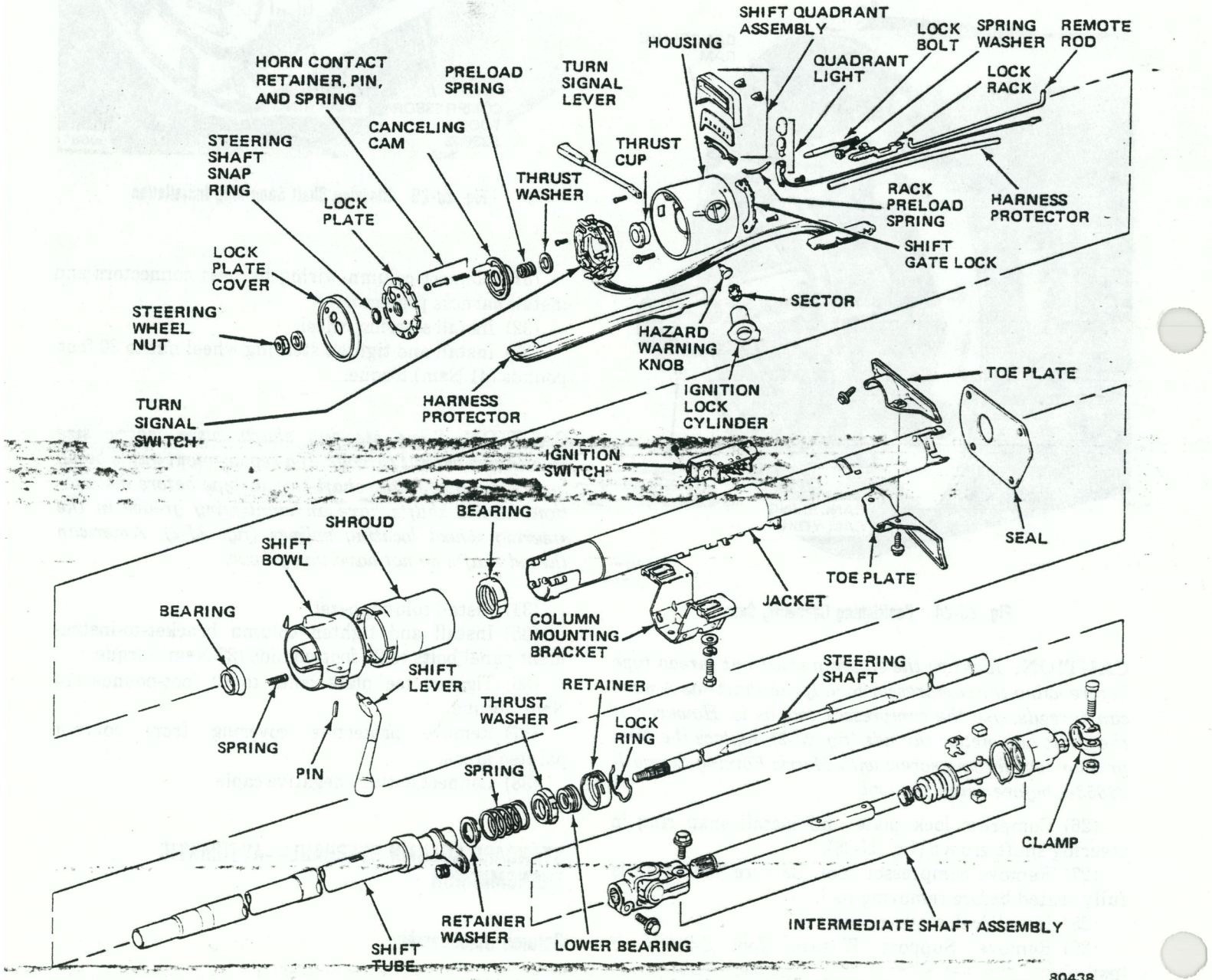


Fig. 2J-26 Steering Column—Automatic Transmission

(c) If shaft has metric nut threads, replace compressor tool standard forcing screw with Metric Forcing Screw J-23653-4 before installing tool on steering shaft.

WARNING: *The lock plate is under strong spring tension. Do not attempt to remove the snap ring without using the compressor tool.*

(8) Remove lock plate compressor tool and remove steering shaft snap ring. Discard snap ring.

CAUTION: *When the snap ring is removed, the steering shaft is free in the column. If the column is removed for bench overhaul, do not let the shaft fall out when the column is moved.*

(9) Remove lock plate, canceling cam, upper bearing preload spring, and thrust washer (fig. 2J-26).

(10) On vehicles without Cruise Command, remove turn signal lever attaching screw and remove lever.

(11) On vehicles with Cruise Command, remove wires from switch terminal. Fold two of four wires back along harness. Tape wires in place and tape length of string to harness to aid removal.

(12) Push inward on hazard warning switch knob and unthread knob in counterclockwise direction.

(13) Place gearshift lever in Park position. Remove lever retaining pin using punch and remove lever.

(14) Unhook turn signal switch wire harness connector from column.

(15) Disconnect turn signal switch harness connector from instrument panel harness connector (fig. 2J-7). Lift connector lock tab to separate connectors.

(16) Using stiff wire or paper clip, compress lock tab retaining shift quadrant light wire in connector block and disconnect wire.

(17) Remove column lower bracket and plastic harness protector.

(18) Remove column-to-instrument panel mounting bracket if turn signal switch is to be removed with column mounted in vehicle.

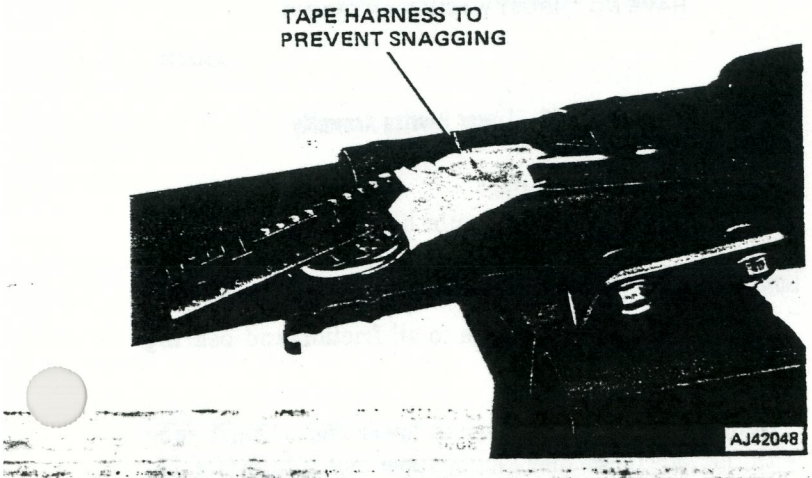


Fig. 2J-27 Turn Signal Switch Harness Removal

(19) Wrap tape around turn signal switch harness connector to prevent snagging (fig. 2J-27).

(20) Remove turn signal switch attaching screws and remove switch and harness. Pull switch straight up and out of column.

(21) On vehicles with Cruise Command, remove turn signal lever attaching screw and remove lever and switch as assembly. Guide switch harness out of column using string previously taped to harness.

(22) Place lock cylinder in LOCK position. Compress lock cylinder retaining tab and remove lock cylinder (fig. 2J-9).

NOTE: *The retaining tab is accessible through the tab slot in the housing (fig. 2J-9). If the tab is not visible through the slot, scrape or knock all casting flash from the slot.*

(23) Remove ignition switch from lower end of column.

(24) Remove upper housing attaching screws and remove upper housing.

NOTE: *The remote rod and shift quadrant light wire, if equipped, will be removed as an assembly along with the upper housing.*

(25) Remove thrust cup from upper housing (fig. 2J-28).

(26) Remove lock bolt and lock rack and remove rack preload spring (fig. 2J-29).

(27) Remove lock sector from sector shaft using blunt punch (fig. 2J-19). Note lock sector position for assembly reference and remove sector through lock cylinder hole in housing.

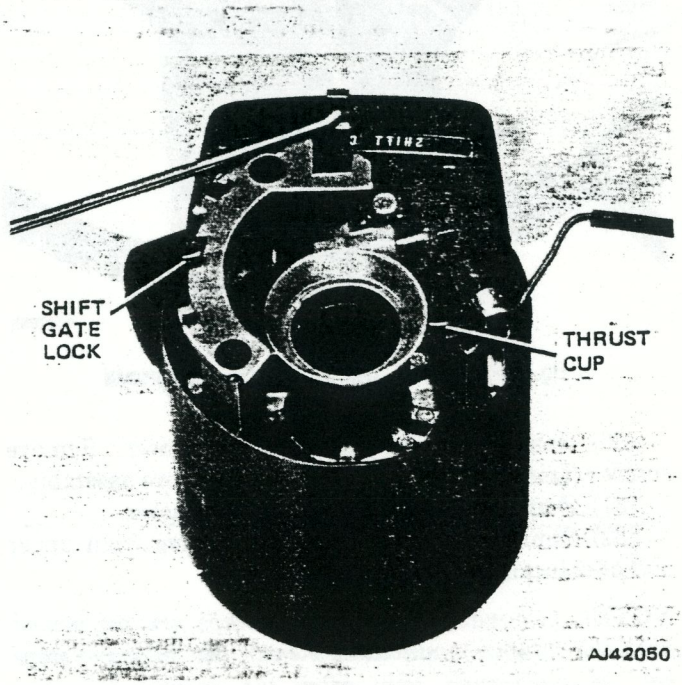


Fig. 2J-28 Thrust Cup Position

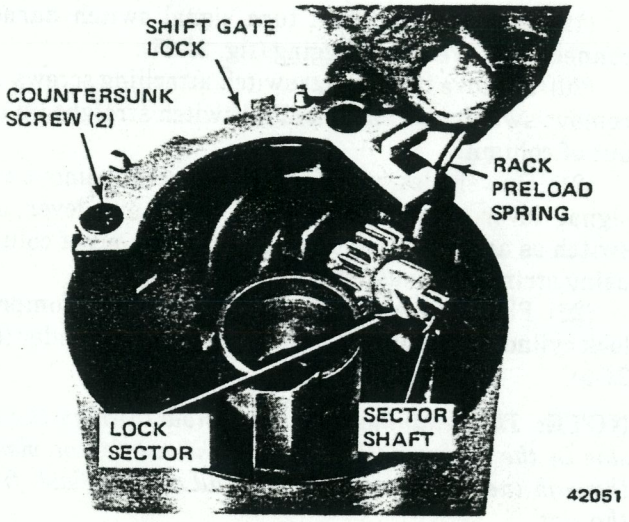


Fig. 2J-29 Housing Components

(28) Remove shift gate lock from upper housing. Examine shift gate lock detents for wear. Replace lock if excessively worn.

(29) Remove shift quadrant. Quadrant is retained by two clips which must be pried out with small punch (fig. 2J-30).

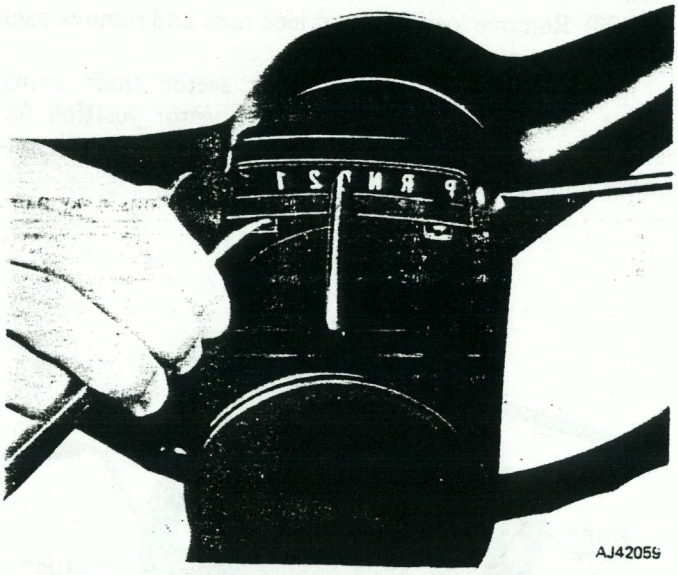


Fig. 2J-30 Shift Quadrant Retainer Clip Removal

(30) Remove shift quadrant light cover. Remove screw retaining socket assembly and remove assembly.

(31) Remove shift bowl from column jacket.

(32) Remove nylon lower bowl bearing from upper end of column tube (fig. 2J-31).

NOTE: *Although the preceding steps are performed with the column mounted in the car, the following steps can be performed only after the column has been removed.*

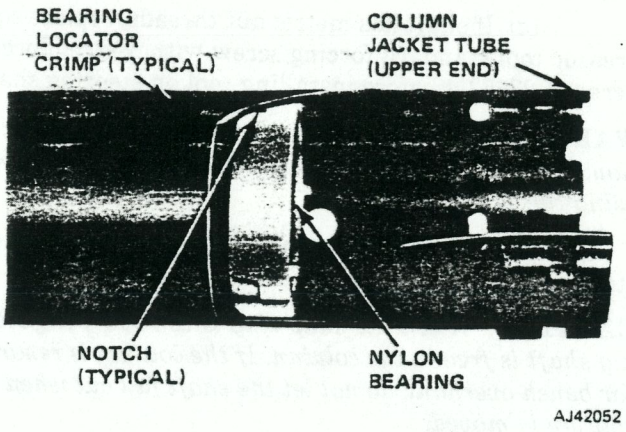


Fig. 2J-31 Shift Bowl Lower Bearing Position

(33) Remove column from vehicle. Refer to Steering Column Removal.

(34) Remove steering shaft from lower end of column.

(35) Remove lower bearing retainer, retainer ring, lower bearing preload spring, and nylon washer (fig. 2J-32).

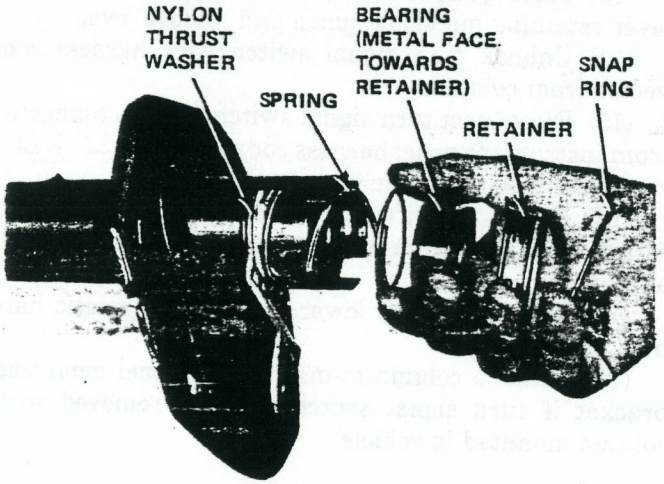


Fig. 2J-32 Lower Bearing Assembly

(36) Remove shift tube.

(37) Remove nylon shift tube bearing from tube.

Column Assembly

(1) Apply chassis grease to all friction and bearing surfaces.

(2) Install shift tube.

(3) Install nylon washer in lower end of shift tube with flat side of washer facing upper end of tube (fig. 2J-32).

(4) Install preload spring, lower bearing (with metal face toward retainer), bearing retainer, and retainer ring.

(5) Install nylon lower bowl bearing in upper end of jacket.

NOTE: *The bearing must be installed with the smaller inside diameter facing the lower end of the jacket, and with the bearing notches engaged in the three locator crimps in the column (fig. 2J-31).*

(6) Align shift bowl with shift tube spline and install bowl.

(7) Install rack preload spring in upper housing (fig. 2J-29).

(8) Position large end of sector on sector shaft and press sector in place using blunt punch (fig. 2J-17).

(9) Install shift gate lock and install two countersunk attaching screws (fig. 2J-28). Tighten screws to 45 inch-pounds (5 N•m) torque.

(10) Install shift quadrant lamp and lamp cover.

(11) Install shift quadrant indicator and press retainer clips into place with flat side toward bowl.

(12) Assemble lock bolt and lock rack (fig. 2J-18).

(13) Install assembled lock bolt and lock rack in shift bowl (fig. 2J-33).

NOTE: *The block tooth of the lock rack must engage the block tooth of the sector (fig. 2J-19).*

(14) Install nylon thrust cup in upper housing with flared end of cup facing outward (fig. 2J-28).

(15) Rotate shift bowl counterclockwise to stop and install upper housing. Tighten housing attaching screws to 60 inch-pounds (7 N•m) torque.

NOTE: *The shift bowl must be in the Park position and the rack pulled downward before the upper housing can be installed.*

(16) Guide shift quadrant lamp wire and remote lock rod into position between shift bowl and column jacket.

(17) Install turn signal switch and harness assembly in column.

(18) Remove tape from turn signal switch wire harness connector and position harness in protector and protector-to-column jacket.

(19) Install turn signal switch retaining screws. Be sure switch actuating lever pivot is correctly aligned and seated in upper housing pivot boss before installing screws.

(20) On vehicles without Cruise Command, install turn signal lever and lever attaching screw. Tighten screw to 35 inch-pounds (4 N•m) torque.

(21) On vehicles with Cruise Command, install turn signal lever and switch assembly. Guide wires into housing using string previously taped in place. Remove string and tape. Connect wires to switch terminals. Install lever attaching screw and tighten screw to 35 inch-pounds (4 N•m) torque.

(22) Install steering shaft if removed. Install shaft through lower end of column and into upper bearing.

(23) Install thrust washer, upper bearing preload spring, and canceling cam on upper end of steering shaft.

(24) Align lock plate splines with steering shaft splines and install lock plate. Be sure canceling cam shaft protrudes through opening in lock plate (fig. 2J-34).

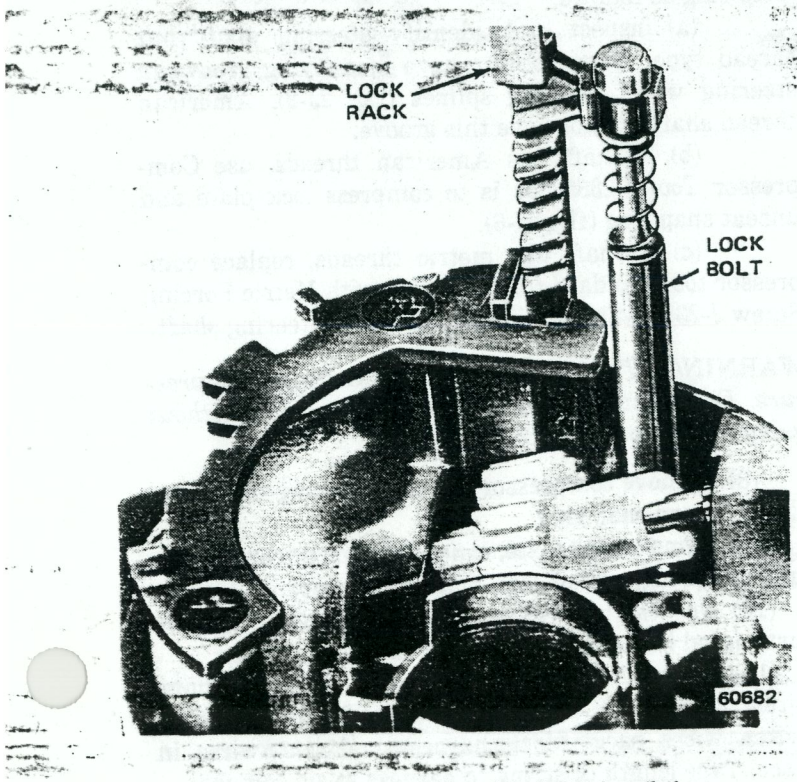


Fig. 2J-33 Lock Rack and Lock Bolt Installation

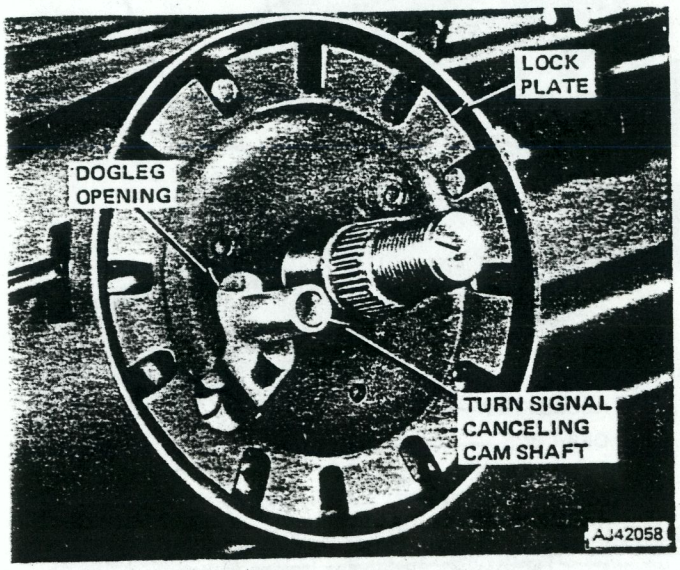


Fig. 2J-34 Canceling Cam and Lock Plate Position

(25) Install replacement steering shaft snap ring on sleeve of Lock Plate Compressor Tool J-23653 and install tool on steering shaft (fig. 2J-25).

CAUTION: *Inspect and identify the steering shaft nut thread type before installing the compressor tool. If the shaft has metric threads (fig. 2J-2), be sure to replace the compressor tool standard forcing screw with Metric Forcing Screw J-23653-4 before installing the tool on the shaft.*

(26) Compress lock plate and seat snap ring in steering shaft groove.

(27) Remove compressor tool.

(28) Install lock plate cover.

(29) Align canceling cam and index marks on steering shaft and steering wheel and install steering wheel. Tighten steering wheel nut to 30 foot-pounds (41 N•m) torque.

CAUTION: *Some steering shafts have metric threads. Be sure to obtain and install the proper thread-type nut. Metric thread shafts have an identifying groove in the steering wheel locating splines (fig. 2J-2).*

(30) Install hazard warning light switch knob and steering wheel trim cover.

(31) Install gearshift lever.

(32) Install lock cylinder in housing.

(33) Place shift bowl in any position except Park and rotate bowl counterclockwise until lock rack bottoms against lower surface of bowl.

(34) Install ignition switch on column:

(a) Move switch slider toward left to Accessory position.

(b) Move slider two positions toward right to Off-Unlock position (fig. 2J-35).

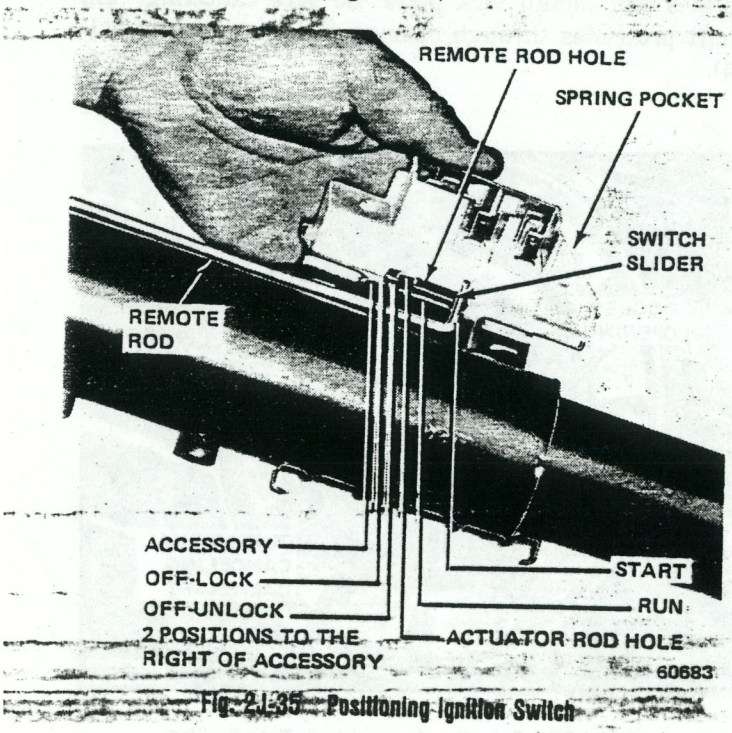


Fig. 2J-35 Positioning Ignition Switch

(c) Insert remote rod into slider hole and attach ignition switch to column. Tighten switch attaching screws to 35 inch-pounds (4 N•m) torque.

(35) Install column if removed. Refer to Steering Column Installation.

(36) Install lower finish panel, air conditioning duct if equipped, and column-to-instrument panel bezel.

(37) Remove protective covering from painted areas of column.

(38) Connect battery negative cable.

TILT COLUMN OVERHAUL—CHEROKEE-WAGONEER-TRUCK MODELS

Column Disassembly

NOTE: *Although it is possible to disassemble the tilt steering column down to the housing with the column in the vehicle, the column must be removed if more extensive disassembly is necessary. If the column is removed, use Steering Column Support Fixture J-23074 to mount the column assembly in a vise (fig. 2J-5).*

(1) Place front wheels in straight-ahead position.

(2) Disconnect battery negative cable.

(3) Cover painted areas of column.

(4) Remove steering wheel.

(5) Remove gearshift lever retaining pin and remove gearshift lever.

(6) Remove lock plate cover. Use two screwdrivers to pry cover off lock plate and out of housing.

(7) Compress lock plate and unseat steering shaft snap ring as follows:

(a) Inspect and identify steering shaft nut thread type. Metric shafts have identifying groove in steering wheel locating splines (fig. 2J-2). American thread shafts do not have this groove.

(b) If shaft has American threads, use Compressor Tool J-23653 as is to compress lock plate and unseat snap ring (fig. 2J-6).

(c) If shaft has metric threads, replace compressor tool standard forcing screw with Metric Forcing Screw J-23653-4 before installing tool on steering shaft.

WARNING: *The lock plate is under strong spring pressure. Do not attempt to remove the lock plate without using the compressor tool.*

(8) Remove compressor tool and steering shaft snap ring. Discard snap ring.

(9) Remove lock plate, canceling cam, upper bearing preload spring, spring seat, and bearing race.

(10) On vehicles without Cruise Command, remove turn signal lever attaching screw and remove lever.

(11) On vehicles with Cruise Command, remove wires from switch terminal in lever. Fold two of four switch wires back along harness and tape wires in place. Tape length of string to harness to aid removal.

(12) Press hazard warning light switch knob inward and remove knob by turning counterclockwise.

(13) Unhook turn signal switch wire harness connector from mounting bracket on lower right side of column jacket.

(14) Loosen toeplate bolts.

(15) Remove bolts attaching column mounting bracket to steering column.

(16) Remove bolts attaching mounting bracket to instrument panel and remove mounting bracket.

(17) Remove wire harness plastic protector from column jacket.

(18) Wrap tape around harness connector to prevent snagging (fig. 2J-27).

(19) Remove turn signal switch retaining screws and remove switch and wire harness. Pull switch straight up and out of column.

(20) On vehicles with Cruise Command, remove turn signal lever attaching screw and remove lever and switch. Guide switch wire harness out of column using string previously taped to harness.

(21) Insert ignition key in lock cylinder and turn cylinder to LOCK position.

(22) Compress lock cylinder retaining tab and remove lock cylinder (fig. 2J-9).

NOTE: *The retaining tab is accessible through the tab slot in the housing (fig. 2J-9). If the tab is not visible through the slot, remove all casting flash from the slot.*

(23) Remove spring clips retaining shift quadrant using punch or long needlenose pliers and remove quadrant (fig. 2J-30).

(24) Remove shift quadrant mounting bracket and light socket.

(25) Remove tilt lever.

(26) Remove cover retaining screws and remove cover from column.

(27) Remove lock sector tension spring retaining screw. Unhook spring from lock sector shaft and remove spring.

(28) Remove snap ring from lock sector shaft and remove lock sector, sector shaft, and retaining ring.

(29) Install tilt lever and place upper housing in full upward tilt position.

(30) Insert screwdriver in tilt spring retainer slot and compress retainer approximately 3/16 inch (4.7 mm). Rotate retainer 1/8 turn counterclockwise and remove retainer and spring.

WARNING: *The tilt spring is under strong spring tension.*

(31) Place housing in center (nontilt) position.

(32) Remove housing pivot pins using tool J-21854-1 (fig. 2J-36).

(33) Lift tilt lever to disengage lock shoes and remove housing. Remove both ball bearing assemblies from housing if bearings are to be replaced.

(34) Remove tilt lever.

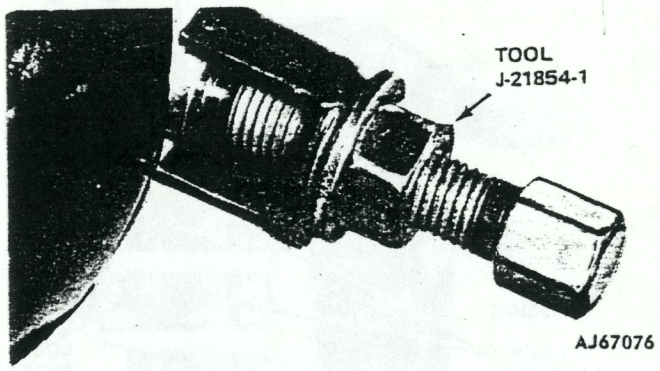


Fig. 2J-36 Pivot Pin Removal

(35) Remove release lever pin from housing using pin punch or tool J-22635 (fig. 2J-37).

NOTE: *When removing the release lever pin, compress the lock shoe springs to relieve spring tension on the pin.*

(36) Remove lock shoe pin from housing using pin punch or tool J-22635 (fig. 2J-38).

NOTE: *When removing the lock shoe pin, compress the lock shoe springs to relieve spring tension on the pin (fig. 2J-38).*

(37) Remove lock shoes and lock shoe springs.

(38) Disconnect steering shaft at intermediate shaft coupling. Remove steering shaft through upper end of column.

(39) Disassemble steering shaft by folding shaft at 90° and separating upper and lower halves of shaft at flexible joint (fig. 2J-39).

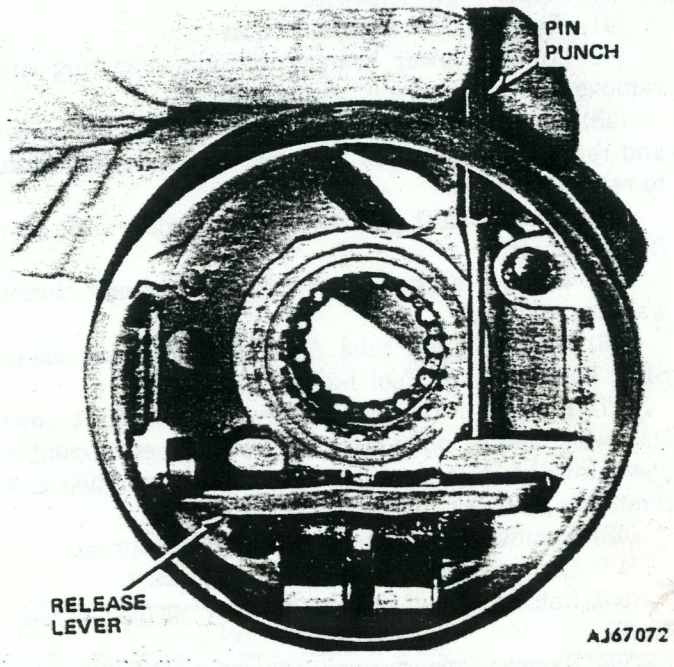


Fig. 2J-37 Release Lever Pin Removal

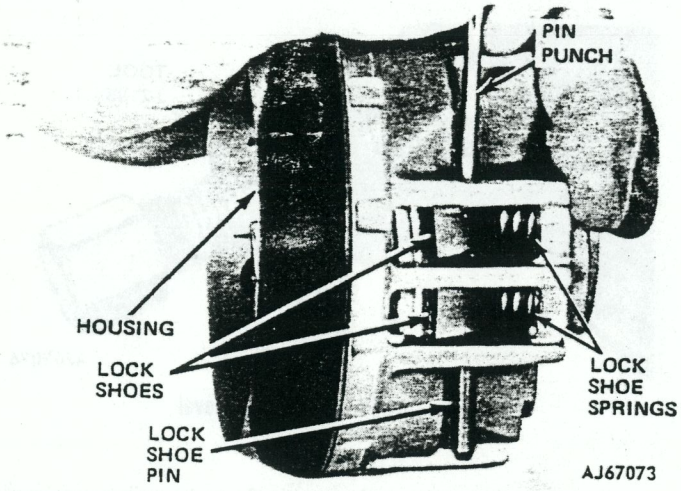


Fig. 2J-38 Lock Shoe Pin Removal

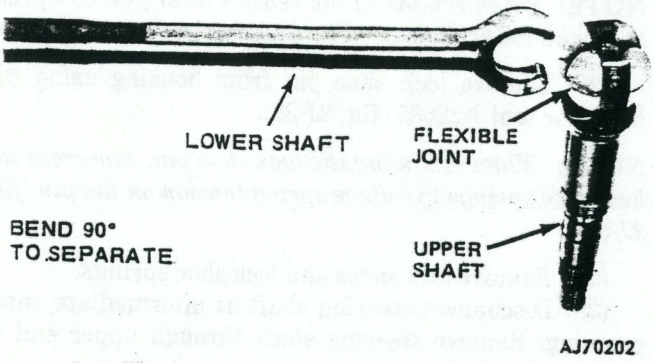


Fig. 2J-39 Steering Shaft Assembly

(40) Remove ignition switch.

(41) Remove lock rack and remote rod.

(42) Remove lower bearing retainer snap ring and remove retainer, bearing, and adapter.

(43) Remove screws attaching support to shift bowl and remove support. Use 1/4-inch, 12-point deep socket to remove screws.

(44) Remove shift gate screws and remove shift gate from support.

(45) Remove shift tube retaining ring and thrust washer.

(46) Remove shift tube from column jacket using Shift Tube Remover Tool J-23072 (fig. 2J-40).

(47) Remove retainer plate by rotating shift bowl clockwise, sliding plate out of jacket notches, tipping it down toward shift bowl hub at 12 o'clock position and removing plate-bottom side first (fig. 2J-41).

(48) Remove wave washer and shift tube spring.

(49) Remove shift bowl from column jacket.

(50) Remove lower bearing retainer spring clip (fig. 2J-42).

(51) Remove lower bearing retainer and remove lower bearing, and bearing adaptor assembly.

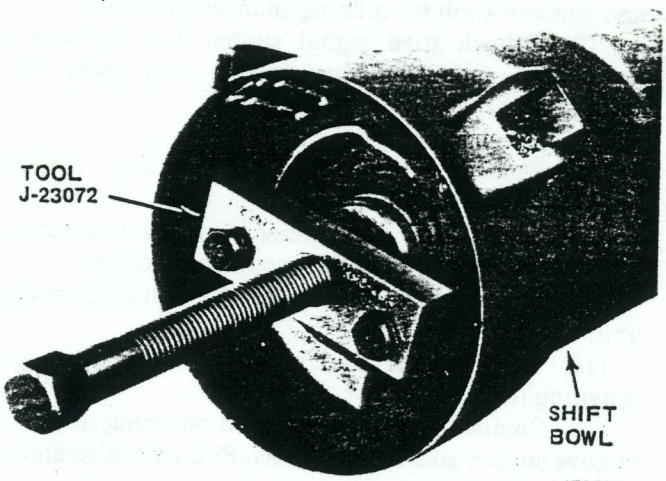


Fig. 2J-40 Shift Tube Removal

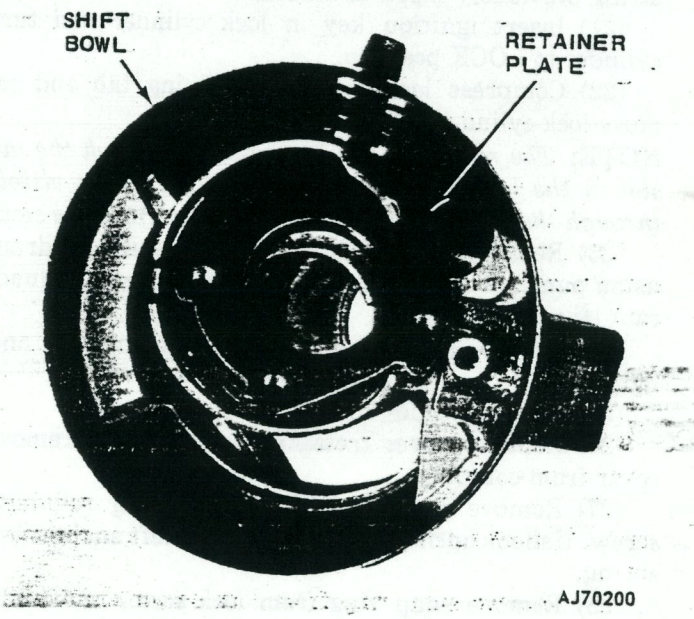


Fig. 2J-41 Retainer Plate Removal

Column Assembly

(1) Coat all bearing and friction surfaces with chassis grease.

(2) Mount shift bowl on column jacket.

(3) Install shift tube spring, wave washer, and retainer plate in shift bowl.

(4) Install shift tube through lower end of column jacket and align tube spline with shift bowl keyway.

(5) Insert Installer Tools J-23073-2 and -4 in shift tube (fig. 2J-43). Spring-loaded lower foot of tool must engage shift tube inner shoulder and tool guide must be seated in shift tube.

(6) Tighten tool spring tension nut to snug fit.

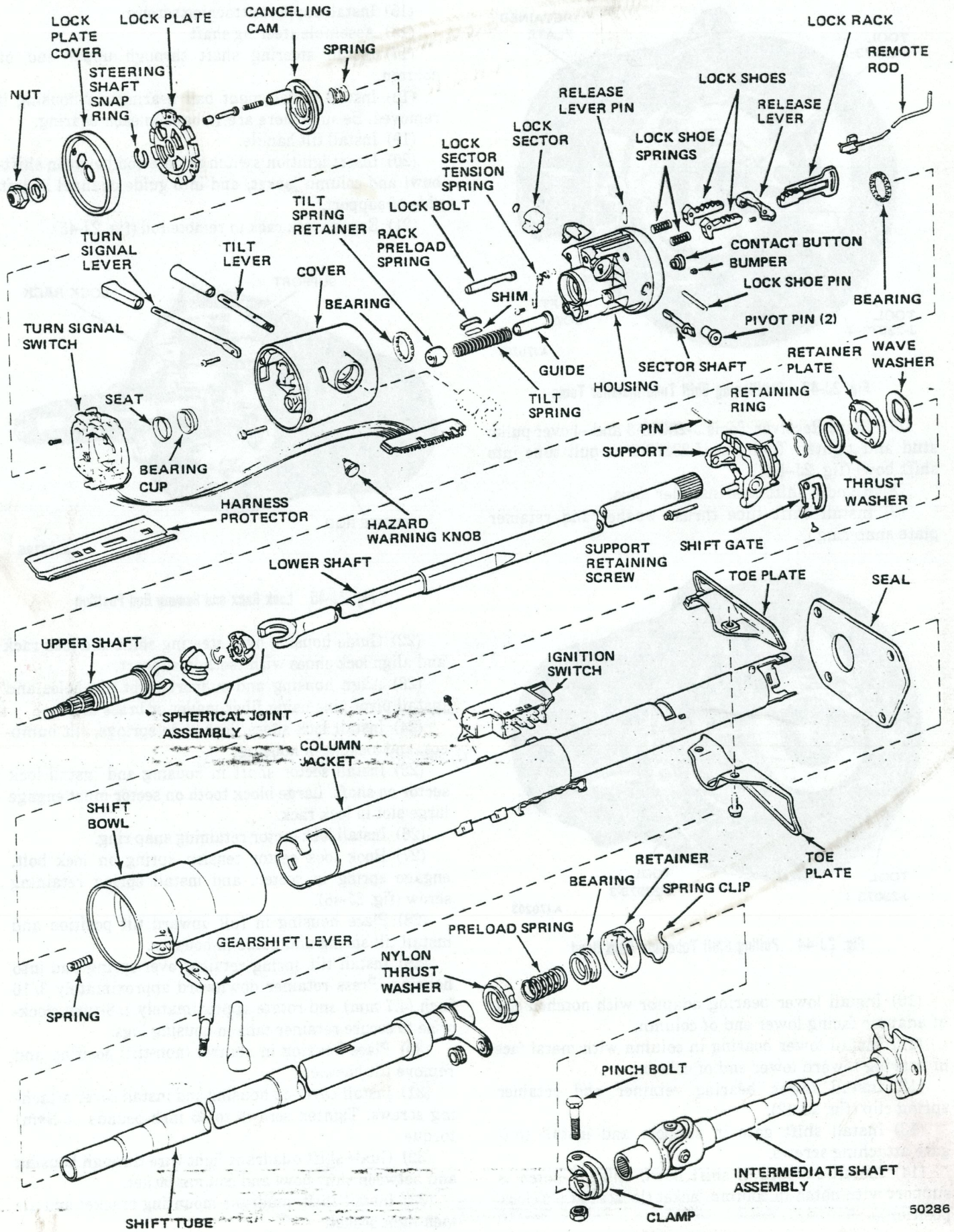


Fig. 2J-42 Tilt Steering Column—Cherokee-Wagoneer-Truck Models

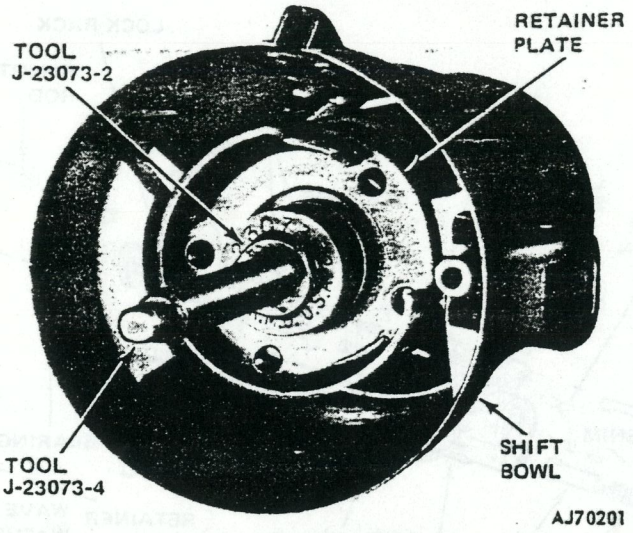


Fig. 2J-43 Positioning Shift Tube Installer Tools

(7) Place Receiver Tools J-23073-3 and -4 over puller stud and tighten Tool Nut J-23073-2 to pull tube into shift bowl (fig. 2J-44).

(8) Remove shift tube installer tools.

(9) Install shift tube thrust washer and retainer plate snap ring.

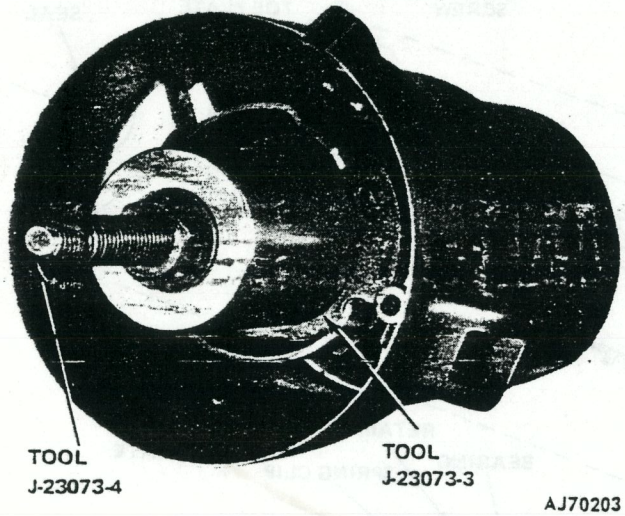


Fig. 2J-44 Pulling Shift Tube into Shift Bowl

(10) Install lower bearing adaptor with notched end of adaptor facing lower end of column.

(11) Install lower bearing in column with metal face of bearing toward lower end of column.

(12) Install lower bearing retainer and retainer spring clip (fig. 2J-42).

(13) Install shift gate in support and install shift gate attaching screws.

(14) Install support in shift bowl. Align V-notch in support with notch in column jacket (located at 9 o'clock position).

(15) Install support attaching screws.

(16) Assemble steering shaft.

(17) Install steering shaft through upper end of column.

(18) Install replacement ball bearings in housing if removed. Be sure there are 14 balls in each bearing.

(19) Install tilt handle.

(20) Insert ignition switch remote rod between shift-bowl and column jacket, and into guide channel in left side of support.

(21) Engage lock rack in remote rod (fig. 2J-45).

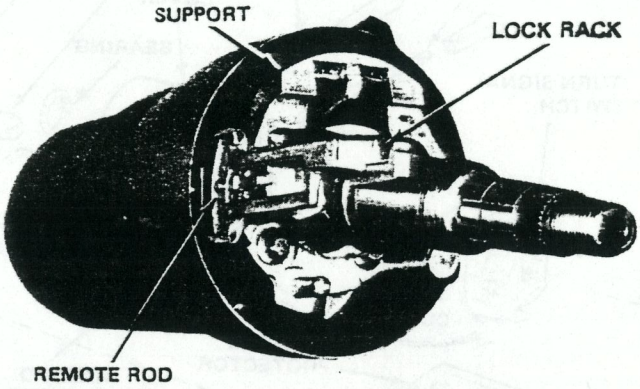


Fig. 2J-45 Lock Rack and Remote Rod Position

(22) Guide housing over steering shaft and lock rack and align lock shoes with teeth in support.

(23) Align housing and support pivot pin holes and install pivot pins using fiber mallet or brass drift.

(24) Install lock shoes, lock shoe springs, tilt bumpers and lockpin in housing.

(25) Install sector shaft in housing and install lock sector on shaft. Large block tooth on sector must engage large slot in lock rack.

(26) Install lock sector retaining snap ring.

(27) Hook lock sector tension spring on lock bolt, engage spring in sector, and install spring retaining screw (fig. 2J-46).

(28) Place housing in full upward tilt position and install tilt spring and guide in housing.

(29) Install tilt spring retainer over spring and into housing. Press retainer downward approximately 3/16 inch (4.7 mm) and rotate approximately 1/8-turn clockwise to secure retainer tabs in housing lugs.

(30) Place housing in neutral (non-tilt) position and remove tilt handle.

(31) Install cover on housing and install cover attaching screws. Tighten screws to 35 inch-pounds (4 N•m) torque.

(32) Guide shift quadrant light wire through housing and between shift bowl and column jacket.

(33) Install shift quadrant mounting bracket and attach light socket.

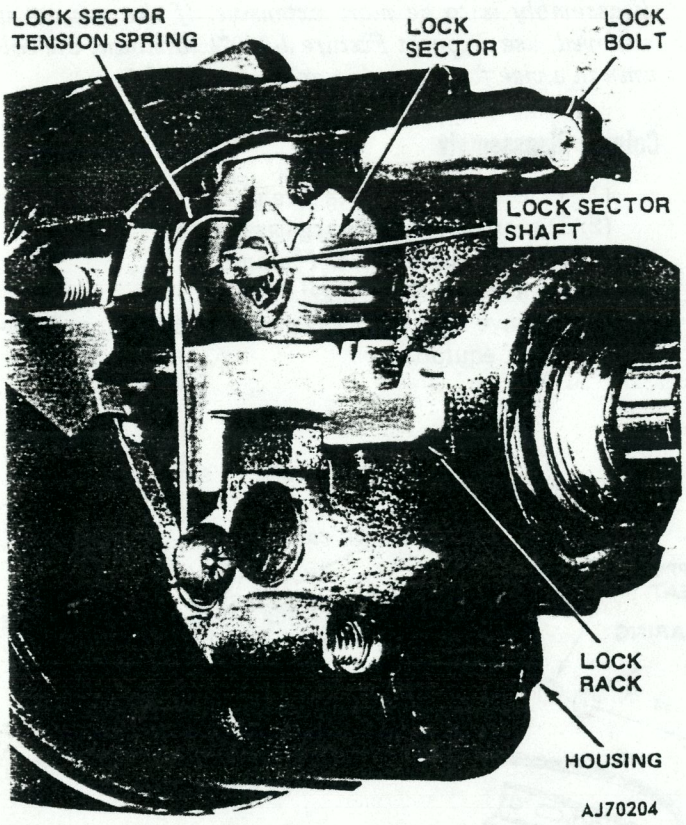


Fig. 2J-46 Lock Sector and Tension Spring Position

(34) Hook base of shift quadrant over tabs on left side of retainer and place in position.

(35) Install shift quadrant pointer in shift bowl and engage pointer in quadrant.

(36) Install quadrant retainer clips so flat side of clips face downward.

(37) Reinstall tilt handle.

(38) Install turn signal switch and switch harness in column. Guide switch wire harness between cover and column jacket.

(39) On vehicles without Cruise Command, install turn signal lever and lever attaching screw. Tighten screw to 35 inch-pounds (4 N•m) torque.

(40) On vehicles with Cruise Command, install turn signal lever and switch assembly. Guide switch wire harness into cover using string previously taped to harness. Remove tape from harness and connect wires to switch terminal. Install lever attaching screw and tighten screw to 35 inch-pounds (4 N•m) torque.

(41) Remove tape from turn signal switch harness connector and position wires in column harness protector.

(42) Align turn signal switch in cover and install switch attaching screws. Tighten screws to 35 inch-pounds (4 N•m) torque.

NOTE: *Be sure the switch actuating lever pivot is correctly aligned and seated in the housing pivot boss before installing the switch attaching screws.*

(43) Install mounting bracket on column. Tighten bracket-to-column bolts to 20 foot-pounds (27 N•m) torque.

(44) Position column mounting bracket on instrument panel and install bracket-to-instrument panel attaching bolts. Tighten bolts to 20 foot-pounds (27 N•m) torque.

(45) Tighten toeplate bolts to 10 foot-pounds (14 N•m) torque.

(46) Install upper bearing race, bearing seat, preload spring, and canceling cam on steering shaft.

(47) Align lock plate splines with steering shaft splines and install lock plate. Canceling cam shaft must protrude through opening in lock plate (fig. 2J-34).

(48) Install replacement steering shaft snap ring on sleeve of Compressor Tool J-23653 and install tool on steering shaft (fig. 2J-25).

CAUTION: *Identify the steering shaft nut thread type before installing the compressor tool on the shaft. If the shaft has American threads, use the compressor tool as is. However, if the shaft has metric threads (fig. 2J-2), replace the compressor tool standard forcing screw with Metric Forcing Screw J-23653-4 before using the tool.*

(49) Compress lock plate and seat snap ring in steering shaft groove (fig. 2J-25).

(50) Connect steering shaft to intermediate shaft coupling.

(51) Install gearshift lever in shift bowl. Guide lever over lock sector tension spring and into bowl. Align lever retaining pin holes with pin punch and install retaining pin using fiber mallet or brass drift.

(52) Install lock cylinder as follows:

(a) Insert ignition key in lock cylinder.

(b) Hold lock cylinder and turn key clockwise until it stops.

(c) Align cylinder retainer tab with keyway in cover and insert cylinder in cover.

(d) Push lock cylinder against lock sector. Rotate cylinder counterclockwise until cylinder engages in sector and push cylinder inward until cylinder retainer tab snaps into place.

(53) Install steering wheel. Tighten steering wheel nut to 30 foot-pounds (41 N•m) torque.

CAUTION: *Some steering shafts have metric size steering wheel nut threads. Be sure to install the proper thread-type nut. Metric shafts have an identifying groove in the steering wheel locating splines (fig. 2J-2). Shafts with American threads do not have this groove.*

(54) Install column if removed. Refer to Steering Column Installation. However, if column was serviced in vehicle, proceed to following steps.

(55) Install and tighten column mounting bracket bolts to 20 foot-pounds (27 N•m) torque.

(56) Position column mounting bracket on instrument panel and install panel-to-bracket nuts. Tighten nuts to 20 foot-pounds (27 N•m) torque.

(57) Install column bezel.

(58) Tighten toeplate screws to 10 foot-pounds (14 N•m) torque.

(59) Remove protective covering from column painted areas.

(60) Connect battery negative cable.

TILT COLUMN OVERHAUL—CJ MODELS

NOTE: *Although the tilt column (fig. 2J-47) can be disassembled down to the housing with the column mounted in the vehicle, the column must be removed if disassembly is to be more extensive. If the column is removed, use Support Fixture J-23074 to mount the column in a vise for service operations (fig. 2J-5).*

Column Disassembly

(1) Place front wheels in straight-ahead position.

(2) Disconnect battery negative cable.

(3) Cover painted areas of column.

(4) Remove steering wheel.

(5) Remove gearshift lever retaining pin and remove lever, if equipped.

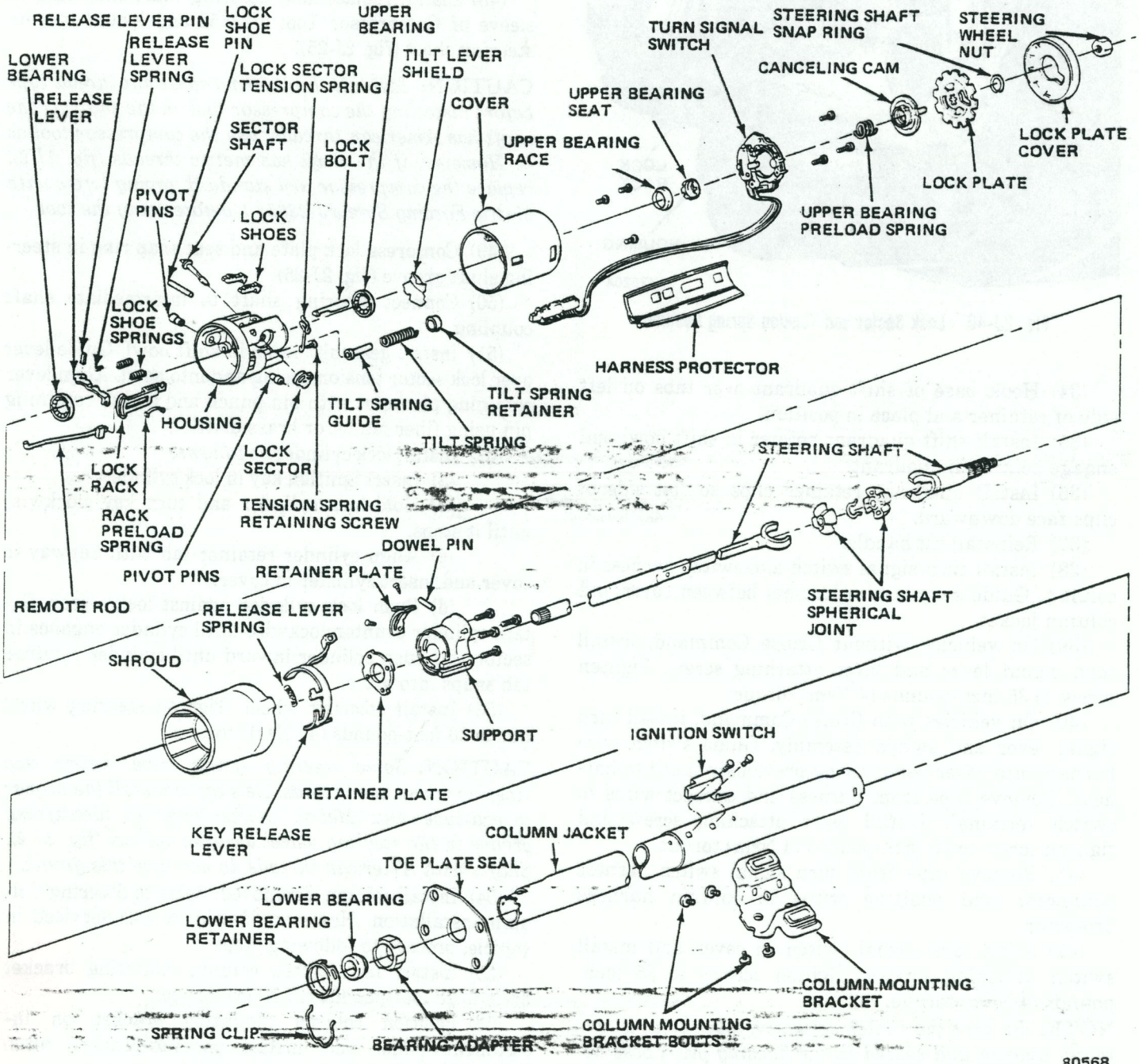


Fig. 2J-47 Tilt Steering Column—CJ Models

(6) Remove lock plate cover. Use two screwdrivers to pry cover off plate and out of column.

(7) Remove tilt and turn signal levers.

(8) Remove hazard warning knob. Press knob inward and turn in counterclockwise direction to remove.

(9) Compress lock plate and unseat steering shaft snap ring as follows:

(a) Inspect and identify steering shaft nut thread type. Metric shafts have identifying groove in steering wheel locating splines (fig. 2J-2). American thread shafts do not have this groove.

(b) If shaft has American threads, use tool J-23653, as is, to compress lock plate and unseat steering shaft snap ring (fig. 2J-6).

(c) If shaft has metric threads, replace compressor tool standard forcing screw with Metric Forcing Screw J-23653-4 before using compressor tool.

WARNING: *The lock plate is under strong spring pressure. Do not attempt to remove the snap ring without using the compressor tool.*

(10) Remove compressor tool and snap ring. Discard snap ring.

(11) Remove lock plate, canceling cam, and upper bearing preload spring (fig. 2J-47).

(12) Disconnect turn signal switch harness at lower right side of column jacket.

(13) Loosen all toeplate screws.

(14) Remove bolts attaching column mounting bracket to column jacket.

(15) Remove nuts attaching column mounting bracket to instrument panel bolts and remove mounting bracket.

(16) Remove wire harness protector from column jacket (fig. 2J-48).

(17) Wrap tape around harness connector to prevent snagging connector when removed (fig 2J-49).

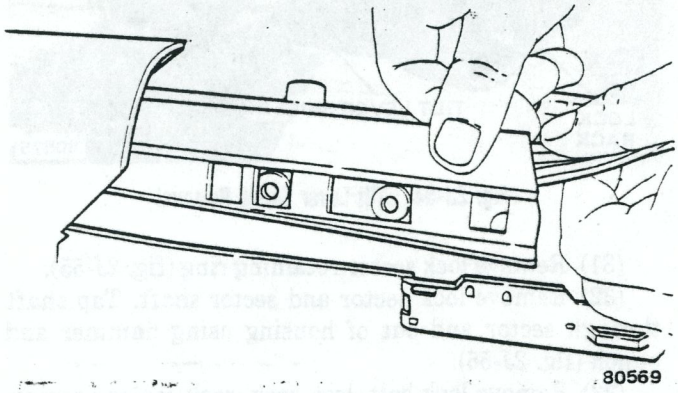


Fig. 2J-48 Harness Protector Removal

(18) Remove turn signal switch attaching screws and remove switch and harness. Pull switch straight up and out of column.

(19) Insert ignition key in ignition lock cylinder and turn cylinder to On position.

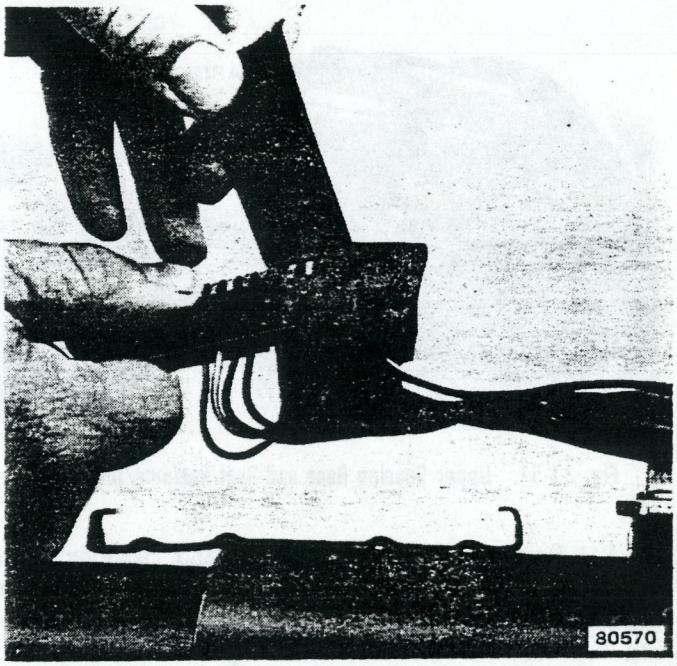


Fig. 2J-49 Taping Harness Connector

(20) Compress ignition lock cylinder retaining tab using thin bladed screwdriver and remove cylinder from column.

NOTE: *The retaining tab is accessible through the slot adjacent to the turn signal switch mounting boss (fig. 2J-9). If the tab is not visible through the slot, scrape or knock any casting flash out of the slot to provide access.*

(21) Remove cover retaining screws and remove cover from column (fig. 2J-50).

(22) Remove upper bearing race and bearing seat from steering shaft (fig. 2J-51).

(23) Reinstall tilt lever and place column in full upward tilt position.

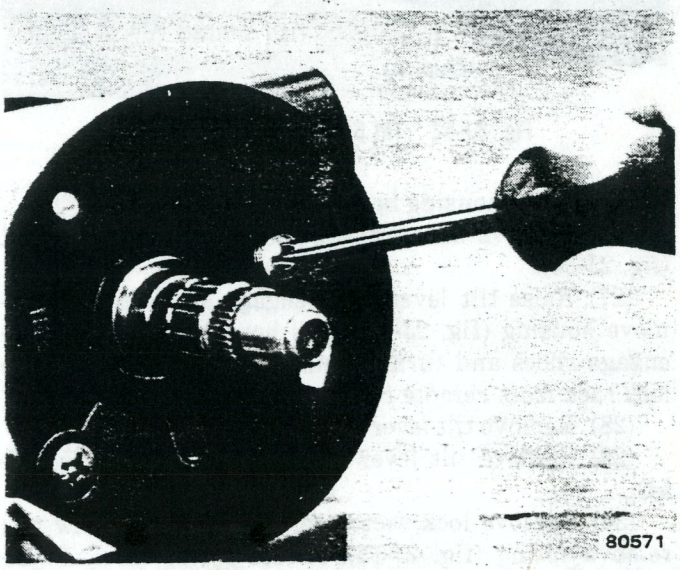


Fig. 2J-50 Cover Removal

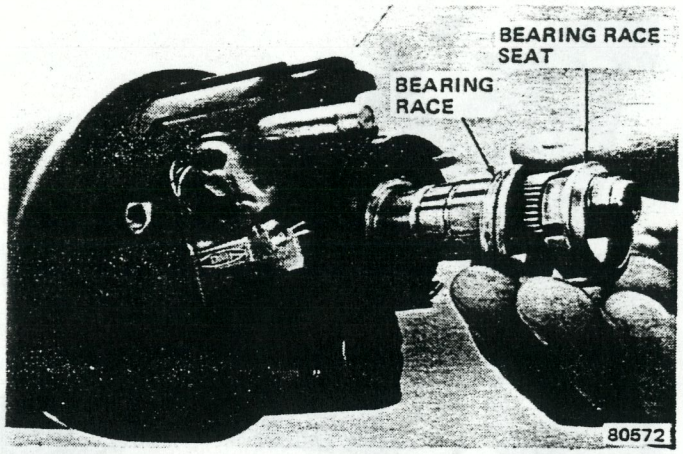


Fig. 2J-51 Upper Bearing Race and Seat Removal/Installation

(24) Remove tilt spring, guide, and retainer using screwdriver (fig. 2J-52). Press retainer inward and turn it counterclockwise until retainer tabs align with housing lugs. Be sure screwdriver blade just fits into retainer slot.

WARNING: *The tilt spring guide is under strong spring pressure.*

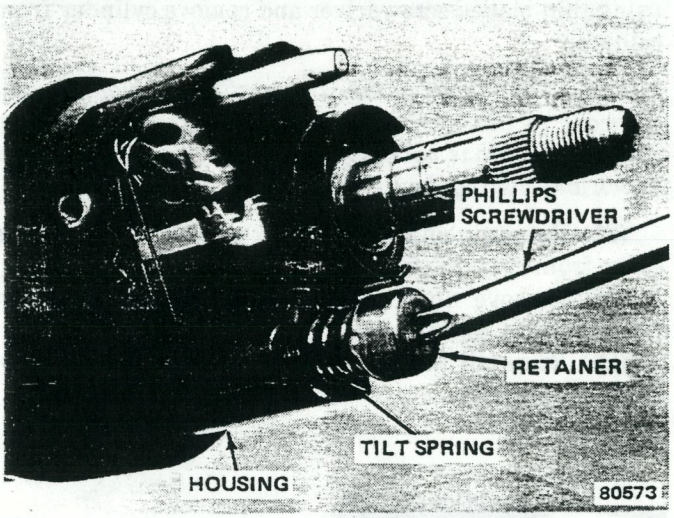


Fig. 2J-52 Tilt Spring and Guide Removal

(25) Place housing in center (nontilt) position.

(26) Remove housing pivot pins using tool J-21854-1 (fig. 2J-36).

(27) Raise tilt lever to disengage lock shoes and remove housing (fig. 2J-53). Pull housing upward to disengage shoes and turn housing to one side to separate lock rack from remote rod.

(28) Remove tilt lever from housing.

(29) Remove tilt lever shield from housing (fig. 2J-54).

(30) Remove lock sector spring retaining screw and remove spring (fig. 2J-55). Rotate spring in clockwise direction to remove it from bolt.

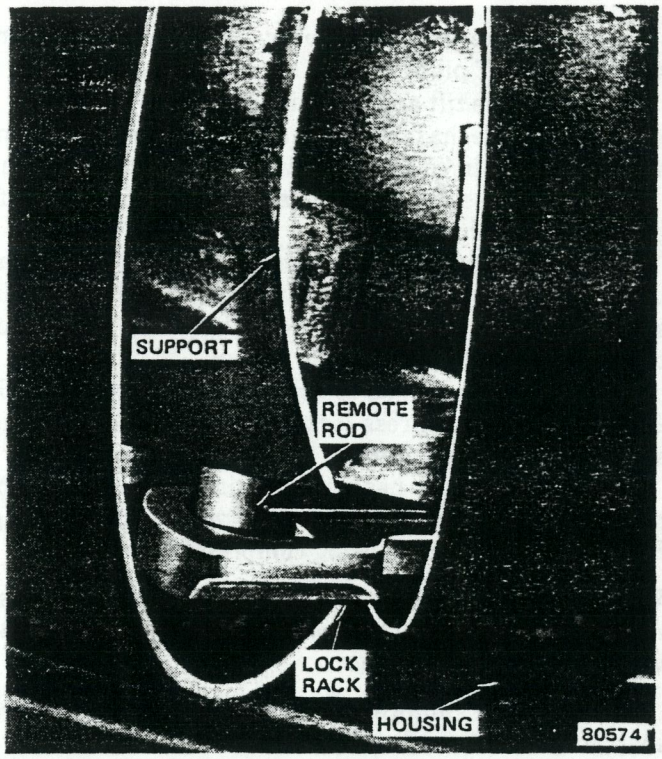


Fig. 2J-53 Housing Removal

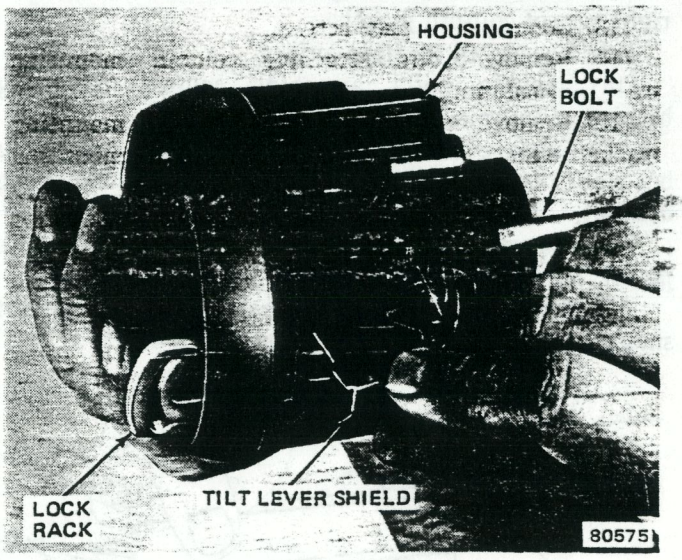


Fig. 2J-54 Tilt Lever Shield Removal

(31) Remove lock sector retaining ring (fig. 2J-55).

(32) Remove lock sector and sector shaft. Tap shaft through sector and out of housing using hammer and punch (fig. 2J-56).

(33) Remove lock bolt, lock rack, rack preload spring, spring shim, if equipped, and remote rod from housing.

(34) Insert wedge between lock shoes and housing to relieve spring tension on tilt and lock shoe pins (fig. 2J-57).

(35) Remove tilt lever pin from housing using tool J-22635 or pin punch (fig. 2J-37).

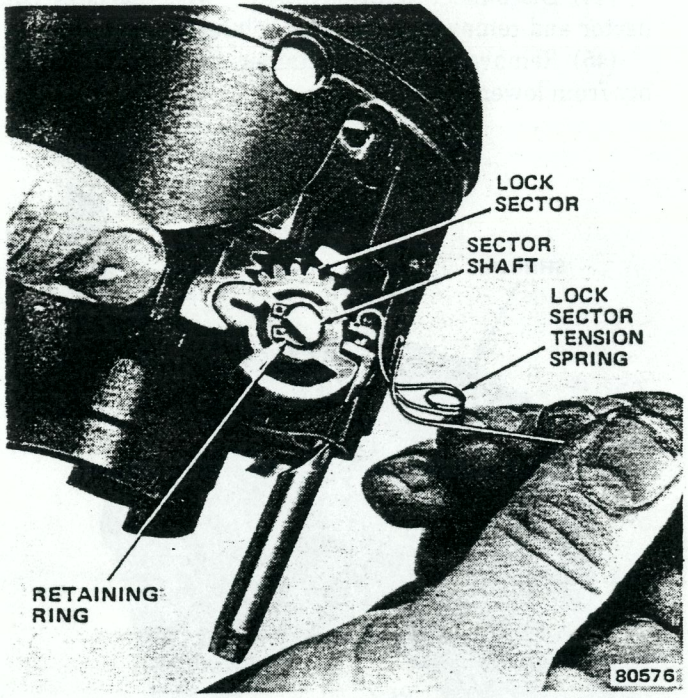


Fig. 2J-55 Lock Sector Tension Spring Removal/Installation

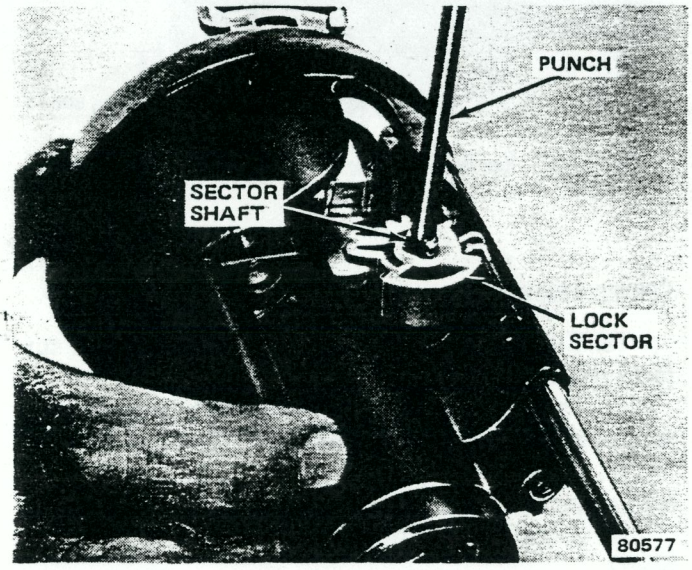


Fig. 2J-56 Lock Sector and Sector Shaft Removal

(36) Remove lock shoe pin from housing using tool J-22635 or pin punch (fig. 2J-38) and remove lock shoes, springs, and wedge.

(37) Remove housing upper and lower bearings and races only if damaged or worn. If bearings and races must be replaced, remove bearings and races using hammer and punch.

NOTE: *Discard the housing bearings and races if removed. They are not reusable.*

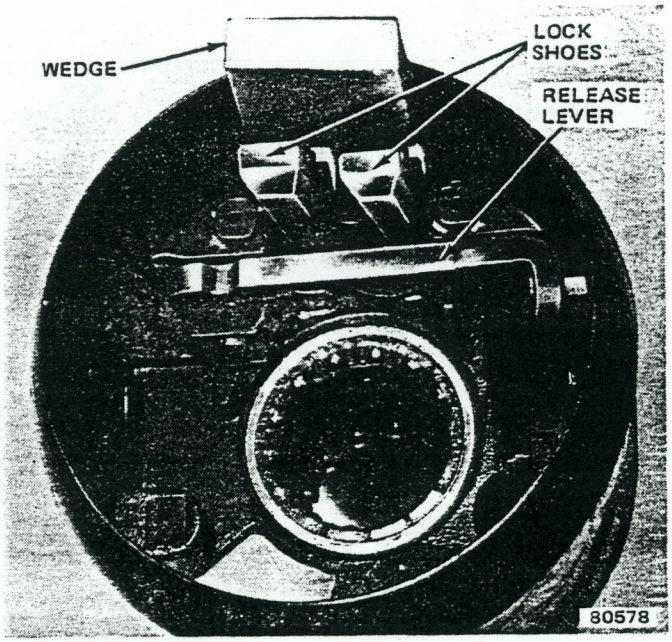


Fig. 2J-57 Relieving Lock Shoe Spring Tension

(38) Disconnect steering shaft at intermediate shaft coupling.

(39) Remove steering shaft through upper end of column (fig. 2J-58).

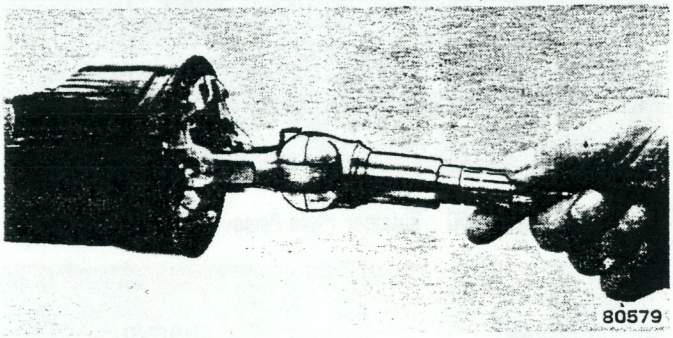


Fig. 2J-58 Steering Shaft Removal/Installation

(40) Remove support attaching bolts and remove support (fig 2J-59). Use 1/4-inch, 12-point deep socket to remove bolts.

(41) Remove retainer plate (fig. 2J-60). Tip upper end of plate rearward and turn plate counterclockwise to remove.

(42) Remove shroud using twisting-pulling motion (fig. 2J-61).

(43) Remove key release lever and lever spring from shroud (fig. 2J-62). Tip lever forward and lift upward to remove.

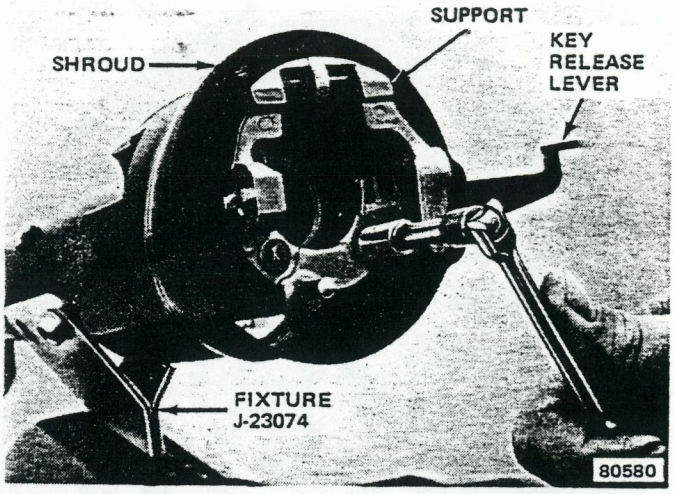


Fig. 2J-59 Support Removal/Installation

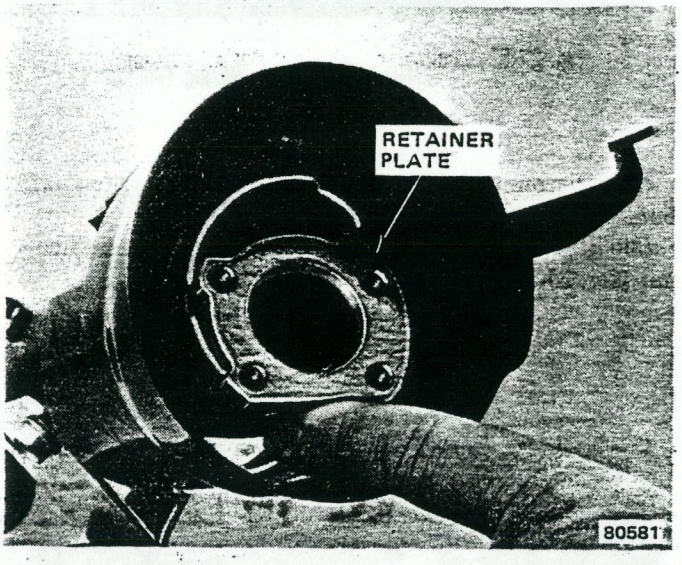


Fig. 2J-60 Retainer Plate Removal/Installation

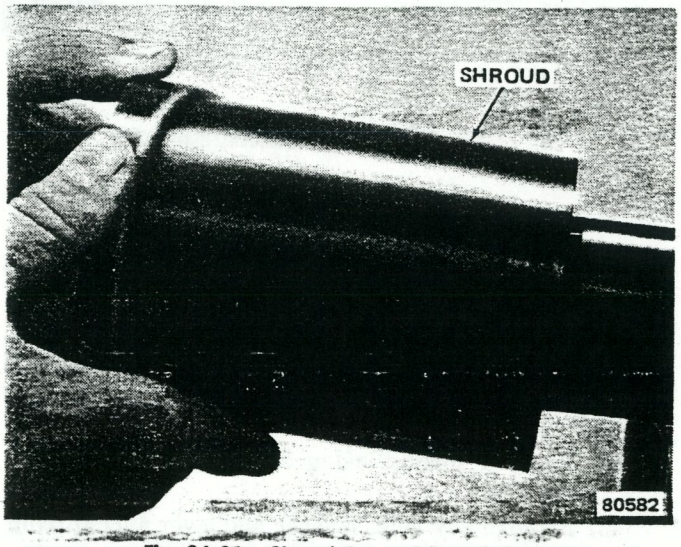


Fig. 2J-61 Shroud Removal/Installation

(44) Disconnect ignition switch wire harness connector and remove switch from column.

(45) Remove snap ring, retainer, and bearing assembly from lower end of column.

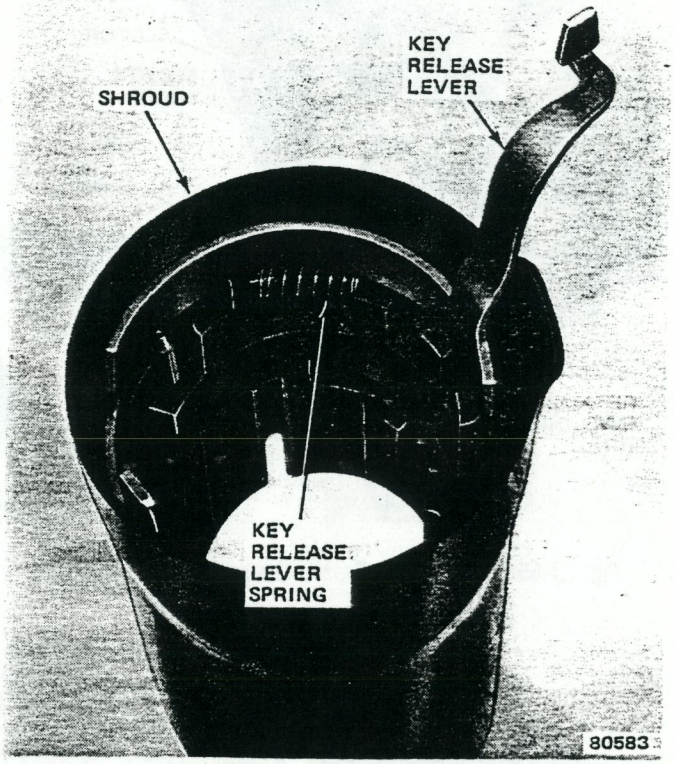


Fig. 2J-62 Key Release Lever and Spring Removal/Installation

Column Assembly

(1) Lubricate all bearing, friction, and thrust surfaces with chassis grease.

(2) Install bearing assembly, bearing retainer, and snap ring in lower end of column (fig. 2J-47).

(3) Install key release lever spring on lever and install assembled lever and spring in shroud (fig. 2J-62).

(4) Align and install shroud on column jacket (fig. 2J-61).

(5) Install retainer plate (fig. 2J-60). Tip plate toward 12 o'clock position, slide it under jacket opening, and seat it in column jacket notches.

(6) Align column jacket "V" notch with corresponding "V" on support and install support in column (fig. 2J-63). Press key release lever downward while pressing support into place to seat support fully.

(7) Install all support attaching screws finger tight. Then tighten screws alternately and evenly to 60 inch-pounds (81 N•m) torque (fig. 2J-59).

(8) Install remote rod in support. Guide rod through upper end of shroud and insert it into rod slot in support.

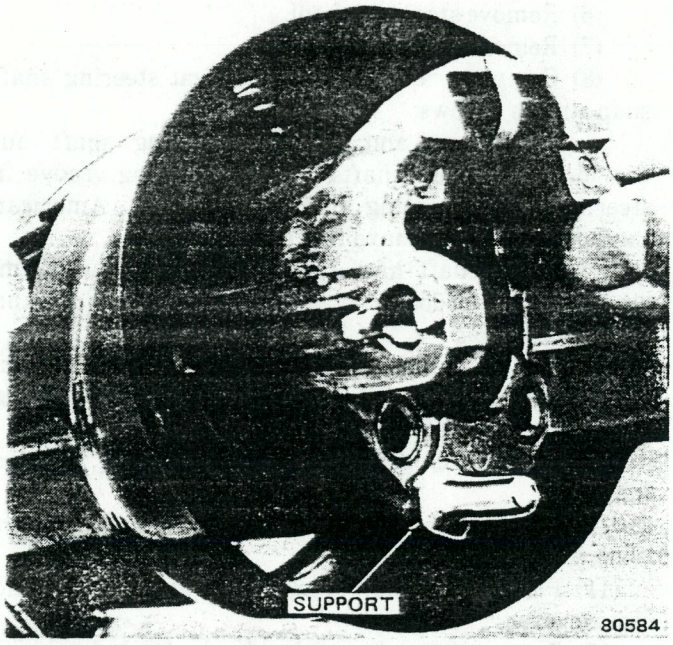


Fig. 2J-63 Support Installation

(9) Install steering shaft in column (fig. 2J-58).

(10) Install replacement bearings in housing, if removed. Be sure to lubricate bearings with chassis grease before installation..

(11) Install lock shoes, lock shoe springs, and lock shoe pin in housing. Use 0.180-inch (4.5 mm) diameter rod to align lock shoes and pin during installation.

(12) Install release lever, lever spring, and lever pin in housing. Insert wedges between housing and lever to relieve spring tension and ease pin installation (fig. 2J-57).

(13) Install sector shaft in housing. Lightly tap shaft into housing using punch.

(14) Install lock sector on shaft. Lightly tap sector onto shaft until shaft snap ring groove is exposed and install sector retaining snap ring.

(15) Install lock bolt in housing and engage bolt in lock sector cam surface (fig. 2L-56).

(16) Install lock rack, rack preload spring, and replacement shim (if used) in housing. Square block tooth of rack must engage square block tooth of sector (fig. 2J-56).

(17) Install lock spring and spring retaining screw (fig. 2J-55). Tighten screw to 35-inch pounds (4 N•m) torque.

(18) Align and install assembled housing on support (fig. 2J-53). Hold lock shoes in disengaged position to ease housing installation.

(19) Align pivot pin holes in housing and support and install pivot pins. Press housing downward when first installing pins to prevent damaging pin holes in support. When pins are started in both housing and support, seat pins fully using hammer and punch.

(20) Insert tilt lever in housing and place housing in full upward tilt position.

(21) Lubricate tilt guide and spring liberally with chassis grease and install tilt spring on guide.

(22) Insert assembled tilt spring and guide in housing and install guide retainer on spring (fig. 2J-52). Engage retainer lock tabs with housing lugs by pressing retainer downward and turning clockwise using screwdriver.

(23) Install tilt lever shield in housing.

(24) Remove tilt lever.

(25) Install cover on housing. Align and install cover attaching screws. Tighten screws to 60 inch-pounds (7 N•m) torque.

(26) Install turn signal switch. Guide switch harness and connector through column and position switch in housing. Do not install switch screws at this time.

(27) Insert hazard warning knob in signal switch, press knob inward, and align and install signal switch-attaching screws. Tighten screws to 35 inch-pounds (4 N•m) torque. Be sure signal switch is properly seated before tightening screws.

(28) Thread hazard warning knob into signal switch and pull knob outward.

(29) Install upper bearing race and seat in housing (fig. 2J-51).

(30) Install upper bearing preload spring, canceling cam, and lock plate (fig. 2J-47).

(31) Install replacement steering shaft snap ring on sleeve of Compressor Tool J-23653 and install tool on steering shaft (fig. 2J-25).

CAUTION: *Identify the steering shaft nut thread type before installing the compressor tool. If the shaft has American threads, use the compressor tool as is. However, if the shaft has metric threads (fig. 2J-2), replace the compressor tool standard forcing screw with Metric Forcing Screw J-23653-4 before installing the tool.*

(32) Compress lock plate and seat snap ring in steering shaft groove (fig. 2J-25).

(33) Remove compressor tool. Be sure snap ring is completely seated before removing tool.

(34) Install tilt and turn signal levers. Tighten turn signal lever attaching screw to 15 inch-pounds (2 N•m) torque.

(35) Install shift lever and lever retaining pin, if equipped.

(36) Install ignition lock cylinder. Hold cylinder sleeve, turn knob clockwise against stop, align cylinder tab with housing keyway and insert cylinder in housing. Turn cylinder knob counterclockwise until cylinder mates with lock sector and push cylinder inward until retainer snaps into place.

(37) Insert key in lock cylinder and turn cylinder to Off-Unlock position.

(38) Install ignition switch as follows:

(a) Move switch slider to Accessory position then back two clicks to Off-Unlock position. Remote rod hole in slider should be almost at center (fig. 2J-64).

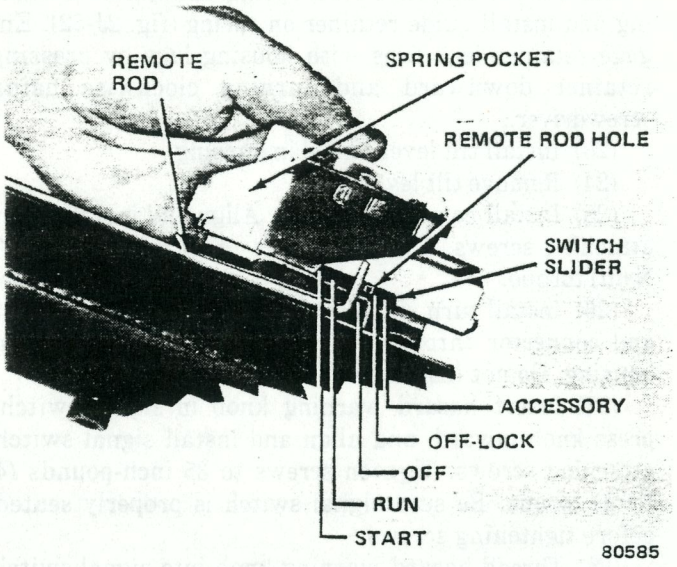


Fig. 2J-64 Ignition Switch Installation

(b) Insert remote rod into slider hole and install switch on column jacket.

(c) Move switch downward to eliminate switch-to-remote rod lash and tighten switch attaching screws to 35 inch-pounds (4 N•m) torque.

(39) Position switch harness protectors, if equipped, over harness and snap protectors into place on column.

(40) Install lock plate cover.

(41) Install steering wheel. Tighten steering wheel nut to 30 foot-pounds (41 N•m) torque.

CAUTION: *Some steering shafts have metric size steering wheel nut threads. Identify the shaft nut thread type before installing a replacement nut. Metric shafts have an identifying groove in the steering wheel locating splines (fig. 2J-2). American thread shafts do not have this groove.*

(42) Remove column support fixture and install column mounting bracket. Tighten bracket attaching bolts to 20 foot-pounds (27 N•m) torque.

(43) Install column if removed. Refer to Steering Column Installation.

TURN SIGNAL AND CRUISE COMMAND SWITCH

Removal

(1) Disconnect battery negative cable.

(2) Cover painted areas of column.

(3) Remove column-to-instrument panel bezel.

(4) Loosen toeplate screws.

(5) On vehicles with tilt column, place column in neutral (nontilt) position.

(6) Remove steering wheel.

(7) Remove lock plate cover.

(8) Compress lock plate and unseat steering shaft snap ring as follows:

(a) Inspect and identify steering shaft nut thread type. Metric shafts have identifying groove in steering wheel locating splines (fig. 2J-2). American thread shafts do not have this groove.

(b) If shaft has American threads, use Compressor Tool J-23653 as is to compress lock plate and unseat snap ring.

(c) If shaft has metric threads, replace compressor tool standard forcing screw with Metric Forcing Screw J-23653-4 before installing tool on shaft.

(9) Remove compressor tool and snap ring. Discard snap ring.

(10) Remove lock plate, canceling cam, and upper bearing preload spring.

(11) Place turn signal lever in right turn position and remove lever.

(12) Remove hazard warning knob. Press knob inward and turn counterclockwise to remove.

(13) Remove column wiring harness protectors, if equipped.

(14) Disconnect column wiring harness connectors at base of column.

(15) If Cruise Command switch is to be serviced, remove switch and harness by removing turn signal lever attaching screw and removing lever, switch, and switch harness as assembly.

(16) If turn signal switch is to be serviced, remove hazard warning knob and turn signal lever. Remove switch attaching screws and remove switch from column.

Installation

(1) If turn signal switch was serviced, install switch in housing and install attaching screws. Tighten screws to 35 inch-pounds (4 N•m) torque. Install hazard warning knob and install turn signal lever. Tighten lever attaching screw to 15 inch-pounds (2 N•m) torque.

(2) If Cruise Command switch was serviced, install signal lever and switch assembly and install attaching screws. Tighten screws to 35 inch-pounds (4 N•m) torque.

(3) Install upper bearing preload spring, canceling cam, and lock plate on steering shaft.

(4) Install replacement steering shaft snap ring on sleeve of Compressor Tool J-23653 and install tool on steering shaft.

CAUTION: *Identify the steering shaft nut thread type before installing the compressor tool. If shaft has American threads, use tool J-23653 as is. However, if the shaft has metric threads (fig. 2J-2), replace the compressor tool standard forcing screw with Metric Forcing Screw J-23653-4 before using the tool.*

(5) Compress lock plate and seat steering shaft snap ring in shaft groove. Remove compressor tool after snap ring installation.

(6) Install lock plate cover.

(7) Install steering wheel and install replacement steering wheel nut. Tighten nut to 30 foot-pounds (41 N•m) torque.

CAUTION: *Some steering shafts have metric size steering wheel nut threads. Be sure to install the proper thread-type nut. Metric shafts have an identifying groove in the steering wheel locating splines (fig. 2J-2).*

(8) Connect signal switch or Cruise Command switch harness connectors at base of column and install harness protector.

(9) Install and tighten column-to-mounting bracket bolts to 20 foot-pounds (27 N•m) torque.

(10) Install and tighten column mounting bracket-to-instrument panel bolts to 20 foot-pounds (27 N•m) torque.

(11) Install column bezel.

(12) Tighten toeplate bolts to 10 foot-pounds (14 N•m) torque.

(13) Remove protective covering from painted areas of column.

(14) Connect battery negative cable.

IGNITION SWITCH

Removal

(1) Insert key in lock cylinder and turn cylinder to Off-Unlock position.

(2) Disconnect battery negative cable.

(3) Disconnect harness connectors at switch.

(4) Remove switch attaching screws.

(5) Disengage remote rod from switch slider and remove switch from column.

Installation

(1) Move switch slider to Accessory position (fig. 2J-64).

(2) Move switch slider back two clicks to Off-Unlock position (fig. 2J-64).

(3) Engage remote rod in switch slider and position switch on column. Do not move slider when positioning switch on column jacket.

(4) Install and tighten switch attaching screws to 35 inch-pounds (4 N•m) torque.

(5) Connect harness connectors to switch.

(6) Connect battery negative cable.

IGNITION LOCK CYLINDER

The key-operated lock cylinder is located at the upper end of the steering column and is mounted in the column housing or cover. The lock cylinder is a two-piece assembly and can be removed, disassembled, and repaired or recoded if necessary.

Conditions Requiring Service

Key Lost—Key Code Number Known

The key code may be converted to a five-digit number that determines key bitting. This number may be obtained from the catalogues furnished by manufacturers of key cutting machines or by calling the Jeep zone office.

Defective Ignition Lock—Ignition Key Available—No Key Code Number

New lock cylinders are available from service parts warehouses only as uncoded cylinders without tumblers. Tumblers are ordered under five different part numbers, one for each depth of cut available. Refer to Key Coding.

Key Lost—Key Code Lost Or Not Known

Contact the servicing dealer and provide the dealer with the vehicle identification number. The dealer may have a record of the key codes involved. If not, the key code numbers assigned to the vehicle may be obtained from the Jeep zone office.

Lock Cylinder Removal

(1) Disconnect battery negative cable.

(2) Apply protective material to painted areas of column.

(3) Remove steering wheel.

(4) Remove lock plate cover. Use two screwdrivers to pry cover out of column.

(5) Compress lock plate and unseat steering shaft snap ring as follows:

(a) Inspect and identify steering shaft nut thread-type. Metric shafts have identifying groove in steering wheel locating splines (fig. 2J-2). American thread shafts do not have this groove.

(b) If shaft has American threads, use Compressor Tool J-23653, as is, to compress lock plate and unseat snap ring (fig. 2J-6).

(c) If shaft has metric threads, replace compressor tool standard forcing screw with Metric Forcing Screw J-23653-4 before installing tool on steering shaft.

WARNING: *The lock plate is under strong spring pressure. Do not attempt to remove the steering shaft snap ring without using the compressor tool.*

(6) Remove compressor tool and snap ring. Discard snap ring.

(7) Remove lock plate, canceling cam, and upper bearing preload spring.

(8) Remove turn signal lever attaching screw and remove lever.

(9) Press hazard warning knob inward and turn knob counterclockwise to remove it.

(10) Disconnect turn signal and Cruise Command wire harness connectors at base of column.

(11) Remove turn signal switch attaching screws and move switch aside to provide working clearance. It is not necessary to remove switch and harness completely.

(12) Insert key in lock cylinder. On manual transmission columns, place cylinder in On position. On automatic transmission columns, place cylinder in Off-Lock position.

(13) Compress lock cylinder retaining tab using thin blade screwdriver and remove lock cylinder from column.

NOTE: *The lock cylinder retaining tab is accessible through the slot adjacent to the turn signal switch mounting boss (fig. 2J-9). If the tab is not visible through the slot, scrape or knock any casting flash out of the slot to provide access.*

Lock Cylinder Installation

(1) Install lock cylinder as follows:

(a) Insert key in lock cylinder.

(b) Hold cylinder sleeve and turn key clockwise until key stops.

(c) Align lock cylinder retaining tab with keyway in housing and insert cylinder into column.

(d) Push cylinder inward until it contacts lock sector. Rotate cylinder to engage it with lock sector, and push cylinder inward until cylinder retaining tab engages in housing groove.

(2) Align and install turn signal switch in column.

(3) Install and tighten switch attaching screws to 35 inch-pounds (4 N•m) torque.

(4) Install hazard warning knob. Tighten knob to 5 inch-pounds (0.56 N•m) torque.

(5) Install turn signal lever. Tighten lever attaching screw to 15 inch-pounds (2 N•m) torque.

(6) Install upper bearing preload spring, canceling cam, and lock plate on steering shaft.

(7) Install replacement steering shaft snap ring on sleeve of Compressor Tool J-23653 and install tool on steering shaft (fig. 2J-6).

CAUTION: *Identify the steering shaft nut thread-type before installing the compressor tool. If the shaft has American threads, use the tool as is. However, if the shaft has metric threads (fig. 2J-2), replace the compressor tool standard forcing screw with Metric Forcing Screw J-23653-4 before installing the tool on the shaft.*

(8) Compress lock plate with compressor tool and seat snap ring in steering shaft groove (fig. 2J-6).

(9) Remove compressor tool.

(10) Install lock plate cover.

(11) Install steering wheel and tighten steering wheel nut to 30 foot-pounds (41 N•m) torque.

CAUTION: *Some steering shafts have metric steering wheel nut threads. Identify the shaft nut thread-type before installing a replacement nut. Metric shafts have an identifying groove in the steering wheel locating splines (fig. 2J-2).*

(12) Connect column wiring harness connectors at base of column.

(13) Remove protective covering from column painted areas.

(14) Connect battery negative cable.

(15) Reset clock if equipped.

Lock Cylinder Disassembly

In the following procedures, all references to turning the key clockwise or counterclockwise are made as if the cylinder is being viewed from the key-end.

(1) Insert key in lock cylinder.

(2) Hold lock sleeve and turn cylinder to Lock position.

(3) Fabricate plunger pin compressor tool from paper clip. Make 90° bend in one end of clip about 1/4 inch (6.35 mm) from end (fig. 2J-65).

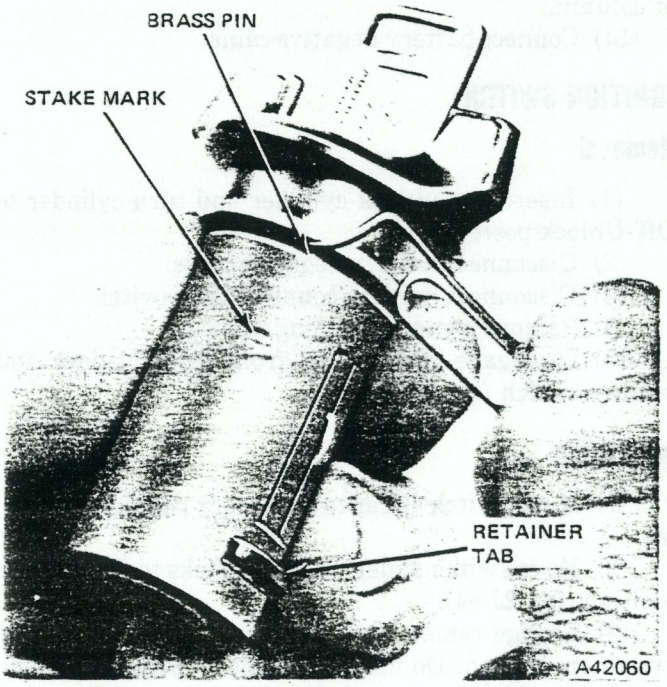


Fig. 2J-65 Compressing Lock Cylinder Plunger Pin

(4) Turn lock cylinder to Accessory position. Brass plunger pins in lock sleeve should now bear against lock cylinder stop lug (fig. 2J-66).

(5) Compress plunger pin using paper clip compressor tool (fig. 2J-65).

NOTE: *There are two brass pins and two staking marks on the lock sleeve. The brass pin that must be compressed in order to separate the cylinder and sleeve is located just above the stake mark that is positioned above and to the left of the retaining tab (fig. 2J-65).*

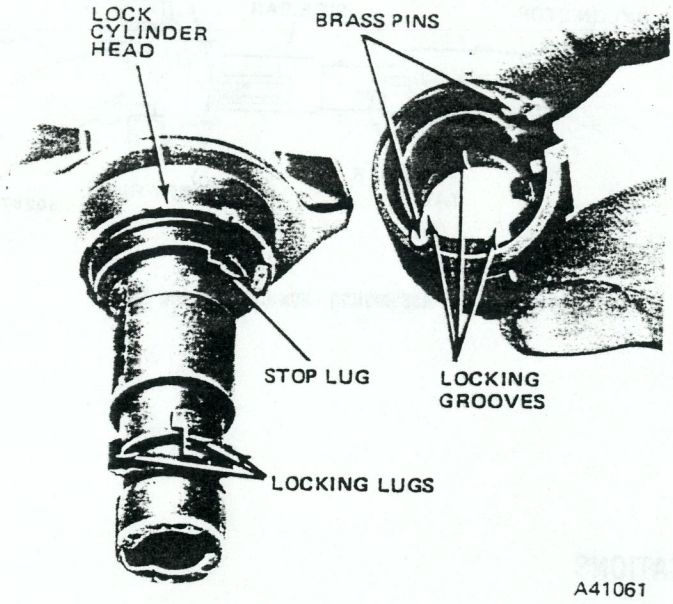


Fig. 2J-66 Lock Cylinder and Sleeve Disassembled

(6) Hold brass plunger pin in compressed position and turn lock cylinder clockwise using paper clip.

(7) Stop turning cylinder when it springs upward slightly. Cylinder locking lugs are now aligned with sleeve locking grooves.

(8) Remove ignition key.

(9) Turn sleeve and cylinder upside down.

(10) Fabricate wire hook from additional paper clip.

(11) Lift nylon stop on lock sleeve using wire hook and separate cylinder from sleeve (fig. 2J-67).

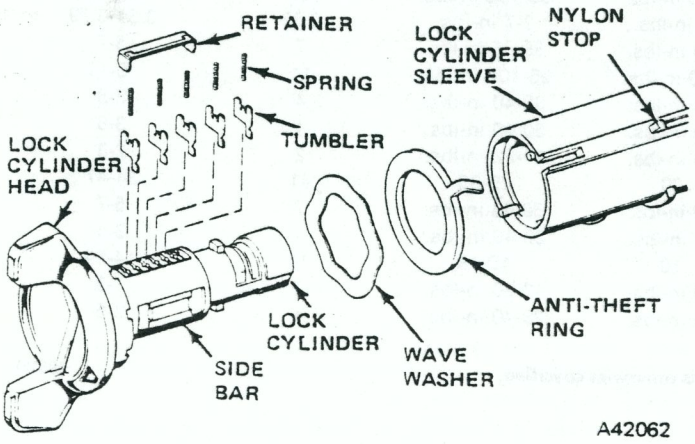


Fig. 2J-67 Ignition Lock Cylinder Assembly

NOTE: *If the cylinder does not separate from the sleeve easily, tap the assembly lightly on the workbench to free the sleeve from the cylinder.*

(12) Pry tumbler retainer from cylinder and remove tumbler springs (fig. 2J-67).

(13) Pull side bar outward slightly and remove tumblers from cylinder (fig. 2J-67).

Key Coding

To determine the tumblers needed when the key code is not available, use the code diagram as follows (fig. 2J-68):

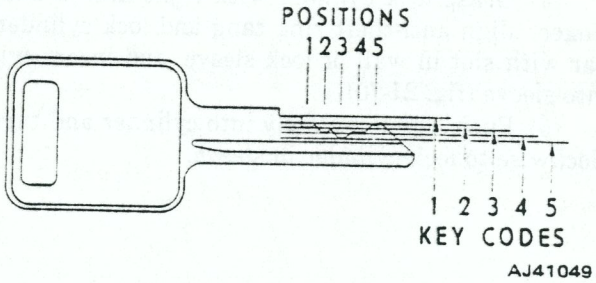


Fig. 2J-68 Key Coding Diagram

(1) Place key over coding diagram with uncut side of key aligned exactly with diagram. Each of five positions will align with key notches.

(2) Starting at head of key blade, determine and record lowest level tumbler number that is visible in each position (1 through 5).

(3) After tumbler number sequence is determined, lock cylinder is ready for assembly.

(4) Starting at key end of lock cylinder, insert tumblers in proper slots and in order required by key code. Pull side bar outward slightly to allow tumblers to drop completely into place.

(5) Install a spring on each tumbler.

(6) Insert tumbler retainer so two end prongs slide into slots in cylinder.

(7) Press retainer downward until it is seated.

(8) Insert key in lock cylinder and check tumbler operation. If tumblers are properly installed, side bar will drop downward when key is inserted. If side bar does not move, disassemble cylinder and check for incorrect assembly or coding of key and tumblers.

(9) If cylinder is correctly assembled and operates properly, stake each end of spring retainer in place using punch (fig. 2J-69).

Assembly

(1) Insert key completely into lock cylinder, then pull key out two notches.

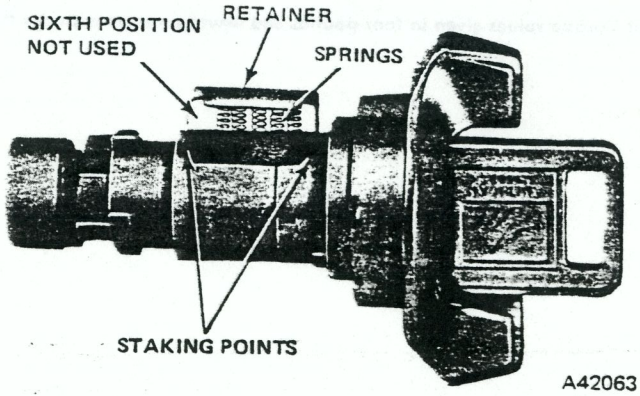


Fig. 2J-69 Tumbler and Spring Installation

(2) Install wave washer and anti-theft ring on lock cylinder (fig. 2J-70).

(3) Grasp lock sleeve with left thumb and forefinger and hold nylon stop in lock sleeve upward with forefinger (fig. 2J-70).

(4) Grasp lock cylinder with right thumb and forefinger, align anti-theft ring tang and lock cylinder side bar with slot in wall of lock sleeve, and insert cylinder into sleeve (fig. 2J-70).

(5) Push key completely into cylinder and turn key clockwise to lock cylinder in sleeve.

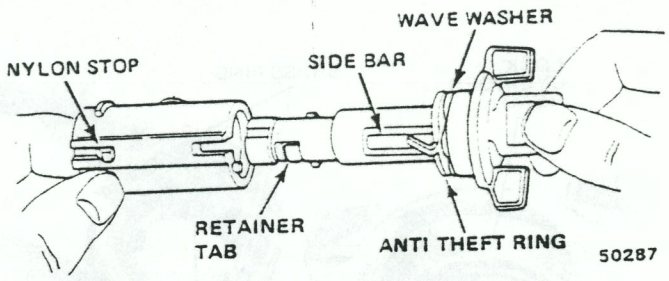


Fig. 2J-70 Assembling Lock Cylinder and Sleeve

SPECIFICATIONS

Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft-lbs)		Metric (N•m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Clamp Bolt, Flexible Coupling	30	25-35	41	34-47
Clamp Bolt, Intermediate Shaft	45	40-55	61	54-75
Clamp Bolt, Steering Shaft U-Joint	45	40-55	61	54-75
Column Mounting Bracket Bolt	20	15-25	27	20-34
Column Mounting Bracket-to-Instrument Panel Bolts	20	15-25	27	20-34
Cover Screws (Auto. Col.)	60 in-lbs.	50-65 in-lbs.	7	5-7
Cover Screws (Tilt Col.)	100 in-lbs.	95-105 in-lbs.	11	10-12
Hazard Warning Knob	5 in-lbs.	3-7 in-lbs.	0.56	0.34-0.79
Housing Screws (Std. Col.)	60 in-lbs.	55-65 in-lbs.	7	5-7
Housing Screws (Tilt Col.)	100 in-lbs.	95-105 in-lbs.	11	10-12
Ignition Switch Mounting Screws	35 in-lbs.	30-40 in-lbs.	4	3-5
Lock Sector Tension Spring Screw	35 in-lbs.	30-40 in-lbs.	4	3-5
Shroud Screws (Man. Trans. Col.)	18 in-lbs.	14-22 in-lbs.	2	2-3
Steering Wheel Nut	30	25-35	41	34-47
Support Screws (Tilt Col.)	60 in-lbs.	50-65 in-lbs.	7	5-7
Tilt Lever Screw	35 in-lbs.	30-40 in-lbs.	4	3-5
Toe Plate Screws	10	10-18	14	14-24
Turn Signal Lever Screw	15 in-lbs.	12-20 in-lbs.	2	1-3
Turn Signal Switch Screws	35 in-lbs.	28-40 in-lbs.	4	3-5

All Torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

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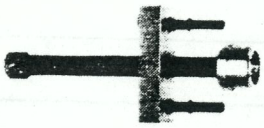
Tools



J-23072
SHIFT TUBE REMOVER

J-22635
PIN REMOVER AND
INSTALLER

J-23653
LOCK PLATE
COMPRESSOR

J-23073
SHIFT TUBE
INSTALLER

J-22569
STEERING SHAFT SNAP RING
REMOVER AND INSTALLER

J-21232
STEERING WHEEL
PULLER

J-23074
STEERING COLUMN
HOLDING FIXTURE

J-21854-1 PIVOT
PIN PULLER

50408A

NOTES

MANUAL STEERING GEAR 2K

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GENERAL

The manual steering gear used on Jeep vehicles is a recirculating ball design (fig. 2K-1). The steering gear wormshaft and ball nut are in line with the steering shaft in the column. Steering ratio of this unit is 24:1.

The steering gear wormshaft and column steering shaft are connected by a removable flexible coupling. The coupling permits independent removal of the steering gear or column.

The steering gear ball nut is mounted on the wormshaft and is driven through steel ball bearings which circulate in the spiral grooves machined in the wormshaft and ball nut. The bearings act as a rolling thread between the wormshaft and ball nut. The ball nut is directly engaged by the pitman shaft sector teeth.

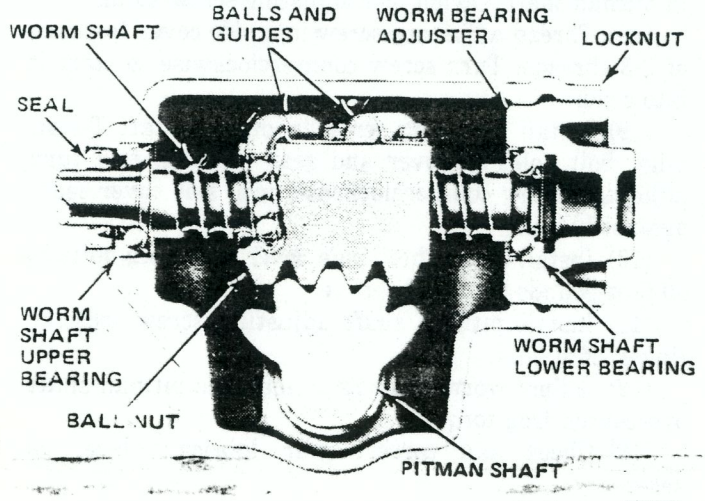

Fig. 2K-1 Recirculating Ball Manual Steering Gear

ON-VEHICLE SERVICE

Steering Gear Adjustment

Adjustments are generally made to compensate for normal wear in the gear or to correct a handling problem caused by improper adjustment. Correct adjustment results in a definite drag or preload but does not cause excessive steering effort through any point of the turn.

CAUTION: *Adjust the steering gear in the following sequence only. Failure to do so could result in damage to the gear or improper steering response. Always adjust worm bearing preload first; then adjust pitman shaft overcenter drag torque last.*

Worm Bearing Preload and Pitman Shaft Overcenter Drag Torque

(1) Raise vehicle and remove crossmember cover, if equipped.

(2) Check and correct steering gear mounting bolt torque if necessary.

(3) Mark pitman arm and steering gear pitman shaft for assembly reference.

(4) Remove pitman arm nut and remove pitman arm using Puller J-6632 (fig. 2K-2).

(5) Loosen pitman adjusting screw locknut and back off adjusting screw 2 or 3 turns.

(6) Remove horn button and cover.

(7) Slowly turn steering wheel in one direction until stopped by gear; then turn wheel back 1/2 turn.

CAUTION: *Do not turn the steering wheel hard against the stop when the linkage is disconnected. This could result in damage to the steering gear ball return guides.*

(8) Install socket and inch-pound torque wrench on steering wheel nut.

(9) Measure worm bearing preload by rotating steering wheel through 90° arc (1/4 turn). Preload should be 5 to 8 inch-pounds (0.6 to 1 N•m).

NOTE: *Steering column misalignment or damage will affect torque readings. If rotating torque is exceptionally high, check the column alignment. If alignment is correct, remove the gear, determine the problem area, and repair as necessary.*

(10) If preload adjustment is necessary, loosen worm bearing adjuster locknut and turn adjuster clockwise to increase preload or counterclockwise to decrease preload.

(11) When desired preload is obtained, tighten adjuster locknut to 90 foot-pounds (122 N•m) torque and check preload again. Correct preload as necessary.

(12) Adjust pitman shaft overcenter drag torque.

CAUTION: *Do not attempt to adjust pitman shaft overcenter drag torque until after worm bearing preload has been adjusted.*

(13) Rotate steering wheel slowly from stop-to-stop and count total number of steering wheel turns.

(14) Turn steering wheel back 1/2 total number of turns to place gear on center; then turn wheel 1/2 turn off center.

(15) Install socket and inch-pound torque wrench on steering wheel nut.

(16) Measure torque required to turn gear through center of travel (this is overcenter drag torque). Drag torque should equal worm bearing preload torque plus 4 to 10 inch-pounds (.5 to 1 N•m) but must not exceed total of 18 inch-pounds (2 N•m).

Example:

Worm bearing preload is adjusted to 6 inch-pounds (0.7 N•m) torque. Over center drag torque is adjusted to 7 inch-pounds (0.8 N•m) in addition to worm bearing preload. This makes a total of 13 inch-pounds (1 N•m) which is acceptable.

(17) If adjustment is required, loosen pitman shaft adjusting screw locknut and loosen or tighten adjusting screw to obtain desired drag torque.

(18) Tighten pitman shaft adjusting screw locknut to 25 foot-pounds (34 N•m) after adjusting drag torque and recheck drag torque again. Correct adjustment if necessary.

(19) Install pitman arm. Index arm to shaft using alignment marks made at disassembly.

(20) Tighten pitman arm nut to 185 foot-pounds (251 N•m) torque and stake nut to shaft threads in one place.

(21) Lower vehicle.

(22) Correct steering wheel-to-steering shaft alignment if necessary and install horn button cover.

Pitman Shaft Seal Replacement

(1) Raise vehicle.

(2) Place front wheels in straight ahead position.

(3) Mark pitman arm and shaft for assembly reference.

(4) Remove pitman arm using Puller J-6632 (fig. 2K-2).

(5) Remove seal using pointed tool or screwdriver with small blade.

(6) Inspect condition of gear lubricant. If contaminated and full of metal particles, remove and overhaul gear.

(7) Wrap pitman shaft splines with shimstock to protect replacement seal during installation.

(8) Lubricate lip of replacement seal with chassis lubricant, slide seal over shimstock and into seal seat in gear housing. Complete seal installation by tapping seal into place using small plastic mallet.

(9) Install pitman arm on shaft. Align arm and shaft using reference marks made at disassembly.

(10) Tighten pitman arm nut to 185 foot-pounds (251 N•m) torque and stake nut to shaft threads in one place.

(11) Lower vehicle.

Side Cover and Gasket Replacement

(1) Raise vehicle.

(2) Remove pitman shaft adjusting screw locknut.

(3) Remove side cover attaching bolts.

(4) Turn pitman shaft adjusting screw clockwise to remove cover from screw.

(5) Inspect condition of gear lubricant. If contaminated and full of metal particles, remove and overhaul gear.

(6) Coat replacement side cover gasket with chassis lubricant and position gasket on replacement side cover.

(7) Slide pitman shaft adjusting screw out of T-slot in pitman shaft. Do not lose adjusting screw shim.

(8) Thread adjusting screw into side cover to depth of 2-3 threads. Turn screw counterclockwise to start it into cover.

(9) Install adjusting screw in pitman shaft T-slot, align bolt holes in cover and gear housing, and turn adjusting screw counterclockwise until side cover seats against housing.

(10) Install and tighten side cover attaching bolts to 30 foot-pounds (41 N•m) torque.

(11) Install pitman shaft adjusting screw locknut finger tight only.

(12) Adjust worm bearing preload and pitman shaft overcenter drag torque.

(13) Check and correct gear lubricant level as necessary.

(14) Lower vehicle.

Service Diagnosis

Condition	Possible Cause	Correction
HARD STEERING	(1) Incorrect tire pressure.	(1) Adjust.
	(2) Lack of lubrication.	(2) Lubricate steering linkage.
	(3) Tie rod ends worn.	(3) Replace rod ends.
	(4) Steering knuckle ball studs tight.	(4) Adjust or replace.
	(5) Steering gear parts worn.	(5) Overhaul hear.
	(6) Frozen steering column bearings.	(6) Replace bearings.
	(7) Lower coupling flange rubbing against steering shaft.	(7) Loosen bolt and assemble properly.
	(8) Steering gear adjusted incorrectly.	(8) Check adjustment. Disconnect pitman arm from gear or disconnect linkage from pitman arm and adjust gear if necessary.
	(9) Front spring sag.	(9) Check front end jounce height. It should be approximately the same at both wheels. Replace front springs if sagged.
	(10) Frame bent or broken.	(10) Repair frame as necessary.
	(11) Steering knuckle bent.	(11) Replace knuckle.
	(12) Ball stud galled or too tight.	(12) Replace ball stud.
	(13) Steering knuckle ball studs binding.	(13) Reseat or replace studs.
	(14) Steering gear or connections binding.	(14) Test steering system with wheels off floor. Adjust and lubricate.
LOOSE STEERING	(1) Tie rod ends worn.	(1) Replace rod ends.
	(2) Steering knuckle ball studs worn.	(2) Replace studs.
	(3) Steering gear parts worn.	(3) Overhaul gear.
	(4) Steering gear improperly adjusted.	(4) Adjust gear.
EXCESSIVE ROAD SHOCK	(1) U-bolts loose.	(1) Repair as necessary.
	(2) Wheel bearings loose.	(2) Adjust bearings.
	(3) Shock absorbers worn.	(3) Replace.
TURNING RADIUS SHORT ONE SIDE	(1) Center bolt in spring sheared off.	(1) Repair as necessary.
	(2) Axle shifted.	(2) Repair as necessary.
	(3) Steering arm bent.	(3) Replace.

REMOVAL

(1) Remove intermediate shaft-to-wormshaft coupling clamp bolt and disconnect intermediate shaft.

(2) Remove pitman arm nut and lockwasher.

(3) Remove pitman arm from steering gear pitman shaft using Tool J-6632 (fig. 2K-2).

(4) On Cherokee, Wagoneer and Truck models, remove bolts attaching steering gear to frame and remove gear.

(5) On CJ models:

(a) Raise left side of vehicle slightly to relieve tension on left front spring and place support stand under frame and remove crossmember cover, if equipped.

(b) Remove bolts attaching steering gear lower bracket to frame (fig. 2K-3).

(c) Remove bolts attaching steering gear upper bracket to frame rail and remove gear.

(d) Remove Torx Head upper bracket bolt using 9 inch (22.86 cm) extension and Torx Bit External Socket Tool J-25359-21 (fig. 2K-3).

(e) Remove remaining bolts attaching upper bracket to tie plate and lower bracket to steering gear and remove brackets from gear.

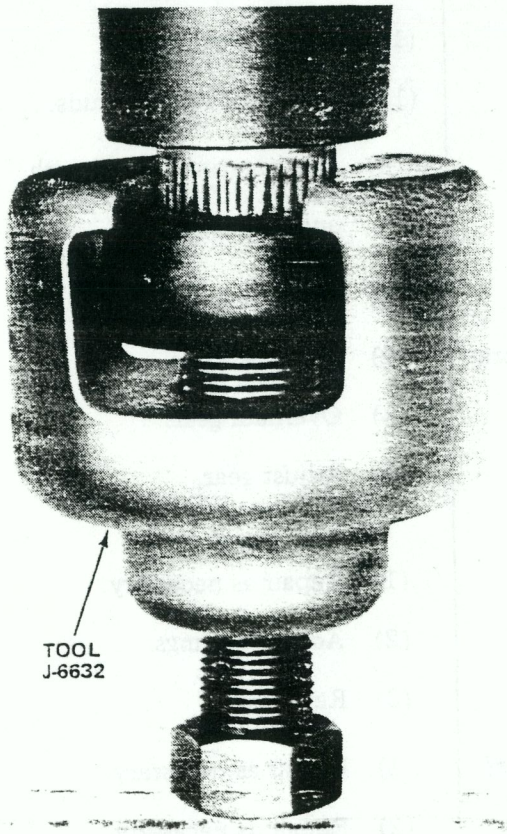

Fig. 2K-2 Pitman Arm Removal

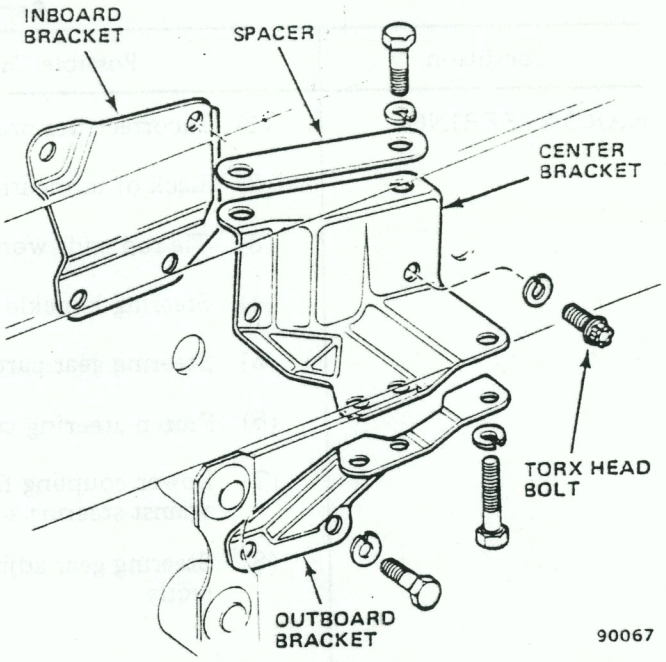

Fig. 2K-3 Steering Gear Mounting Brackets—CJ Models

INSTALLATION

NOTE: *Proper retention of the steering gear is important. Some of the following steps in gear installation require the application of Loctite 271 or similar material to attaching bolt threads. Wherever indicated, use Loctite 271 Adhesive/Sealant or equivalent. Before applying this material, first clean all bolt threads thoroughly to remove dirt and grease and apply the material to the bolt threads no more than five minutes before installation.*

(1) On Cherokee, Wagoneer and Truck models:

(a) Apply Loctite 271 or equivalent, to steering gear-to-frame mounting bolts.

(b) Align and engage intermediate shaft coupling with splines on steering gear wormshaft.

(c) Position gear on frame and install gear attaching bolts. Tighten bolts to 70 foot-pounds (95 N•m) torque.

(d) Install intermediate shaft coupling pinch bolt and nut. Tighten nut to 45 foot-pounds (61 N•m) torque.

(2) On CJ models:

(a) Apply Loctite 271, or equivalent, to all steering gear mounting bracket attaching bolts.

(b) Position tie plate and upper and lower mounting brackets on steering gear and install mounting bracket-to-gear attaching bolts. Tighten hex-head bolts to 70 foot-pounds (95 N•m) torque. Tighten torx head bolt to 55 foot-pounds (75 N•m) torque using Torx Head External Socket Tool J-25359-21.

(c) Apply Loctite 271, or equivalent, to all steering gear-to-frame and crossmember mounting bolts.

(d) Align and engage intermediate shaft coupling with steering gear wormshaft splines.

(e) Position steering gear on frame and install remaining gear mounting bolts. Tighten bolts to 55 foot-pounds (75 N•m) torque and install crossmember cover, if equipped.

(3) Install intermediate shaft coupling clamp bolt and nut. Tighten nut to 45 foot-pounds (61 N•m) torque.

(4) Install pitman arm on pitman shaft and install lockwasher and pitman arm nut. Tighten nut to 185 foot-pounds (251 N•m) torque.

(5) On CJ models, remove support stand and hydraulic jack.

NOTE: *After the steering gear is installed, it may produce a slightly rough feel. To eliminate this roughness, turn the gear full left and right for 10 to 15 complete cycles.*

DISASSEMBLY

(1) Mount steering gear in vise. Clamp vise jaws on gear mounting bosses only.

(2) Place ball nut and pitman shaft in centered position. Rotate wormshaft stop-to-stop and count total number of turns. Turn wormshaft back 1/2 total number of turns to center shaft and nut.

(3) Remove pitman shaft adjuster screw locknut (fig. 2K-4).

(4) Remove side cover attaching bolts (2K-5).

(5) Turn pitman shaft adjuster screw clockwise to unthread side cover from screw and remove side cover and gasket.

(6) Slide adjuster screw and shim out of T-slot in pitman shaft (fig. 2K-4). Retain shim and screw for end play measurement at assembly.

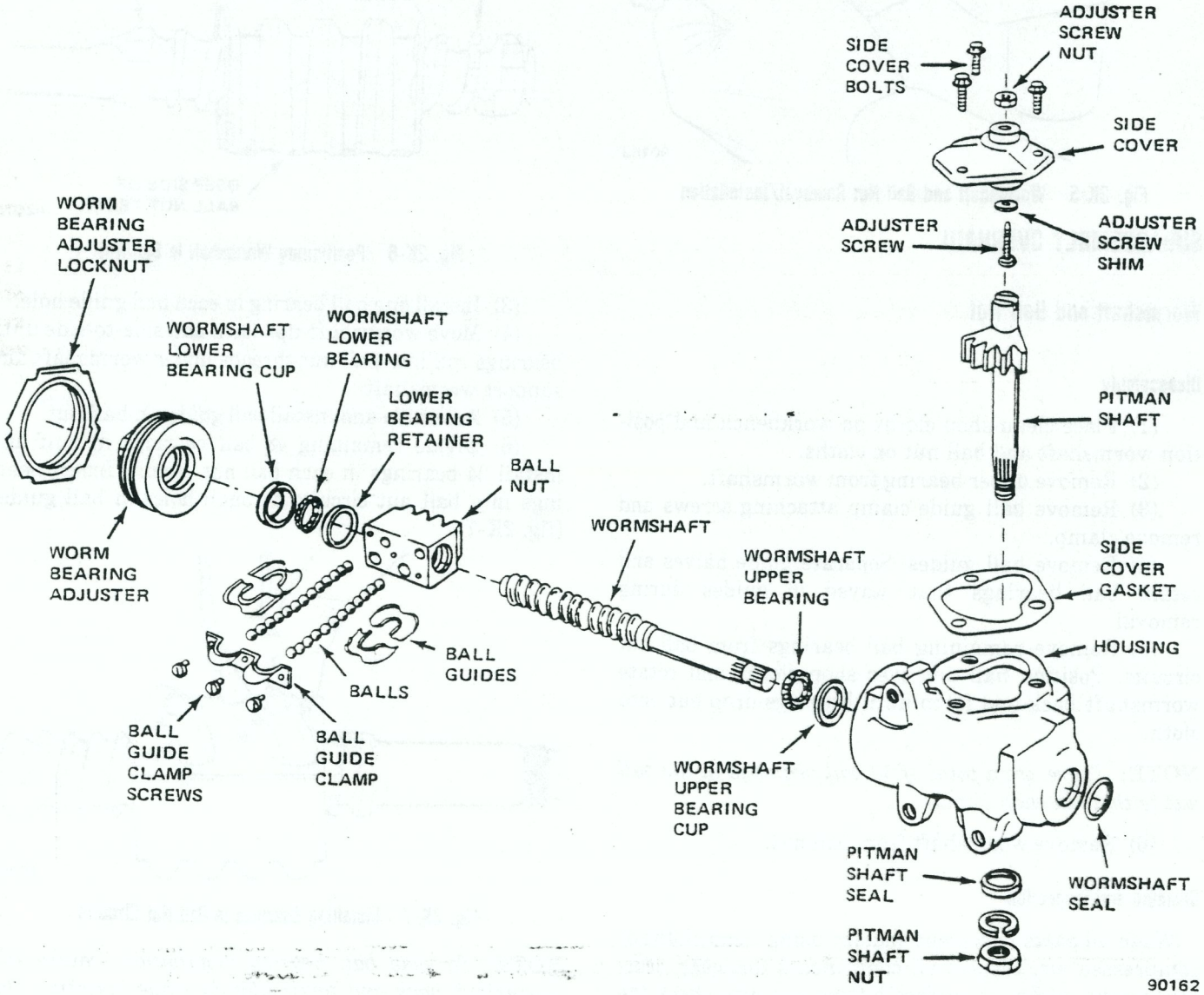

Fig. 2K-4 Manual Steering Gear

(7) Remove pitman shaft. If necessary, tap shaft lightly with plastic mallet to remove it.

(8) Remove worm bearing adjuster locknut.

(9) Remove worm bearing adjuster.

(10) Remove wormshaft and ball nut (fig. 2K-5).

CAUTION: *During service operations, do not allow the ball nut to rotate freely and bottom at either end of the wormshaft. This can damage the tangs at the ends of the ball guides.*

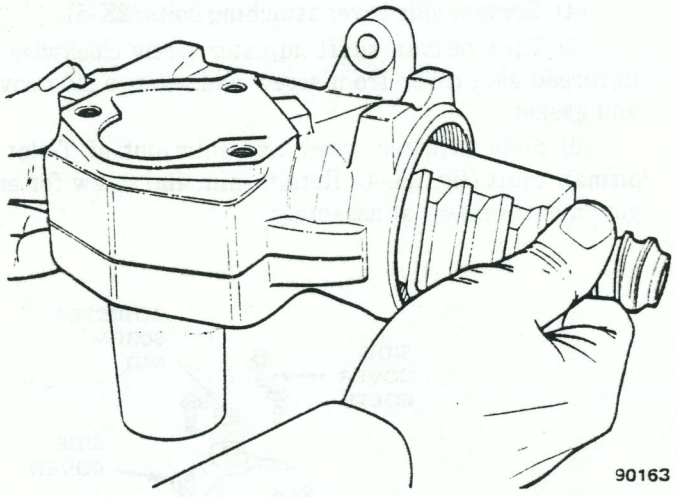

Fig. 2K-5 Wormshaft and Ball Nut Removal/Installation

SUBASSEMBLY OVERHAUL

Wormshaft and Ball Nut

Disassembly

(1) Place clean shop cloths on workbench and position wormshaft and ball nut on cloths.

(2) Remove upper bearing from wormshaft.

(3) Remove ball guide clamp attaching screws and remove clamp.

(4) Remove ball guides. Separate guide halves and retain ball bearings that stayed in guides during removal.

(5) Remove remaining ball bearings from ball nut circuits. Position ball nut over shop cloths and rotate wormshaft back and forth until bearings drop out onto cloth.

NOTE: *There are a total of 50 ball bearings in the ball nut with 25 in each circuit.*

(6) Remove wormshaft from ball nut.

Cleaning and Inspection

Wash all parts in solvent and dry using clean cloths or compressed air. Inspect all components for wear, scoring, cracks, nicks, or surface pitting and also check the upper bearing and ball bearings for flat spots. If the upper bearing is damaged, the upper bearing cup must also be replaced.

Assembly

(1) Position ball nut on workbench with ball guide holes facing upward and deep side of ball nut teeth facing edge of workbench (fig. 2K-6).

(2) Install wormshaft in ball nut from left side. Thread shaft into nut until equal number of shaft threads are visible at each end of nut (fig. 2K-6).

CAUTION: *The ball nut teeth are machined to a greater width and depth on one side. When assembling the wormshaft and ball nut, position the ball nut so the wider-deeper side of the teeth will face the housing side cover opening after installation (fig. 2K-6).*

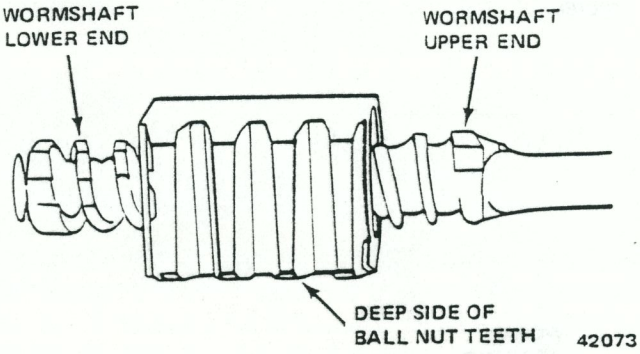

Fig. 2K-6 Positioning Wormshaft in Ball Nut

(3) Install one ball bearing in each ball guide hole.

(4) Move wormshaft up/down and side-to-side until bearings roll into ball nut threads under wormshaft and support wormshaft.

(5) Assemble and install ball guides in ball nut.

(6) Divide remaining 48 ball bearings in half and install 24 bearings in each ball nut circuit. Insert bearings into ball nut circuits through holes in ball guides (fig. 2K-7).

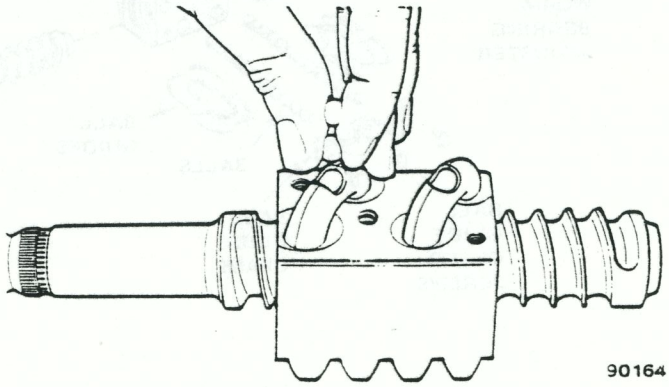

Fig. 2K-7 Installing Bearings in Ball Nut Circuits

NOTE: *To ease ball bearing installation, rotate the wormshaft back and forth slightly while inserting the bearings.*

(7) Position ball guide clamp on ball nut and install clamp attaching screws. Tighten screws to 4 foot-pounds (6 N•m) torque.

(8) Lubricate wormshaft threads with chassis grease and thread shaft in and out of ball nut to circulate grease.

CAUTION: *To avoid damaging the tangs on the ball guide ends, do not not allow the wormshaft to bottom in either direction.*

(9) Lubricate wormshaft upper bearing with chassis grease and install bearing on wormshaft.

Worm Bearing Adjuster

Disassembly

(1) Remove wormshaft lower bearing retainer from worm bearing adjuster. Use screwdriver to pry retainer out of adjuster (fig. 2K-8).

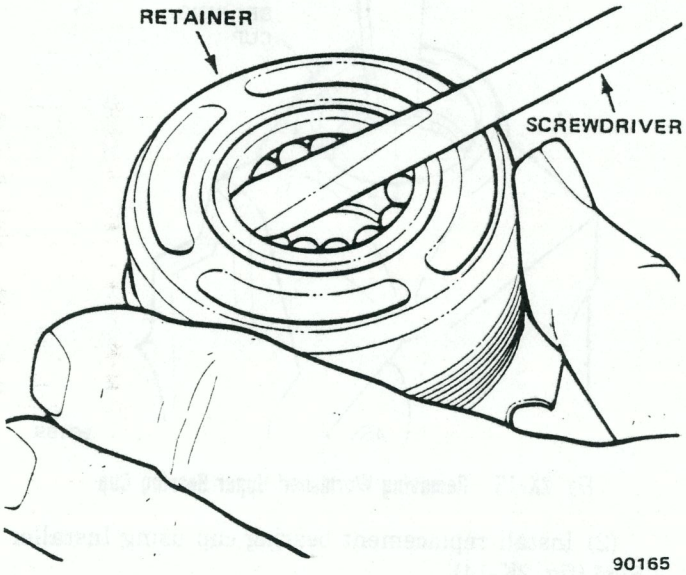

Fig. 2K-8 Removing Wormshaft Lower Bearing Retainer

(2) Remove wormshaft lower bearing from adjuster.

Cleaning and Inspection

Clean parts in solvent and dry using clean cloths only. Inspect all components for wear or damage and also inspect the bearing for flat spots or scoring. If either the lower bearing or bearing cup is damaged, both parts must be replaced.

Assembly

(1) If lower bearing cup is to be replaced, remove old cup and install replacement as follows:

(a) Install spare locknut on worm bearing adjuster and clamp adjuster in vise. Clamp vise jaws on locknut only.

(b) Assemble Puller J-5822 and Slide Hammer J-2619-01 (fig. 2K-9). Position puller legs under bearing cup and tighten puller screw to expand and hold legs in position. Bump outward with slide hammer weight to remove bearing cup.

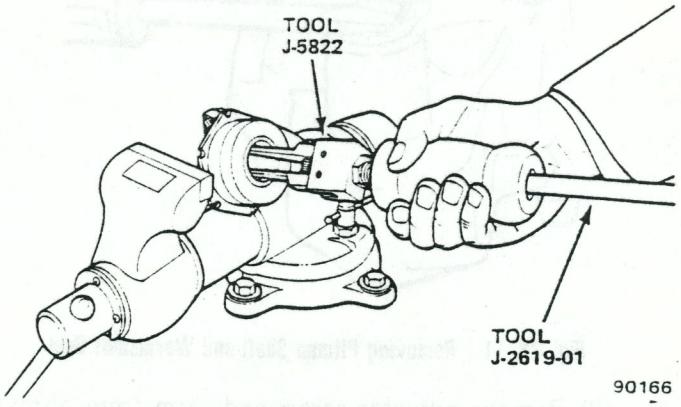

Fig. 2K-9 Removing Wormshaft Lower Bearing Cup

(c) Remove adjuster from vise and remove spare locknut from adjuster.

(d) Install replacement bearing cup in adjuster using Tool J-5755 (fig. 2K-10).

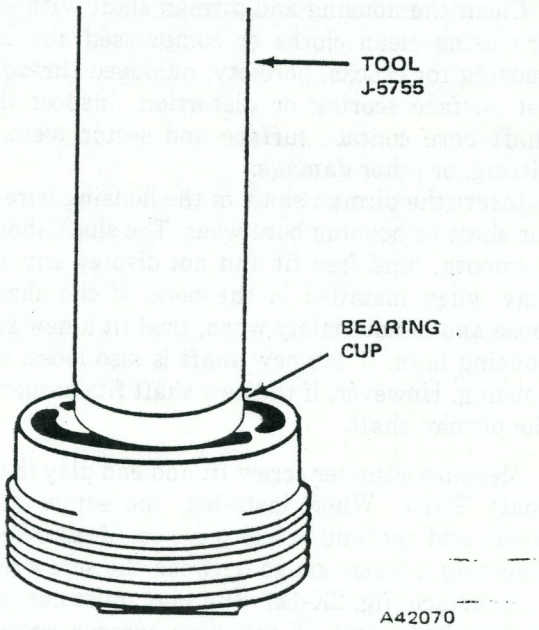

Fig. 2K-10 Installing Wormshaft Lower Bearing Cup

(2) Lubricate lower bearing with chassis grease and install bearing in adjuster.

(3) Install lower bearing retainer in adjuster. If necessary, tap retainer lightly with plastic mallet to seat it.

Steering Gear Housing and Pitman Shaft

Disassembly

(1) Remove pitman shaft and wormshaft seals from housing. Use screwdriver to pry seals out (fig. 2K-11).

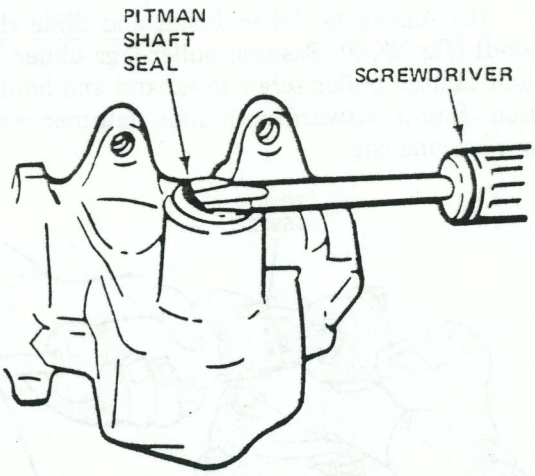

Fig. 2K-11 Removing Pitman Shaft and Wormshaft Seal

(2) Remove adjuster screw and shim from pitman shaft T-slot (if not removed previously). Retain screw and shim for end play check.

Cleaning and Inspection

Clean the housing and pitman shaft with solvent and dry using clean cloths or compressed air. Inspect the housing for cracks, porosity, damaged threads and gasket surface scoring or distortion. Inspect the pitman shaft bore contact surface and sector teeth for wear, pitting, or other damage.

Insert the pitman shaft in the housing bore and check for shaft or housing bore wear. The shaft should exhibit a smooth, bind free fit and not display any visible side play when installed in the bore. If the shaft appears loose and is not visibly worn, trial fit a new shaft in the housing bore. If the new shaft is also loose, replace the housing. However, if the new shaft fits properly, replace the pitman shaft.

Measure adjuster screw fit and end play in the pitman shaft T-slot. When installed, the screw must rotate freely and not bind in any position. Measure end play by inserting a feeler gauge between the screw head and T-slot surface (fig. 2K-12). End play must not exceed 0.002 inches (0.05 mm). If end play exceeds specified limit, select and install a replacement shim that will provide the specified clearance. Shims are furnished in four thicknesses: 0.063, 0.065, 0.067 and 0.069 inch (1.60, 1.65, 1.70 and 1.75 mm) and are available in kit form.

Inspect the wormshaft upper bearing and bearing cup for wear, looseness, flat spots, pitting, cracks, or other damage. If either the bearing or bearing cup is damaged, both parts must be replaced. If the cup is loose in the housing, trial fit a new cup. If the new cup is also loose, replace the housing. If the new cup fits properly, replace only the bearing cup.

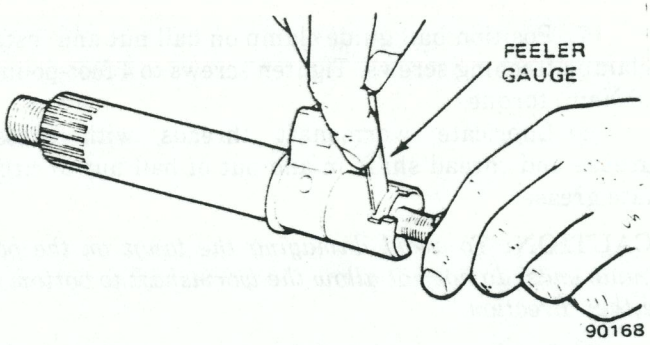

Fig. 2K-12 Measuring Adjuster Screw End Play

Assembly

(1) If wormshaft upper bearing cup is to be replaced, remove old cup using hammer and brass punch (fig. 2K-13).

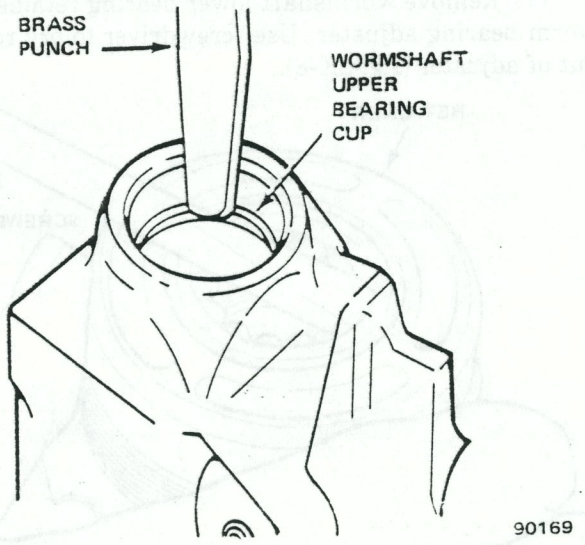

Fig. 2K-13 Removing Wormshaft Upper Bearing Cup

(2) Install replacement bearing cup using Installer J-5755 (fig. 2K-14).

NOTE: *Do not install the wormshaft or pitman shaft seals at this time. Refer to Assembly and Adjustment.*

ASSEMBLY AND ADJUSTMENT

(1) Lubricate all components with chassis grease if not lubricated previously.

(2) Place gear housing in vise. Clamp vise jaws on housing mounting bosses only.

(3) Install wormshaft and ball nut in housing.

CAUTION: *Be sure the ball nut is installed with the deep side of the ball nut teeth facing the side cover opening.*

(4) Install worm bearing adjuster in housing and tighten adjuster only enough to remove wormshaft end play.

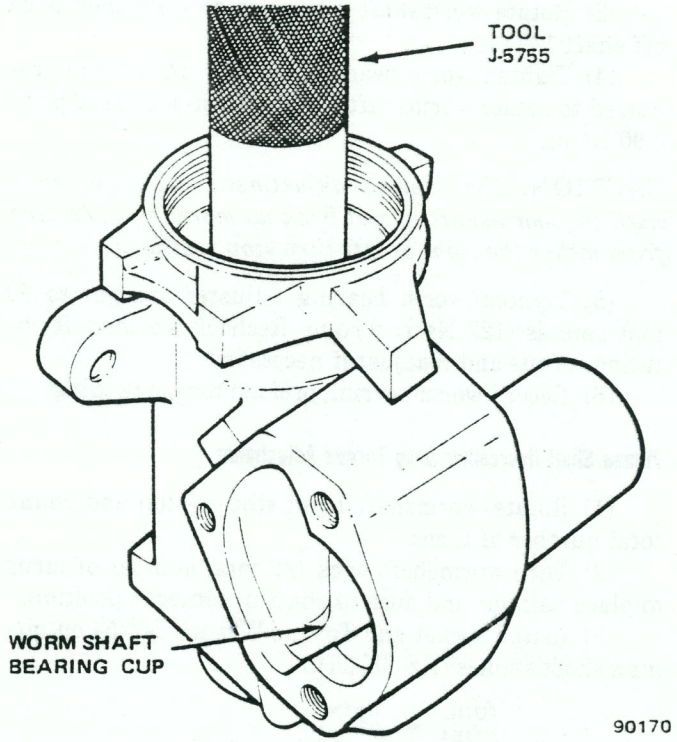

Fig. 2K-14 Installing Wormshaft Upper Bearing Cup

(5) Install locknut on worm bearing adjuster but do not tighten locknut at this time.

(6) Pack steering gear housing with as much chassis grease as possible.

NOTE: *In order to pack the maximum amount of grease into the housing, the ball nut must be moved back and forth for better access to the housing interior. Rotate the wormshaft in one direction until ball nut travel ceases. Pack the unobstructed housing end full of grease; then rotate the shaft in the opposite direction and repeat the packing procedure.*

(7) Place ball nut in centered position. Rotate wormshaft from stop to stop and count total number of turns. Turn wormshaft back 1/2 number of turns to center ball nut.

(8) Lubricate pitman shaft with chassis grease and install shaft in housing. Engage center tooth of shaft in center groove of ball nut (fig. 2K-15).

(9) Coat replacement side cover gasket with chassis grease and position gasket on housing side cover opening.

(10) Install end play shim on adjuster screw and thread screw into side cover to depth of 2-3 threads.

(11) Slide adjuster screw into pitman shaft T-slot and turn screw counterclockwise to thread it into cover. Stop turning screw when side cover almost contacts gasket.

(12) Align gear housing and side cover bolt holes and install cover attaching bolts finger tight only (do not attempt to seat cover on housing by tightening bolts).

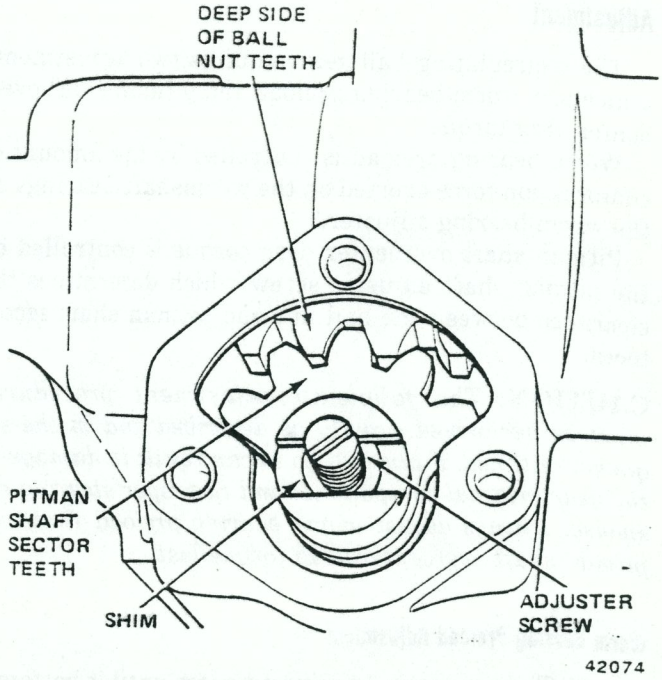

Fig. 2K-15 Pitman Shaft and Ball Nut In Centered Position

(13) Tighten adjuster screw until it bottoms and back off screw 1/2 turn.

(14) Tighten side cover bolts to 30 foot-pounds (41 N•m) torque.

(15) Install pitman shaft and wormshaft seals as follows:

(a) Wrap 0.005 inch (0.1 mm) thick shim stock (or single layer of thinnest tape available) around shaft splines and threads. Shim stock (or tape) will serve as seal protecter when seals are installed.

(b) Lubricate seals with chassis grease. Slide each seal over protective material and down shaft until seal contacts housing.

(c) Start seals into housing seal seats by hand. Complete seal installation by tapping seals into place using plastic mallet. Be sure each seal is fully seated in housing.

CAUTION: *Some type of protective wrap must be used during seal installation. If the seals are installed over exposed shaft splines or threads, the seal lips could be cut or distorted resulting in leakage after assembly.*

(16) Check gear operation. With adjuster screw backed off, wormshaft should rotate freely and without bind in either direction. Also check for grease leaks past seals. If gear binds, repair as necessary and recheck operation. If seals leak, replace them and recheck operation.

(17) Adjust steering gear worm bearing preload and overcenter drag torque. Refer to following adjustment procedure.

Adjustment

The recirculating ball gear requires two adjustments which are, worm bearing preload and pitman shaft overcenter drag torque.

Worm bearing preload is controlled by the amount of compression force exerted on the wormshaft bearings by the worm bearing adjuster.

Pitman shaft overcenter drag torque is controlled by the pitman shaft adjuster screw which determines the clearance between the ball nut and pitman shaft sector teeth.

CAUTION: *The following adjustment procedures must be performed exactly as described and in the sequence outlined. Failure to do so can result in damage to the gear internal components and improper steering response. Always adjust worm bearing preload first and pitman shaft overcenter drag torque last.*

Worm Bearing Preload Adjustment

(1) Tighten worm bearing adjuster until it bottoms, then back off adjuster 1/4 turn.

(2) Install socket and Torque Wrench J-7754 on splined end of wormshaft (fig. 2K-16).

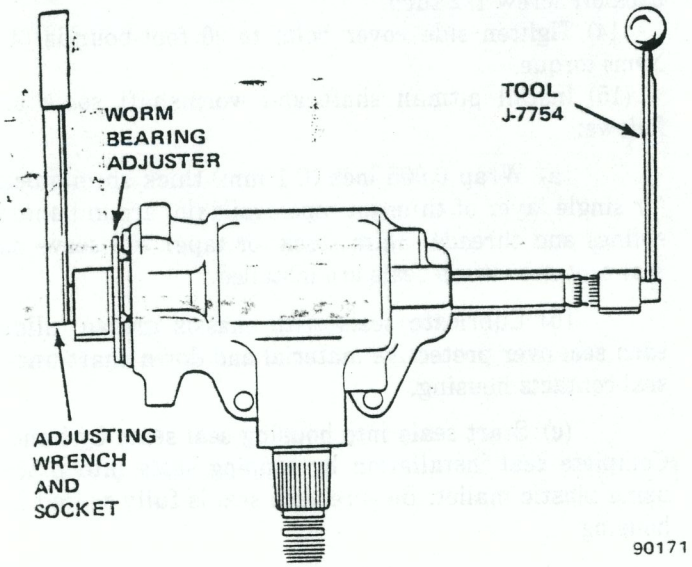

Fig. 2K-16 Adjusting Worm Bearing Preload Torque

(4) Tighten pitman shaft adjuster screw (while rotating shaft back and forth over center) until torque required to rotate shaft over center equals worm bearing preload setting.

(5) Rotate shaft over center and continue tightening adjuster screw until drag torque is increased by additional 4 to 10 inch-pounds (0.45 to 1.13 N•m) but do not exceed total of 16 inch-pounds (1.81 N•m).

CAUTION: *The total amount of over center drag torque (worm bearing preload setting plus additional 4-10 inch-pounds) must not exceed combined total of 16 inch-pounds (1.81 N•m).*

(3) Rotate wormshaft clockwise to stop; then back off shaft 1/2 turn.

(4) Tighten worm bearing adjuster until torque required to rotate wormshaft is 5 to 8 inch-pounds (0.60 to 0.90 N•m).

CAUTION: *The preload adjustment must be made with the wormshaft turned back no more than 1/2 turn from either the right or left turn stop positions.*

(5) Tighten worm bearing adjuster locknut to 90 foot-pounds (122 N•m) torque. Recheck wormshaft rotating torque and readjust if necessary.

(6) Record worm bearing preload torque reading.

Pitman Shaft Overcenter Drag Torque Adjustment

(1) Rotate wormshaft from stop-to-stop and count total number of turns.

(2) Turn wormshaft back 1/2 total number of turns to place ball nut and pitman shaft in centered position.

(3) Install socket and Torque Wrench J-7754 on pitman shaft splines (fig. 2K-17).

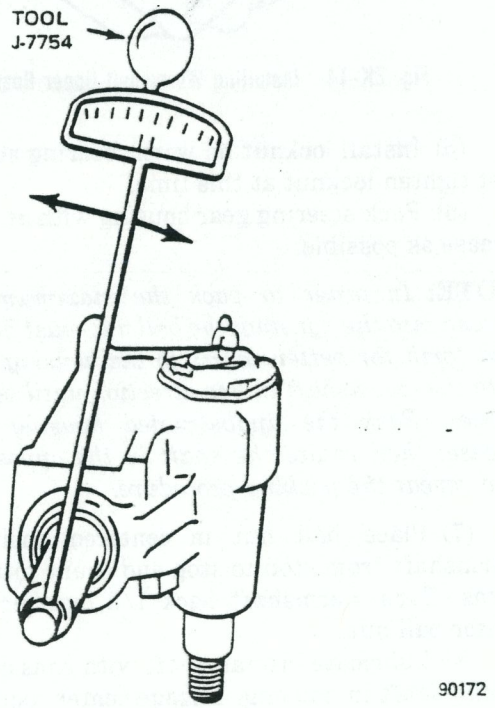

Fig. 2K-17 Adjusting Pitman Shaft Overcenter Drag Torque

(6) Hold adjuster screw in position using screwdriver and tighten adjuster screw locknut to 23 foot-pounds (31 N•m) torque. Do not allow screw to turn when tightening locknut.

NOTE: *If the adjuster screw is allowed to turn when the locknut is tightened, the entire drag torque adjustment procedure will have to be performed once again.*

(7) Recheck overcenter drag torque and readjust if necessary.

SPECIFICATIONS

Manual Steering Gear Specifications

Gear-Type	Recirculating Ball
Ratio	24:1
Bearings	
Upper	Ball
Lower	Ball
Adjustments:	
Worm Bearing Preload	8 in-lbs. (0.90 N·m)
Pitman Shaft Overcenter Drag Torque	4-10 in-lbs. (0.45-1.13 N·m) in addition to 8 in-lbs. (0.90 N·m) worm bearing preload for a total of 16 in-lbs. (1.8 N·m) maximum
Adjuster Screw End Play	0.002 in. (0.05 mm)

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Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft-lbs)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Intermediate Shaft Coupling Clamp Bolt	45	40-50	61	54-68
Pitman Arm Nut	185	160-210	251	217-285
Steering Gear Mounting Bracket-to-Gear Bolts (CJ)	70	60-80	95	81-108
Steering Gear Mounting Bracket-to Tie Plate Bolt (CJ)	55	50-60	75	68-81
Steering Gear Mounting Bolts (Cke., Wag., Trk.,)	70	60-80	95	81-108
Side Cover Bolts	30	25-35	41	34-47
Adjuster Screw Locknut	23	18-27	31	24-37
Worm Bearing Adjuster Locknut	90	70-110	122	95-149

All torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

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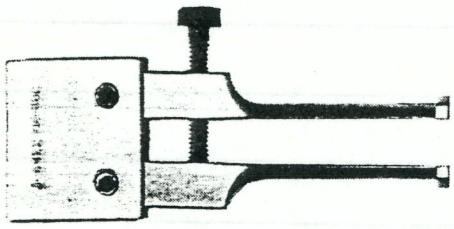
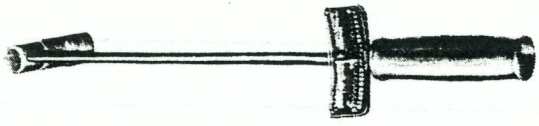
Tools

BEARING CUP INSTALLER J-5755

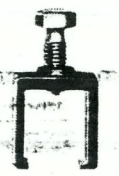


BEARING CUP PULLER J-5822



TORQUE WRENCH J-7754

SLIDE HAMMER J-2619-01



J-6632 PITMAN ARM PULLER

NOTES

POWER STEERING GEAR AND PUMP 2L

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GENERAL INFORMATION

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General	2L-1	Service Diagnosis	2L-6
Hydraulic Pressure Test	2L-15	Specifications	2L-18
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GENERAL

The power steering system consists of a power steering gear, hydraulic pump, and interconnecting hoses. The system fluid supply is contained in a reservoir mounted on the pump. Fluid from the pump is supplied to the gear through the interconnecting pressure and return hoses. The pump is operated by a drive belt mounted on pulleys attached to the pump shaft and engine crankshaft.

Two different ratio steering gear units are used. CJ models use a constant ratio gear with a 17.5:1 steering ratio. Cherokee, Wagoneer and Truck models use a variable ratio gear with a 16:1 ratio on center and 13:1 ratio at full lock.

Although the steering ratios of the two units differ, exterior appearance and service procedures for both units are the same. However, the internal components of the two gears are not interchangeable.

A vane-type power steering pump with a combination flow control/relief valve is used on all models. Two valve calibrations are used. On CJ models, the valve is calibrated to open at 1100 psi (7 584 kPa). On Cherokee, Wagoneer and Truck models, the valve is calibrated to open at 1500 psi (10 342 kPa).

The power steering gear is designed to operate manually if a system malfunction should ever occur. This feature provides the driver with continued steering control of the vehicle. In this condition, the gear operates like a manual steering gear; hydraulic fluid is bypassed through the gear valve body to allow manual operation.

NOTE: *The power steering gear and pump form a closed system. Contaminants or foreign material must not be allowed to enter the system at any point. If either the gear or pump become contaminated, or incur damage extensive enough to produce debris, both components must be disassembled, cleaned, and serviced.*

DESCRIPTION AND OPERATION

Steering Gear

The power steering gear is a recirculating ball-type unit (fig. 2L-1). Steel ball bearings act as a rolling thread between the steering gear wormshaft and rack piston.

Two different ratio gears are used. CJ models use a constant ratio gear with 17.5:1 steering ratio. Cherokee, Wagoneer and Truck models use a variable ratio gear with 16:1 steering ratio on center and 13:1 at full lock. Although the two gears have different steering ratios, exterior appearance, diagnosis, and service procedures are the same for both.

Steering gear wormshaft fore and aft thrust is controlled by a bearing and two races at the lower end, and a bearing assembly in the adjuster plug at the upper end. The lower bearing races are conical in shape. This design maintains constant preload on the wormshaft to

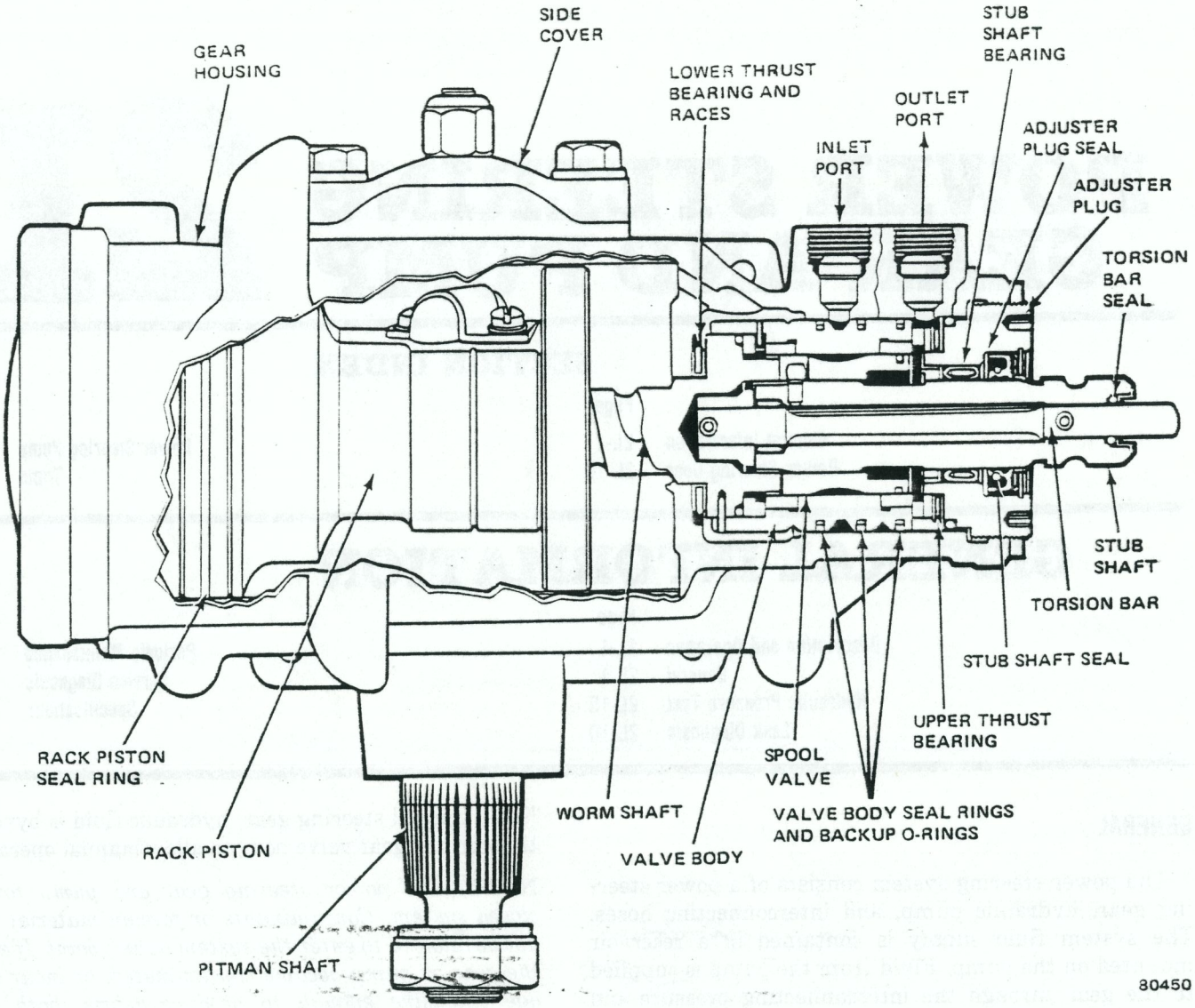


Fig. 2L-1 Power Steering Gear

prevent loss of thrust bearing preload. The adjuster plug provides initial worm bearing preload and service adjustment.

In a right-turn position, the rack piston moves upward within the gear. In a left-turn position, the rack piston moves downward within the gear. The rack piston teeth mesh with the pitman shaft sector teeth. The sector is forged as an integral part of the pitman shaft. Turning the wormshaft also turns the pitman shaft which, through mechanical linkage, turns the wheels.

Power Steering Pump

A vane-type, constant displacement hydraulic pump is used to develop system fluid pressure (fig. 2L-2). The pump has an integral reservoir that contains the system fluid supply.

The reservoir cap is vented to maintain atmospheric pressure within the reservoir and allow air trapped in the system to escape. A dipstick mounted in the reservoir cap is used to check system fluid level.

System operating pressures are maintained by a combination flow control/relief valve located in the pump (fig. 2L-2). The relief section of the valve prevents excessive system pressure buildup.

Hydraulic Assist

An open center, three position, rotary-type valve body is used to control fluid flow within the gear (fig. 2L-1). Pump supplied fluid enters the valve body through a pressure port in the gear housing. The valve then directs fluid to the rack piston through passages in the housing.

The valve body, spool valve, torsion bar, and stub shaft (which is pinned to the torsion bar) are connected to the front wheels through mechanical linkage.

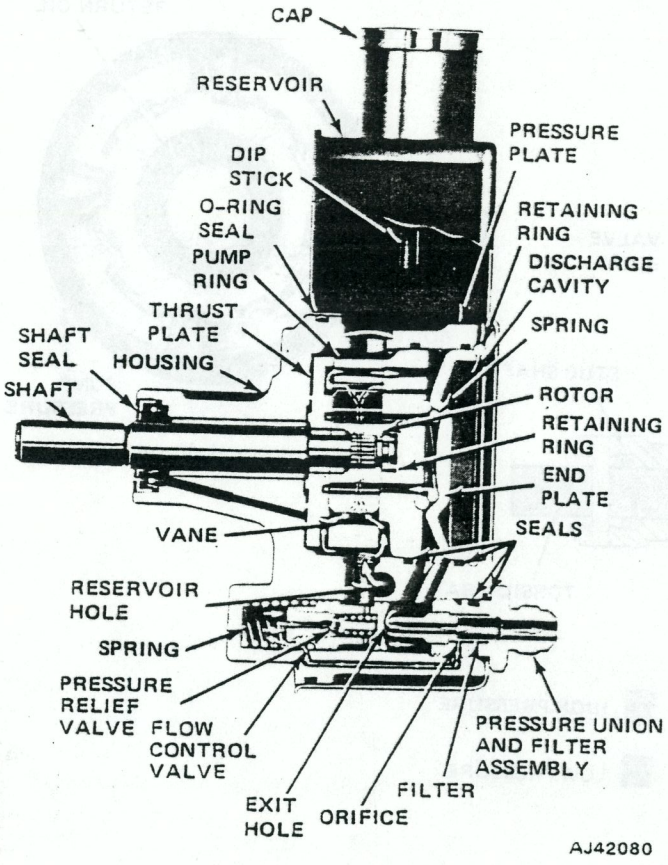


Fig. 2L-2 Power Steering Pump

Because of the pressure exerted on the front wheels by vehicle weight, the wheels and valve body tend to resist any turning effort applied at the steering wheel. As front wheel resistance to turning effort increases, the torsion bar (which is pinned to the stub shaft) deflects. Since the spool valve is connected to the stub shaft by a locating pin, torsion bar deflection causes the spool valve to rotate within the valve body. As the spool valve rotates, fluid directional passages in the valve are brought into alignment with matching passages in the valve body. When these passages are aligned, high pressure fluid from the pump is directed through the passages and against either side of the rack piston to provide hydraulic assist.

Torsion bar deflection provides the required amount of steering gear "road feel." If the bar should ever break, road feel would be lost but the steering system would still function due to auxiliary locking tabs on the stub shaft. In this situation, the gear would operate as a manual-type recirculating ball steering gear.

Neutral (Straight-Ahead) Position

In this position, fluid does not enter the rack piston chamber. Fluid from the pump flows through the open-center valve body and back to the pump reservoir.

The valve body remains in the open center position at all times, except when turning, to reduce fluid and pump friction losses. In addition, the gear is always filled with fluid to lubricate internal components and absorb road shock.

Right Turn Position

The valve body is held in position by the resistance to movement of the front wheels. When the steering wheel is turned to the right, torsion bar deflection causes the spool valve to rotate within the valve body.

As the spool valve rotates, the spool valve fluid return grooves are closed off while the right turn grooves are aligned with high pressure fluid grooves in the valve body (fig. 2L-3). The spool valve left turn grooves are closed off from pump pressure and are aligned with the valve body fluid return grooves. In this position, the valve body directs high presure fluid into the lower end of the rack piston chamber to force the rack piston upward and apply additional turning effort to the pitman shaft (fig. 2L-3).

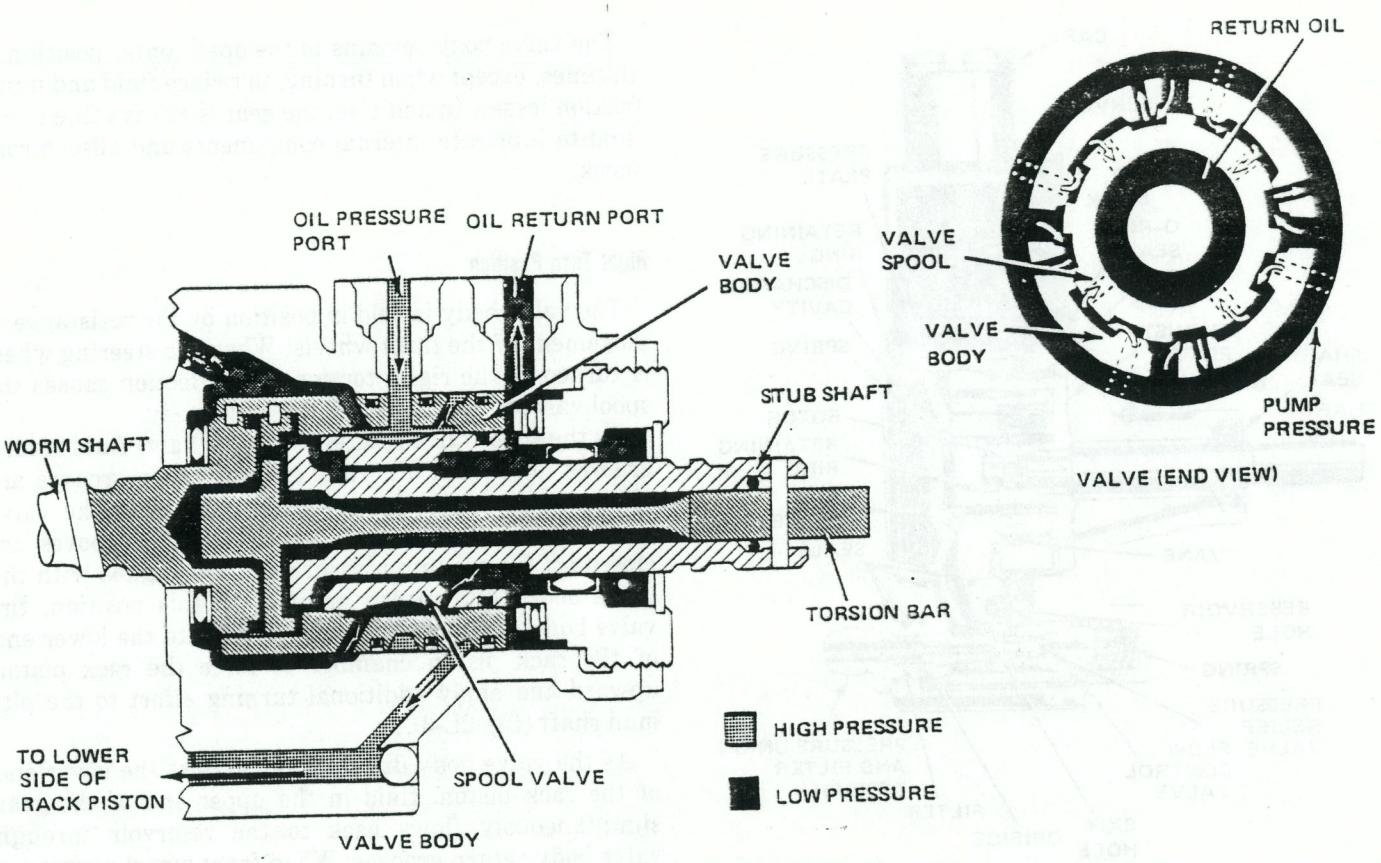
As the valve body directs fluid against the lower end of the rack piston, fluid in the upper end of the gear simultaneously flows back to the reservoir through valve body return grooves. When front wheel resistance to turning effort increases, torsion bar deflection causes additional spool valve rotation. This exposes more of the spool valve right turn grooves to the valve body pressure grooves increasing fluid pressure exerted on the rack piston.

When the driver stops applying turning effort at the steering wheel, the torsion bar unwinds returning the spool valve to the neutral (straight ahead) position. At this point, fluid pressure on each end of the rack piston is equalized once again and steering geometry causes the front wheels to resume a straight ahead position.

Left Turn Position

In the left turn position, the torsion bar, spool valve, and valve body operate the same as in a right turn except that valve rotation is now reversed (fig. 2L-4). This causes the valve body to channel high pressure fluid into the upper end of the rack piston chamber forcing the rack piston downward (fig. 2L-4). Fluid in the lower end of the gear flows back to the pump reservoir through the valve body and steering gear return port.

When the driver stops applying turning effort at the steering wheel, the torsion bar unwinds returning the spool valve to the neutral (straight ahead) position. As in the right turn position, fluid pressure on each end of the rack piston is equalized again and steering geometry causes the front wheels to resume a straight ahead position.



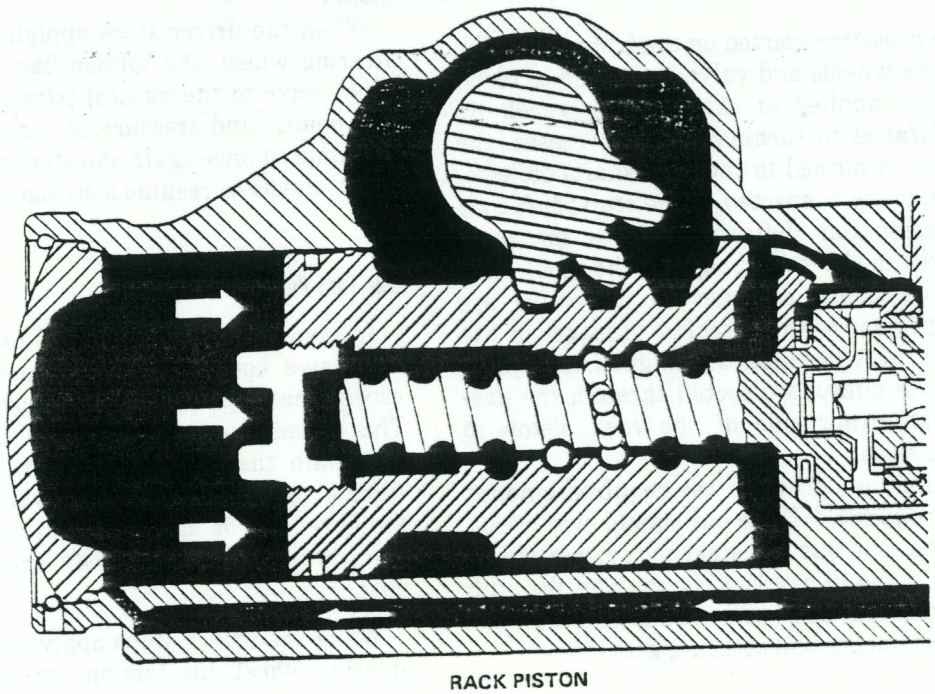


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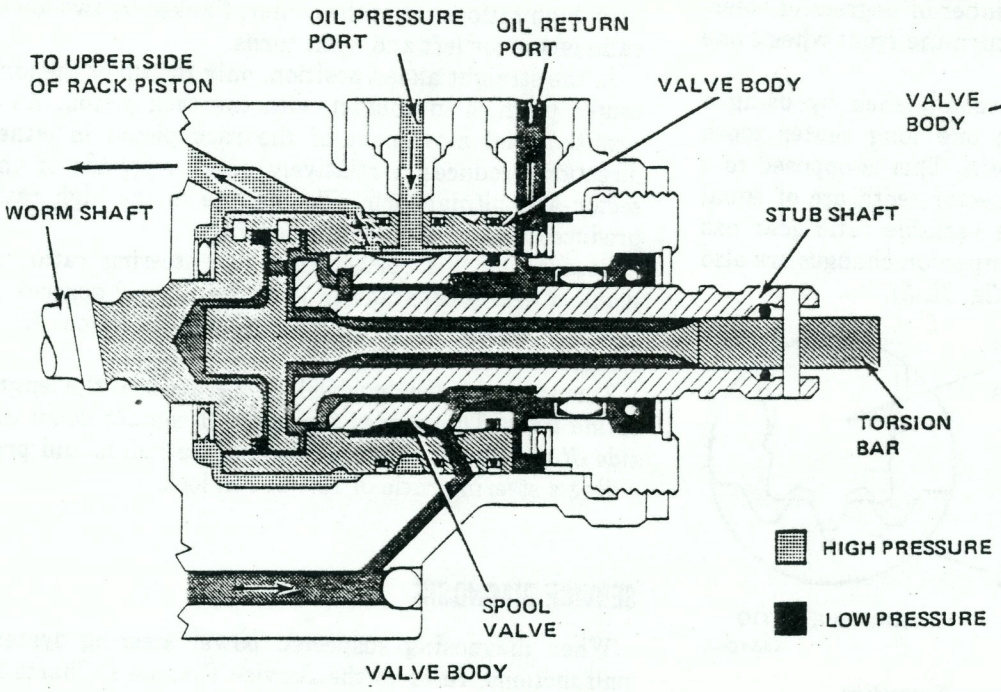
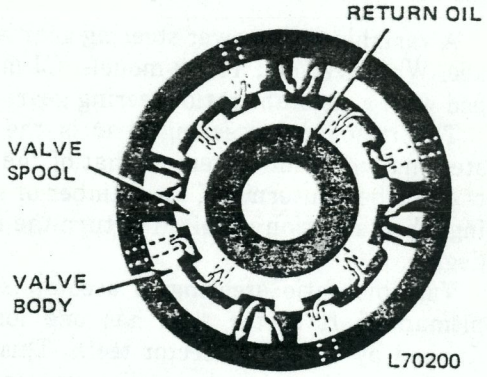
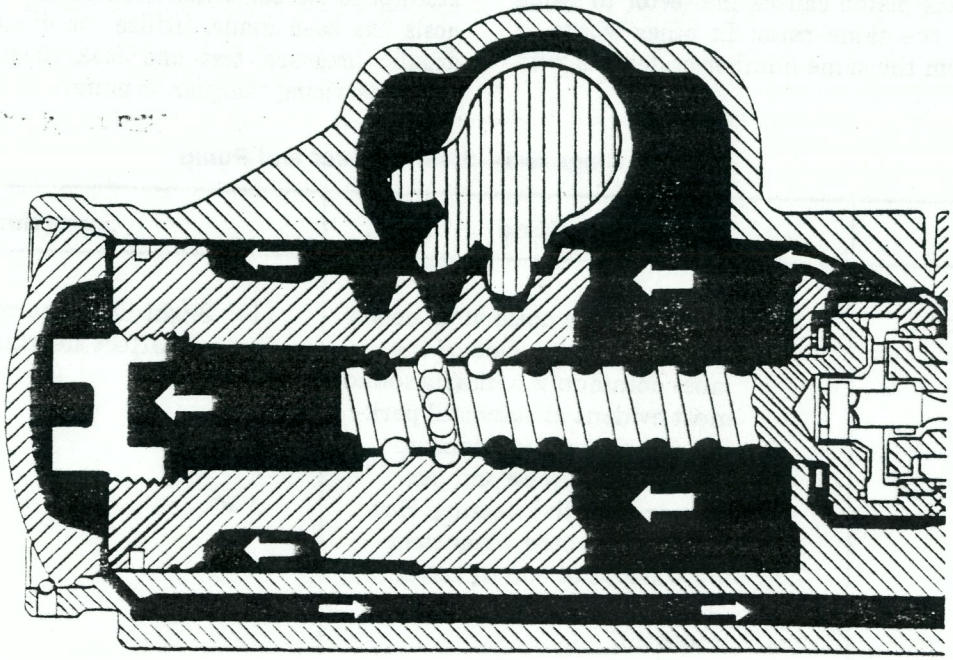
Fig. 2L-3 Fluid Flow—Right Turn Position



VALVE BODY



VALVE (END VIEW)



RACK PISTON

Fig. 2L-4 Fluid Flow—Left Turn Position

Variable Ratio Power Steering

A variable ratio power steering gear is used on Cherokee, Wagoneer and Truck models. CJ models are equipped with a constant ratio steering gear.

The ratio of a steering gear is the relationship of steering wheel movement to that of the front wheels. It is described in terms of the number of degrees of steering wheel rotation required to turn the front wheels one degree.

Variable ratio steering is accomplished by using a pitman shaft sector that has one long center tooth flanked by two short sector teeth. This is opposed to a constant ratio gear where all sector teeth are of equal length (fig. 2L-5). Because the variable ratio gear has unequal length sector teeth, companion changes are also made in the rack piston teeth (fig. 2L-5).

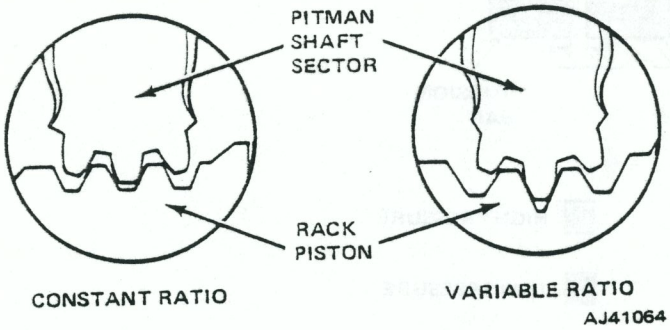


Fig. 2L-5 Rack and Sector Comparison

Since the sector is basically a series of levers, any movement of the rack piston causes the sector to swing the pitman arm in the same ratio. In other words, it turns the pitman arm the same number of degrees with each sector tooth.

To increase or decrease steering ratio, it is only necessary to change the length of the sector teeth. A low numerical ratio (smaller radius sector with shorter teeth) produces greater pitman arm movement than would a high ratio sector with longer teeth and greater leverage.

On this basis, the variable ratio sector is in reality one long, high ratio lever at the center, flanked by two lower ratio levers for left and right turns.

In the straight ahead position, only the tip of the long center tooth is in contact with the rack piston. As a result, initial movement of the rack piston in either direction produces a relatively small response of the sector and pitman arm. This is due to the high ratio produced by a long lever relationship.

Because of this relationship, the steering ratio remains a nearly constant 16:1 for the first 40 degrees of steering wheel movement in either direction from center.

Turning the steering wheel further reduces the length of the lever. This moves the point of contact down the side of the center tooth decreasing the radius and providing a steering ratio of 13:1 at full lock.

SERVICE DIAGNOSIS

When diagnosing suspected power steering system malfunctions, refer to the Service Diagnosis Charts in this section for probable causes and indicated repair procedures.

To avoid ineffective or unneccessary repair, do not attempt to correct a malfunction until an accurate diagnosis has been made. Utilize the diagnosis charts, hydraulic pressure test and leak diagnosis procedures before servicing the gear or pump.

Service Diagnosis—Steering Gear and Pump

Condition	Possible Cause	Correction
HISSING NOISE IN STEERING GEAR	(1) There is some noise in all power steering systems. One of the most common is a hissing sound most evident at standstill parking. There is no relationship between this noise and performance of the steering. Hiss may be expected when steering wheel is at end of travel or when slowly turning at standstill.	(1) Slight hiss is normal and does not affect steering.
RATTLE OR CHUCKLE NOISE IN STEERING GEAR	(1) Gear loose on frame.	(1) Tighten gear-to-frame mounting bolts.

60702A

Service Diagnosis—Steering Gear and Pump (Continued)

Condition	Possible Cause	Correction
RATTLE OR CHUCKLE NOISE IN STEERING GEAR (CONTINUED)	(2) Steering linkage looseness.	(2) Check linkage pivot points for wear. Replace if necessary.
	(3) Pressure hose touching other parts of vehicle.	(3) Adjust hose position. Do not bend tubing by hand.
	(4) Insufficient pitman shaft over center drag torque. NOTE: A slight rattle may occur on turns because of increased clearance off the "high point." This is normal and clearance must not be reduced below specified limits to eliminate this slight rattle.	(4) Adjust to specifications.
	(5) Loose pitman arm.	(5) Tighten pitman arm nut to specifications, or replace nut.
SQUAWK NOISE IN STEERING GEAR WHEN TURNING OR RECOVERING FROM A TURN	(1) Damper O-ring on spool valve cut.	(1) Replace damper O-ring.
CHIRP NOISE IN STEERING PUMP	(1) Loose or damaged belt.	(1) Adjust belt tension or replace belt.
BELT SQUEAL (PARTICULARLY NOTICEABLE AT FULL WHEEL TRAVEL AND STAND STILL PARKING)	(1) Loose or damaged belt.	(1) Adjust belt tension or replace belt.
GROWL NOISE IN STEERING PUMP	(1) Excessive back pressure in hoses or steering gear caused by restriction.	(1) Locate restriction and correct. Replace part if necessary.
GROWL NOISE IN STEERING PUMP (PARTICULARLY NOTICEABLE AT STAND STILL PARKING)	(1) Scored pressure plates, thrust plate or rotor.	(1) Replace parts and flush system.
	(2) Extreme wear of cam ring.	(2) Replace parts.
GROAN NOISE IN STEERING PUMP	(1) Low oil level.	(1) Fill reservoir to proper level.
	(2) Air in the oil or loose pressure hose connection.	(2) Tighten connector to specified torque. Bleed system by operating steering from right to left-full turn.
RATTLE NOISE IN STEERING PUMP	(1) Vanes not installed properly.	(1) Install properly.
	(2) Vanes sticking in rotor slots.	(2) Free up by removing burrs, varnish, or dirt.

Service Diagnosis—Steering Gear and Pump (Continued)

Condition	Possible Cause	Correction
WHINE NOISE IN STEERING PUMP	(1) Pump shaft bearing scored.	(1) Replace housing and shaft. Flush system.
POOR RETURN OF STEERING WHEEL TO CENTER	(1) Tires not properly inflated.	(1) Inflate to specified pressure.
	(2) Lack of lubrication in linkage and ball studs.	(2) Lube linkage and ball studs.
	(3) Lower coupling flange rubbing against steering gear adjuster plug.	(3) Loosen pinch bolt and assemble properly.
	(4) Improper front wheel alignment	(4) Check and adjust as necessary. With front wheels still on alignment pads of front-end machine, disconnect pitman arm from pitman shaft. Turn front wheels by hand. If wheels will not turn or turn with considerable effort, determine if linkage or ball studs are binding.
	(5) Steering linkage binding.	(5) Replace rod ends.
	(6) Ball studs binding.	(6) Replace ball studs.
	(7) Tight or frozen steering shaft bearings.	(7) Replace bearings.
	(8) Sticky or plugged spool valve.	(8) Remove and clean or replace valve.
	(9) Steering gear adjustments over specifications.	(9) Check adjustment with gear out of vehicle. Adjust as required.
	(10) Steering gear poppet valve installed incorrectly.	(10) Inspect and install valve correctly.
	(11) Return hose kinked.	(11) Replace hose.
CAR LEADS TO ONE SIDE OR THE OTHER (KEEP IN MIND ROAD CONDITION AND WIND. TEST CAR IN BOTH DIRECTIONS ON FLAT ROAD)	(1) Incorrect tire pressure.	(1) Check and adjust.
	(2) Front end misaligned.	(2) Adjust to specifications.
	(3) Unbalanced steering gear valve.	(3) Replace valve.
MOMENTARY INCREASE IN EFFORT WHEN TURNING WHEEL FAST TO RIGHT OR LEFT	(1) Low oil level in pump.	(1) Add power steering fluid as required.
	(2) Pump belt slipping.	(2) Tighten or replace belt.
	(3) High internal leakage.	(3) Check pump pressure. (See pressure test)

60702C

Service Diagnosis—Steering Gear and Pump (Continued)

Condition	Possible Cause	Correction
STEERING WHEEL SURGES OR JERKS WHEN TURNING WITH ENGINE RUNNING ESPECIALLY DURING PARKING	(1) Low oil level.	(1) Fill as required.
	(2) Loose pump belt.	(2) Adjust tension to specification.
	(3) Insufficient pump pressure.	(3) Check pump pressure. (See pressure test). Replace relief valve if defective.
	(4) Flow control valve sticking.	(4) Inspect for varnish or damage, replace if necessary.
LOOSE STEERING	(1) Steering gear loose on frame.	(1) Tighten attaching bolts to specified torque.
	(2) Steering gear flexible coupling loose on shaft or rubber disc mounting screws loose.	(2) Tighten flange pinch bolts. If serrations are not damaged, tighten upper flange to coupling nuts to specified torque.
	(3) Steering linkage rod ends worn.	(3) Replace rod ends.
	(4) Worn poppet valve (Gear).	(4) Replace poppet valve.
	(5) Insufficient wormshaft bearing preload.	(5) Adjust to specification with gear out of vehicle.
	(6) Insufficient overcenter drag torque.	(6) Adjust to specification with gear out of vehicle.
HARD STEERING OR LACK OF ASSIST	(1) Loose pump belt.	(1) Adjust belt tension to specification.
	(2) Low oil level in pump reservoir.	(2) Fill to proper level. If excessively low, check all lines and joints for evidence of external leakage. Tighten loose connectors.
	NOTE: Low oil level will also result in excessive pump noise.	
	(3) Tires not properly inflated.	(3) Inflate to recommended pressure.
NOTE: If checks (1) through (3) do not reveal cause of hard steering, refer to pressure test.	(4) Sticky flow control valve.	In order to diagnose conditions such as listed in (4), (5), (6), (7) a test of the entire power steering system using pressure test tool J-21567 is required.
	(5) Pump pressure low.	
	(6) Pump internal leakage.	
	(7) Gear internal leakage.	

Service Diagnosis—Steering Gear and Pump (Continued)

Condition	Possible Cause	Correction
FOAMING AERATED POWER STEERING FLUID, LOW FLUID LEVEL AND POSSIBLE LOW PRESSURE	(1) Air in fluid, and loss of fluid due to pump internal leakage causing overflow.	(1) Check for leak and correct. Bleed system. Extremely cold temperatures will cause system aeration should the oil level be low. If oil level is correct and pump still foams, remove pump from vehicle and separate reservoir from housing. Check welsh plug and housing for cracks. If plug is loose or housing is cracked, replace housing.
LOW PRESSURE DUE TO STEERING PUMP	(1) Flow control valve stuck or inoperative.	(1) Remove burrs or dirt or replace. Flush system.
	(2) Pressure plate not flat against cam ring.	(2) Correct.
	(3) Extreme wear of cam ring.	(3) Replace parts. Flush system.
	(4) Scored pressure plate, thrust plate, or rotor.	(4) Replace parts. Flush system.
	(5) Vanes not installed properly.	(5) Install properly.
	(6) Vanes sticking in rotor slots.	(6) Freeup by removing burrs, varnish, or dirt.
	(7) Cracked or broken thrust or pressure plate.	(7) Replace part.
LOW PRESSURE DUE TO STEERING GEAR	(1) Pressure loss in cylinder due to worn piston ring or badly worn housing bore.	(1) Remove gear for disassembly and inspection of ring and housing bore.
	(2) Leakage at valve rings, valve body-to-worm seal.	(2) Remove gear for disassembly and replace seals.

60702E

LEAK DIAGNOSIS

The actual source of power steering system fluid leaks should always be determined before attempting repair. Because inaccurate diagnosis can lead to ineffective repair, proper inspection procedures are necessary. The most common fluid leak sources are shown in figures 2L-6, 2L-7, and 2L-8.

Inspection Procedure

(1) Raise front of vehicle.

(2) Clean exterior surfaces of steering gear, pump, hoses, and fittings thoroughly.

(3) Check pump fluid level. Add or remove fluid as necessary.

(4) Check for aerated fluid (orange in color and full of bubbles) which can cause overflow from reservoir and be mistaken for leak.

(5) Check and tighten all hose connections at gear and pump. Do not exceed 30 foot-pounds (41 N•m) torque at any fitting.

(6) Start engine. Have helper turn steering wheel left and right several times while locating source of leak. Contact steering stops momentarily in each direction when turning wheel.

(7) Stop engine when leak source is identified.

Leak Diagnosis and Correction—Steering Gear

NOTE: *Refer to figures 2L-6 and 2L-7 for an illustration of steering gear leak sources.*

(1) If leak occurs from hose or hose fittings, replace hose and O-ring if equipped with metric thread fittings. If leak continues to occur at gear housing pressure or return port and hose or O-ring has been replaced, replace hose connector seats in gear housing or hose and O-ring if equipped with metric thread fittings.

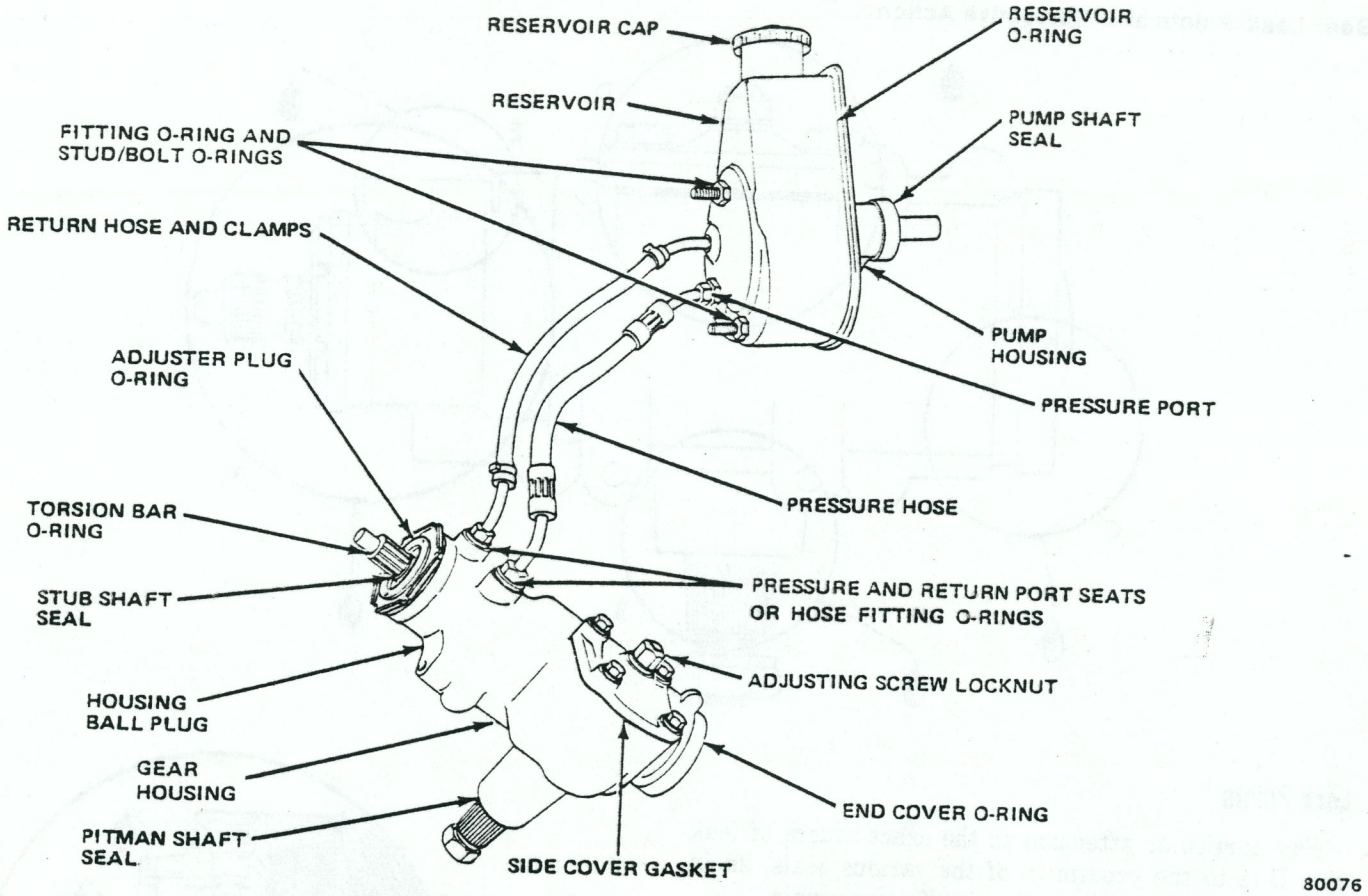


Fig. 2L-6 Power Steering System Leak Points

CAUTION: *Some steering gear units may have metric thread pressure and return port and hose fittings that use an O-ring instead of connector seats (fig. 2L-7).*

(2) If leak occurs between adjuster plug and housing, replace adjuster plug O-ring.

(3) If leak occurs between stub shaft and stub shaft seal in adjuster plug, replace seal.

(4) If leak occurs from steering gear housing ball plug, seat plug in housing using blunt punch. Spray ball area with Loctite Solvent 7559, or equivalent.

Dry area using compressed air. Cover ball wth Loctite Sealant 290, or equivalent. Allow sealant to cure for approximately two hours before installing housing.

(5) If leak occurs between torsion bar and torsion bar seal, replace entire valve body assembly.

(6) If leak occurs at side cover gasket or locknut, replace gasket or locknut as necessary.

NOTE: *The locknut has a left-hand thread.*

(7) If leak occurs between pitman shaft and shaft seal, replace seal and check shaft for nicks, scores, burrs, or pitting. Remove minor surface imperfections using crocus cloth. Replace shaft if severely damaged.

(8) If leak occurs between end plug and housing, replace end plug O-ring seal.

(9) If leak is from crack or porous spot in gear housing, replace housing.

Leak Diagnosis and Correction—Pump

NOTE: *Refer to figure 2L-8 for an illustration of the various pump leak sources.*

(1) If leak occurred between pump union fitting and hose fitting, replace union and hose. If pump has metric thread union fitting, replace O-ring or hose and O-ring if damaged.

(2) If leak occurred between pump union fitting and pump body, replace pump union fitting O-rings.

(3) If leak occurred between reservoir and pump body, replace reservoir O-ring seal.

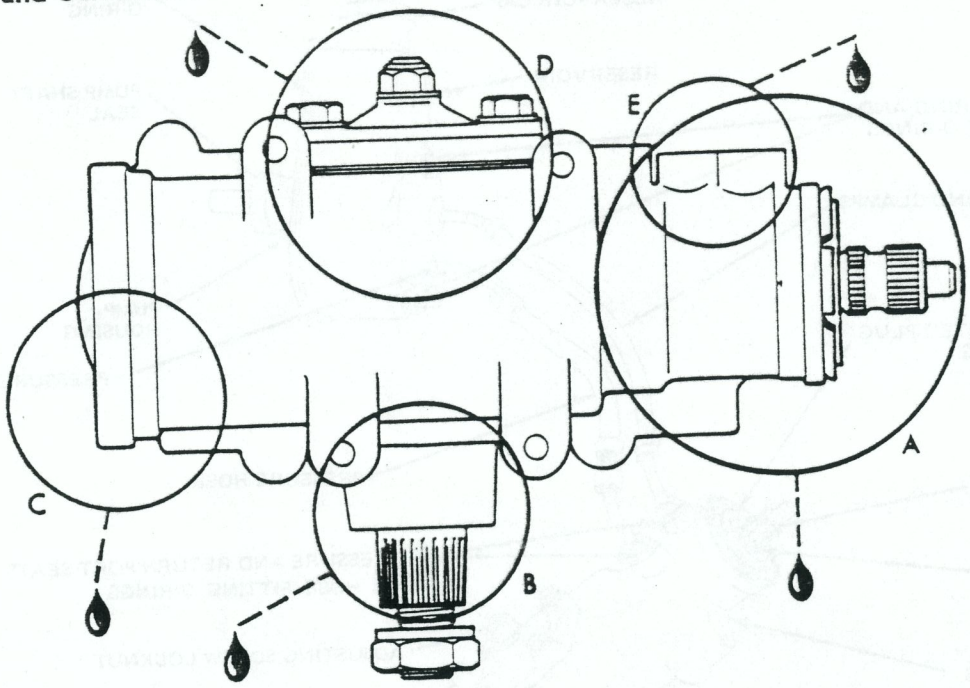
(4) If leak occurred between pump shaft and pump shaft seal, replace seal and check pump shaft for nicks, scores, burrs, or pitting.

(5) If leak is result of overfill condition, drain fluid from reservoir to correct level.

(6) If fluid is aerated, check for overfill condition, or air entering fluid through loose hose connection or reservoir O-ring seal, or perform hydraulic pressure test to check for sticking flow control valve.

(7) If leak occurs from cracked or porous pump body or reservoir, replace pump as assembly.

Gear Leak Points and Corrective Action



Leak Points

Pay particular attention to the exact source of leakage. Due to the proximity of the various seals, an incorrect diagnosis will result in ineffective repair.

Corrective Action

Replace adjuster plug O-ring seal.

Replace Dust and stub shaft seals.

If seepage is observed between the torsion bar and stub shaft, do not attempt repair. The rotary valve assembly must be replaced.

Seat housing ball with blunt punch. Spray ball area with Loctite solvent 75559 or equilavent. Dry ball area with compressed air. Apply Loctite sealent 290 or equivalent to ball area. Allow sealent to cure for approximately two hours before installing housing.

Replace both pitman shaft seals.

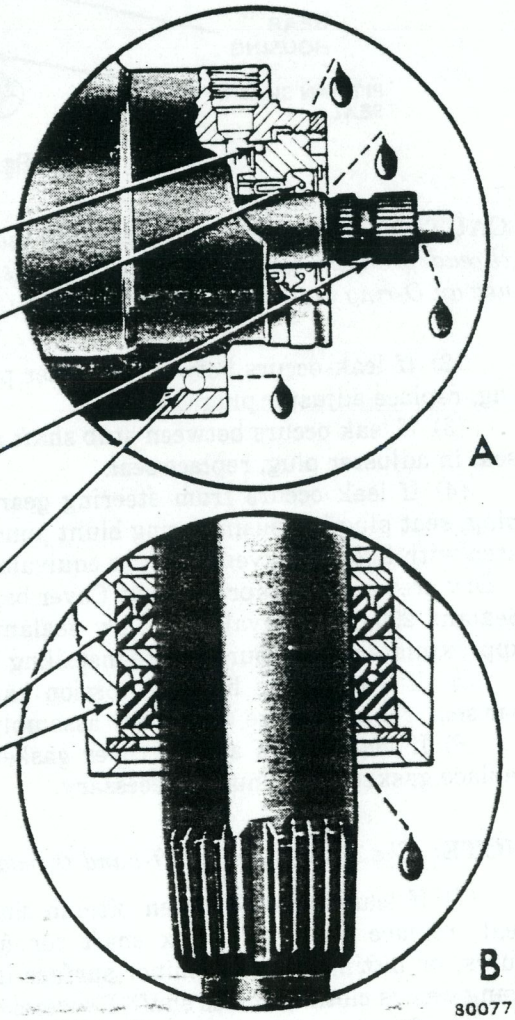
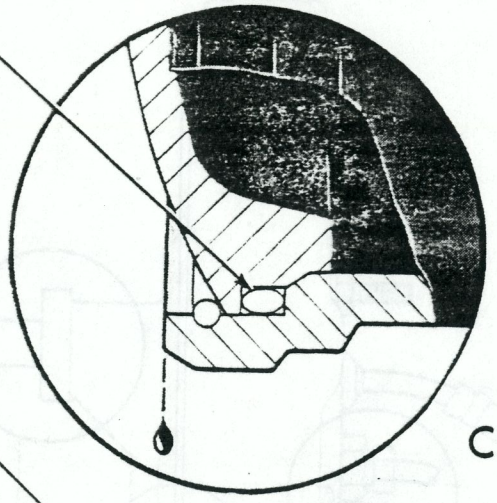


Fig. 2L-7 Steering Gear Leak Diagnosis and Corrective Action (View A)

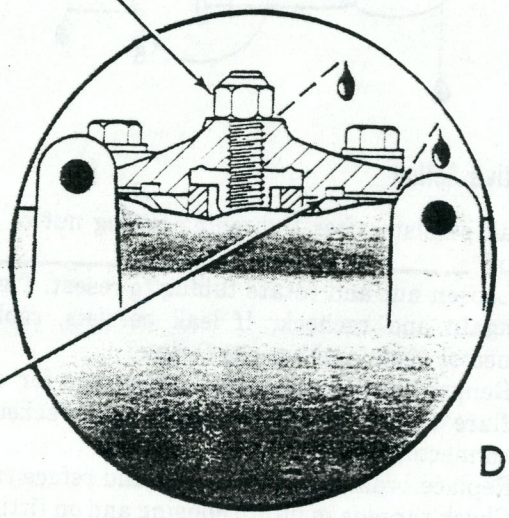
Corrective Action (cont.)

Replace end plug O-ring seal.



Tighten nut to 35 foot-pounds (47 N·m) torque. Replace nut if leak persists.

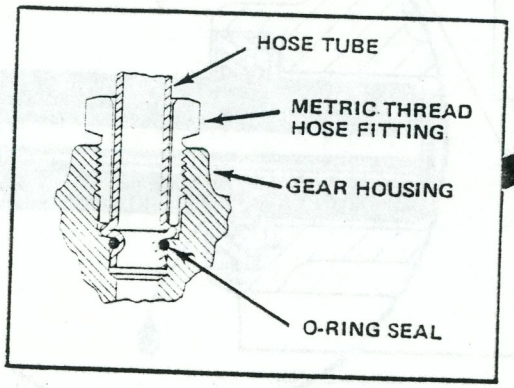
Tighten side cover bolts to 50 foot-pounds (68 N·m) maximum. Replace side cover seal if leak persists. If side cover seal replacement is required, discard bolts and install replacement. Whenever the side cover is removed, install bolts supplied in overhaul kit.



If leak continues after tightening fitting nut to specified torque:

a. Loosen nut and rotate tubing to reseat. Tighten nut again and recheck. If leak persists, replace connector seats.
b. Remove hose and check sealing face for cracks. If flare is cracked, replace connector seats.
c. Replace brass connector seats and reface hose flare. Check threads in housing and on fitting nut. If nut threads are damaged, replace nut. If housing threads are damaged, replace both housing and nut.

CAUTION: Some steering gear units may be equipped with metric thread hose fittings that use O-ring seals. Replace the seal if it leaks or replace the hose and seal if the fitting is damaged.



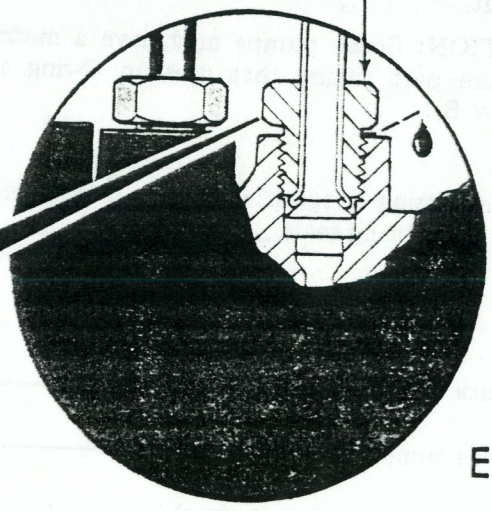


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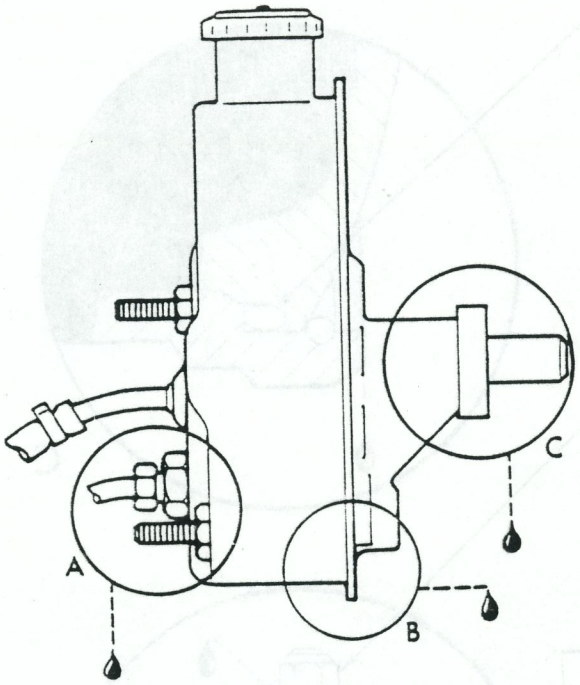
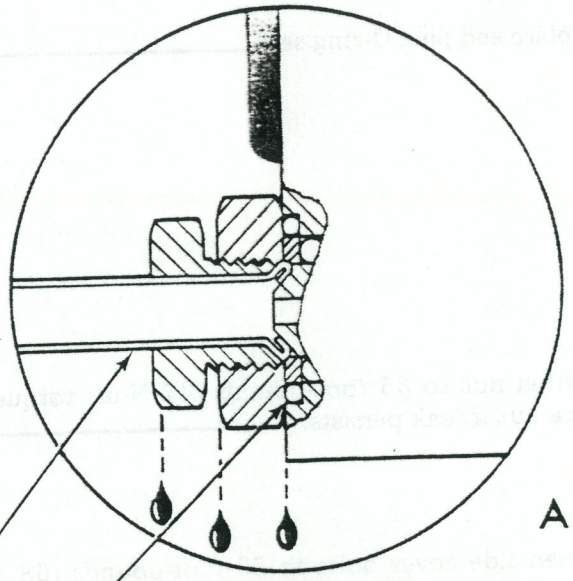
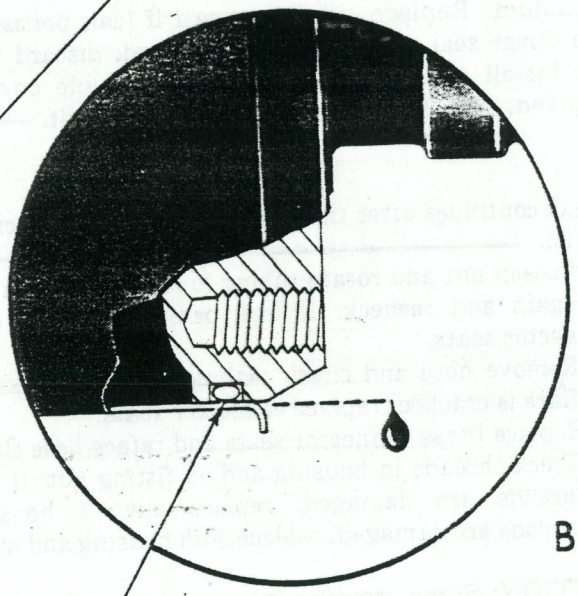
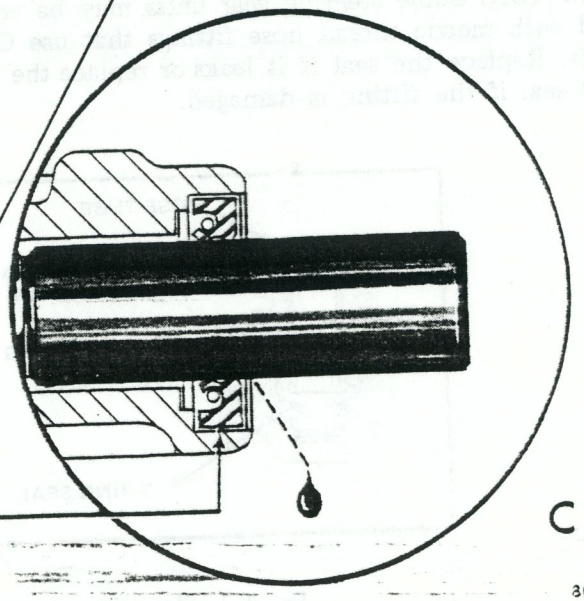
Fig. 2L-7 Steering Gear Leak Diagnosis and Corrective Action (View B)

Pump Leak Points and Corrective Action









Corrective Action

If leak persists after tightening fitting nut to specified torque:

a. Loosen nut and rotate tubing to reseat. Tighten nut again and recheck. If leak persists, replace connector seats and hose or O-ring.
b. Remove hose and check sealing face for cracks. If flare is cracked, replace hose. If not cracked, replace connector seats.
c. Replace brass connector seats and reface tube flare. Check threads in pump housing and on fitting nut. If nut threads are damaged, replace both housing and nut.

CAUTION: Some pumps may have a metric thread pressure part fitting that uses an O-ring seal (2L-7 view B).

Tighten fitting to specified torque. If leak persists, Replace both O-ring seals.

Replace reservoir O-ring.

Replace pump shaft seal.

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Fig. 2L-8 Power Steering Pump Leak Diagnosis and Corrective Action

HYDRAULIC PRESSURE TEST

The hydraulic pressure test is performed using Test Gauge J-21567. The fittings on the test gauge and gauge valve have 1/4 pipe threads. Any combination of fittings is acceptable for gauge installation and connection can be made at the pump or gear as desired. However, the gauge must be connected in the pressure line circuit between pump and test gauge valve at all times.

CAUTION: *Some steering gear and pump units have metric thread fittings and hose fittings which use an O-ring seal (fig. 2L-7, View B). In order to use gauge J-21567, hose fitting adapters J-5176-5, must be installed on the existing gauge hoses before using the test gauge.*

Test Procedure

(1) Check condition of power steering fluid. Drain and replace fluid if it contains small amount of dirt or contaminant. If fluid is exceptionally dirty, contaminated, or full of debris or foreign material, gear and pump should be disassembled and serviced.

(2) If fluid is full of bubbles, bleed power steering system. Refer to Fluid Level and Initial Operation in Power Steering Pump section.

(3) Check and adjust pump drive belt tension if necessary.

(4) Position drip pan under pump.

(5) Disconnect pressure hose at pump. Keep hose end raised to avoid excessive fluid loss.

(6) Connect pressure hose to Test Gauge J-21567. Refer to Pump Diagnosis Charts. Install hose fitting adapters J-5176-5 if gear and pump have metric thread fittings.

(7) Connect test gauge hose to pump. Refer to Pump Diagnosis Charts.

(8) Open test gauge valve completely. Turn valve counterclockwise to open.

(9) Fill pump reservoir with power steering fluid.

(10) Shift transmission into neutral, apply parking brakes, start engine, and operate engine until power steering fluid reaches normal operating temperature.

(11) Record pump initial output pressure registered on test gauge. Pressure should be 80-125 psi (552-862 kPa) with gauge valve open completely.

NOTE: *If the initial output pressure exceeds 200 psi (1 379 kPa), stop the engine and check the test gauge and pressure hoses for restrictions.*

(12) Check pump maximum output pressure as follows: Close gauge valve completely for 2-3 seconds; then open valve completely. Perform this procedure three times in succession and record highest pressure developed each time valve is closed.

CAUTION: *Do not hold the gauge valve closed for more than five seconds at a time as pump damage could occur.*

(13) On CJ models, maximum pump output pressures should be in 1000-1100 psi (6 895-7 584 kPa) range and not vary by more than 50 psi (345 kPa). On all other models, pressures should be in 1400-1500 psi (9 653-10 342 kPa) range and also not vary by more than 50 psi (345 kPa).

For example if recorded pressures on CJ models were 1050-1060-1070 psi (7 240-7 309-7 378 kPa), or 1450-1480-1470 psi (9 998-10 205-10 136 kPa) on Cherokee, Wagoneer and Truck models, maximum pressures are within allowable variance and pump operation is within limits.

(14) If maximum pressures were within specified high ranges but varied by more than 50 psi (345 kPa), flow control valve is sticking. Remove and clean valve and remove any surface imperfections with crocus cloth.

(15) If pump flow control valve was serviced, repeat pressure test to check valve operation before proceeding.

(16) Turn steering wheel right and left. Contact steering stops in both directions and record highest pressure developed when each stop is contacted. If pressures are 1000-1100 psi (6 895-7 584 kPa) on CJ models, or 1400-1500 psi (9 653-10 342 kPa) on all other models, pump is operating properly.

CAUTION: *Do not hold the steering wheel against the steering stops for more than five seconds at a time as pump damage could occur.*

(17) If pump maximum output pressure cannot be duplicated at each steering stop, steering gear is leaking internally and must be disassembled and serviced.

(18) If pump output pressures were duplicated at each steering stop, proceed to next step.

(19) Stop engine and remove test gauge.

(20) Connect pressure hose to pump. Tighten hose fitting to 30 foot-pounds (41 N•m) torque.

(21) Check and adjust power steering fluid level as necessary.

(22) Remove drain pan.

PERIODIC MAINTENANCE

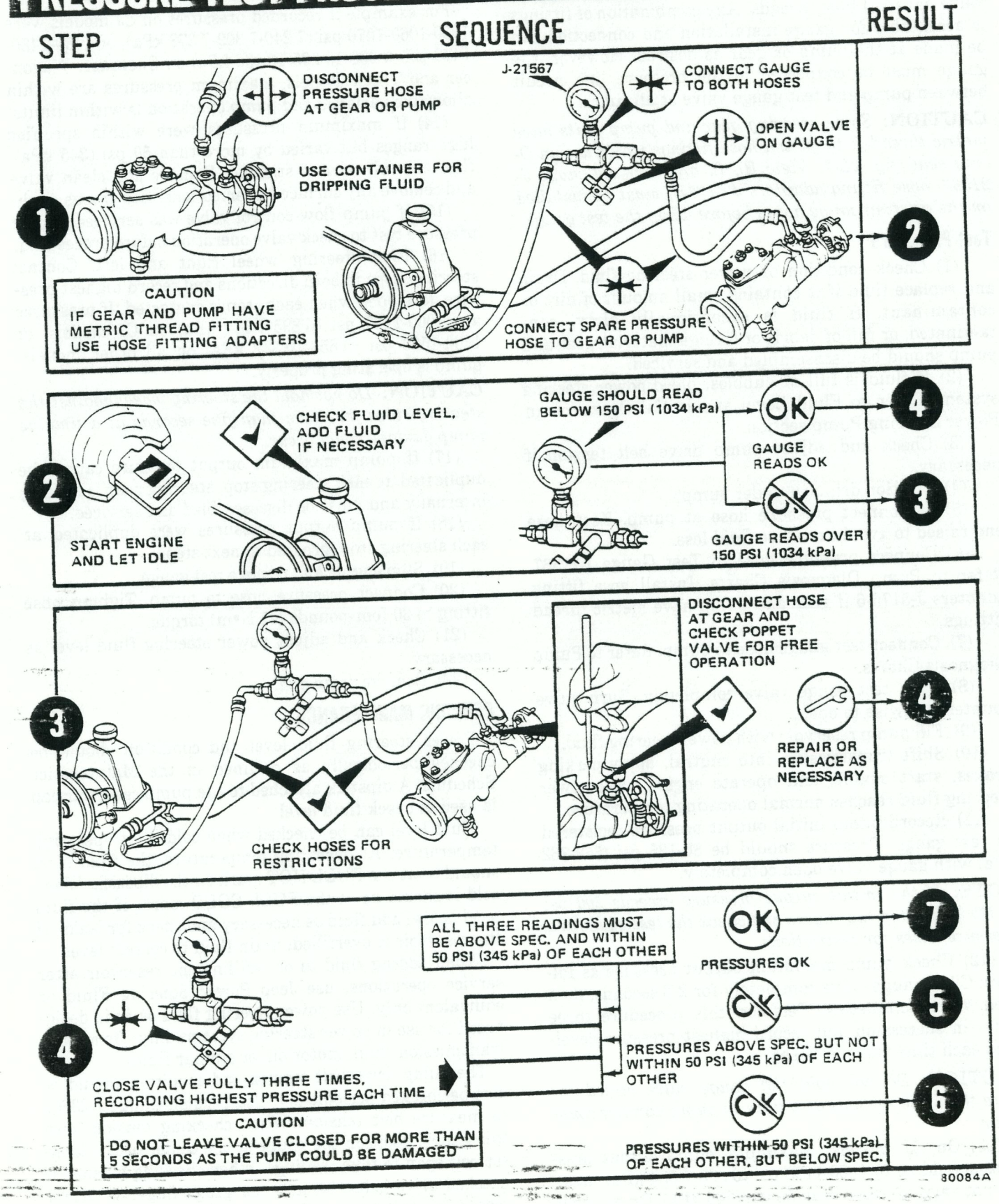
Power steering fluid level and condition should be checked periodically as outlined in the Maintenance Schedule. A dipstick attached to the pump reservoir cap is used to check fluid level.

Fluid level can be checked when cold or at operating temperature. At operating temperature, the fluid level should be at the FULL HOT mark on the dipstick. When cold it should be at the FULL COLD mark. If the fluid level is low, add fluid as necessary and check for leaks. If the reservoir is overfilled, drain fluid to correct level.

When adding fluid to or refilling the reservoir after service operations, use Jeep Power Steering Fluid or equivalent only. Use power steering fluid or fluid designated for use in power steering systems only. Do not use transmission fluid, motor oil, or similar fluids.

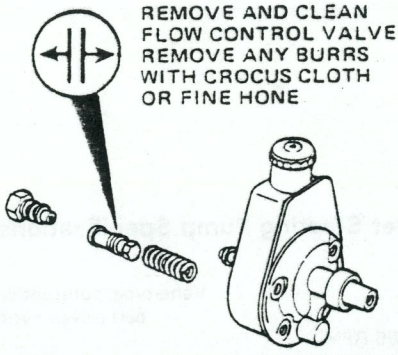
The pump drive belt tension and condition should be also be checked periodically. Use Tension Gauge J-23600 to measure belt tension. When checking tension with this gauge, position the gauge at the center of the longest belt span to take readings. When checking tension of notched drive belts, be sure the gauge finger is firmly seated in a belt notch before taking readings.

POWER STEERING SYSTEM HYDRAULIC PRESSURE TEST PROCEDURE



STEP | SEQUENCE | RESULT

5



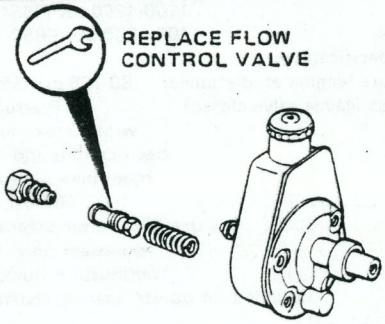
REMOVE AND CLEAN FLOW CONTROL VALVE REMOVE ANY BURRS WITH CROCUS CLOTH OR FINE HONE

CHECK FLUID CONDITION

OK → FLUID CLEAN → 7

OK → FLUID DIRTY → DISASSEMBLE PUMP AND GEAR AND CLEAN. REASSEMBLE → 7

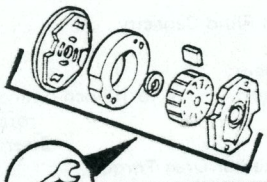
6



REPLACE FLOW CONTROL VALVE

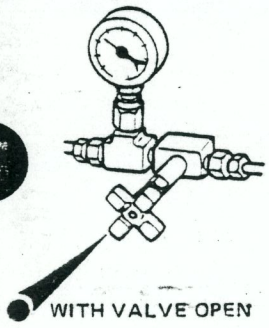
RECHECK PRESSURES (SEE STEP 4)

OK → PRESSURES OK → 7

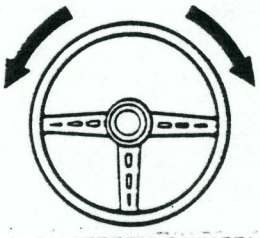


OK → PRESSURES LOW → REPLACE ROTATING GROUP → 7

7



WITH VALVE OPEN



TURN STEERING WHEEL ALL THE WAY LEFT AND RIGHT. RECORD HIGHEST PRESSURE AT EACH STOP

COPY HIGHEST PRESSURE FROM STEP 4

LEFT	
RIGHT	

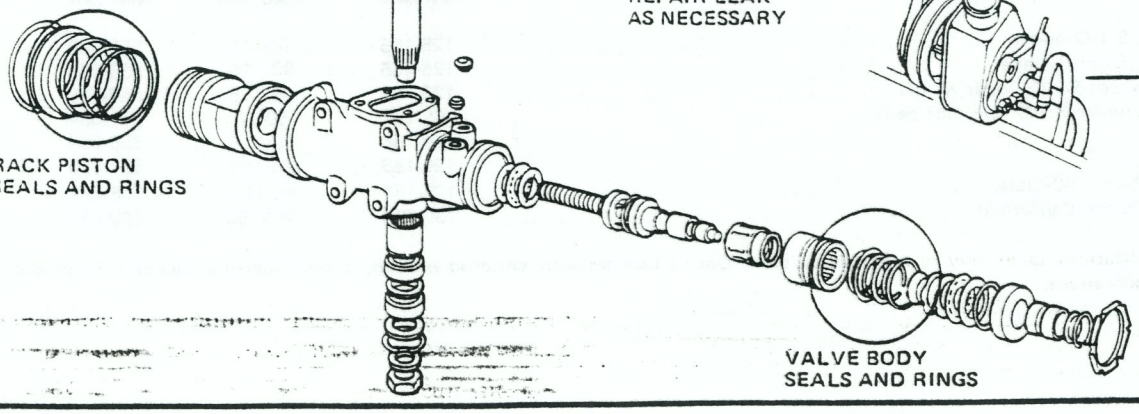
COMPARE PRESSURES- LEFT AND RIGHT. PRESSURE READING MUST BE SAME AS HIGH PRESSURE STEP 4

OK → PRESSURE OK → STOP

OK → PRESSURE NOT OK → 8

8

DISASSEMBLE GEAR AND CHECK FOR INTERNAL LEAKS MOST LIKELY AREAS ARE CIRCLED



RACK PISTON SEALS AND RINGS

REPAIR LEAK AS NECESSARY

RECHECK FLUID LEVEL ADD IF NECESSARY

STOP

VALVE BODY SEALS AND RINGS

80084B

SPECIFICATIONS

Power Steering Gear Specifications

Type	Recirculating Ball, worm and nut.
Bearings	
Wormshaft Upper	Needle Roller
Lower	Needle Roller
Pitman Shaft	Needle Roller
Fluids	Use Jeep Power Steering Fluid or equivalent only. Do not use transmission fluid.
Power Steering System Fluid Capacity	1-1/4 pints (0.59 liters)
Steering Gear Adjustment:	
Worm Bearing Preload	4 to 10 inch-pounds (0.45 to 1.13 N·m) rotating torque. Refer to Steering Gear Adjustment.
Pitman Shaft Overcenter Drag Torque	
(New gear with less than 400 miles service)	.4 to 8 inch-pounds (0.45 to 0.90 N·m) in addition to worm bearing preload but not to exceed total of 14 inch-pounds (1.58 N·m)
(Used gear with over 400 miles service)	.4 to 5 inch-pounds (0.45 to 0.56 N·m) in addition to worm bearing preload but not to exceed total of 18 inch-pounds (2.03 N·m)
Steering Ratio	
CJ	17.5:1 constant ratio
Cke-Wag-Trk	13/16:1 variable ratio
Valve Body	Three-way, open center, rotary-type.

80499

Power Steering Pump Specifications

Pump Type	Vane-type, constant displacement, belt-driven hydraulic pump.
Capacity at 465 RPM	1.25 GPM
Flow Range	1.25 to 2.15 GPM
Relief Valve Setting (Maximum Pressure):	
CJ	1100-1200 psi (7584-8274 kPa)
Cke-Wag-Trk	1400-1500 psi (9653-10342 kPa)
Pressure Test Specifications:	
Initial pressure (engine at idle speed)	80-125 psi (552-862 kPa)
Test pressures (gauge valve closed)	Pressures must be within maximum pressure specifications and not vary by more than 50 psi (345 kPa)
Turning	400 psi (2758 kPa)
Fluids	Use Jeep Power Steering Fluid or equivalent only. Do not use transmission fluid. Use fluids designed for power steering system use only.

80502

Drive Belt Tension Specifications

	USA (pounds)		Metric (N)	
	New Belt*	Used Belt	New Belt*	Used Belt
Air Conditioner, Six-Cylinder	125-155	90-115	556-689	400-512
Air Conditioner, Eight-Cylinder	125-155	90-115	556-689	400-512
Air Pump (All except Six-Cylinder w/AC)	125-155	90-115	556-689	400-512
Air Pump Six-Cylinder w/AC (3/8 inch belt)	65-75	60-70	291-334	267-311
Fan	125-155	90-115	556-689	400-512
Idler Pulley	125-155	90-115	556-689	400-512
Power Steering Pump (49-State)	125-155	90-115	556-589	400-512
Power Steering Pump (California)	180-200	140-160	800-890	623-712

*New belt specifications apply only to replacement belts. Once a belt has been tensioned and run, it is considered a used belt and should be adjusted to used belt specifications.

80503

POWER STEERING GEAR

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GENERAL

Although service and adjustment procedures for constant and variable ratio steering gears are the same, do not attempt to interchange gear internal components.

When servicing a gear, perform all repair operations on a clean work surface only. Small amounts of foreign material or contaminants can cause a malfunction after assembly. Clean all parts in clean-filtered solvent only and dry all parts, except bearings, using filtered compressed air. Use lint-free paper towels or cloths only to dry bearings.

During assembly operations, use the recommended torque values and adjustment specifications only. Failure to adhere to these specifications can result in accelerated wear and unsatisfactory gear operation.

IN-VEHICLE SERVICE

Steering Gear Adjustment

Because of the close tolerance involved in adjusting worm bearing preload and pitman shaft overcenter drag torque plus the friction effect of hydraulic fluid, the steering gear must be adjusted off the vehicle only. Refer to Worm Bearing Preload and Pitman Shaft Overcenter Drag Torque Adjustment under Steering Gear Assembly and Adjustment.

CAUTION: *Do not attempt on-vehicle adjustment of the power steering gear. Incorrect adjustment could result in accelerated wear of gear internal components and undesirable steering response.*

Conditions such as shimmy and hard or loose steering may be caused by wheels and tires or worn or damaged front suspension components. These items should be checked before attempting power steering gear repairs.

Before performing any service operations, check and correct fluid level and condition, belt adjustment, and pump pressures.

CAUTION: *Use power steering fluid only in the system.*

Pitman Shaft Seal Replacement

(1) Raise vehicle.

(2) Disconnect pitman arm using tool J-6632 (fig. 2L-9).

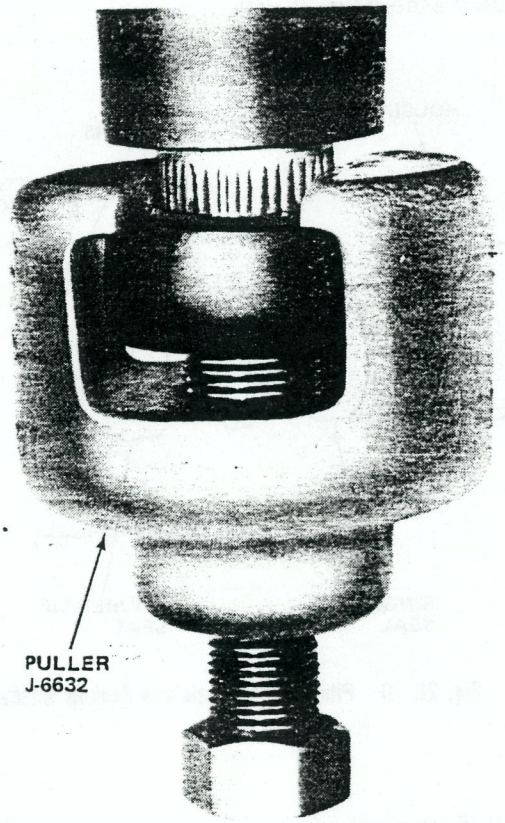

Fig. 2L-9 Pitman Arm Removal

(3) Position drain pan under gear.

(4) Remove seal retaining ring using tool J-4245 and remove outer seal backup washer.

(5) Start engine and momentarily hold steering wheel in full left turn position to actuate spool valve. This builds pressure on upper end of piston and in pitman shaft chamber to force seals and backup washers out of gear.

CAUTION: *To avoid excessive fluid loss and possible pump damage, do not hold the gear in the full left turn position for more than one or two seconds at a time.*

(6) Stop engine and remove seals and backup washers from pitman shaft.

(7) Inspect outer diameter of seals for damage. If scored or cut, inspect housing bore for burrs and nicks. Remove any burrs or nicks, before installing replacement seals, using crocus cloth.

(8) Inspect pitman shaft surface for roughness, pitting, scoring, rust, or nicks. Clean dirt, rust or corrosion from shaft seal surfaces using crocus cloth. Replace shaft if pitted or severely corroded.

(9) Lubricate replacement seals and shaft surfaces with power steering fluid.

(10) Apply single layer of thin tape to pitman shaft splines to avoid cutting seals.

(11) Insert single lip seal in bore first; then insert backup washer (fig. 2L-10).

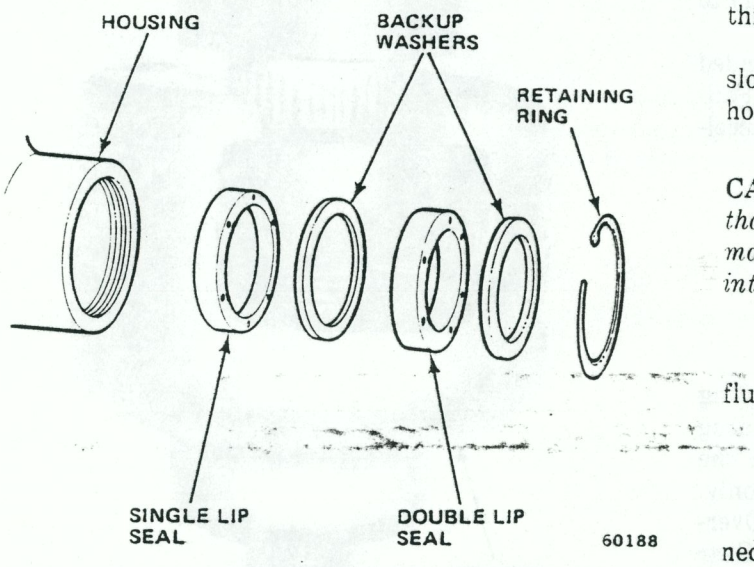

Fig. 2L-10 Pitman Shaft Seals and Backup Washers

(12) Seat single lip seal and washer using Snap Ring Tool J-21553. Install seal and washer only far enough to provide clearance for remaining seal, backup washer, retaining ring, and for clearance between seals. Do not allow seal to bottom in housing bore.

CAUTION: *To ensure proper seal action, be sure to allow enough space for clearance between the two seals.*

(13) Install double lip seal and backup washer in housing bore using tool J-21553. Install seal only far enough into bore to allow clearance for retaining ring.

(14) Install retaining ring using Snap Ring Tool J-4245. Be sure ring is fully seated.

(15) Install pitman arm on shaft and install replacement pitman arm nut and lockwasher. Tighten nut to 185 foot-pounds (251 N•m) torque. Stake nut in two places to retain it.

(16) Lower vehicle.

(17) Fill power steering pump reservoir to correct level with power steering fluid.

(18) Start and idle engine for at least three minutes. Do not turn steering wheel during this time.

(19) Turn steering wheel left and right and check for leaks. Add additional fluid as necessary.

End Plug O-Ring Seal Replacement

CJ Models

(1) Raise vehicle.

(2) Rotate end plug retaining ring (fig. 2L-11) until one end of ring is positioned over hole in side of housing.

(3) Remove retaining ring by inserting punch through hole in housing and unseating ring.

(4) Remove end plug by turning steering wheel slowly to left until rack piston forces end plug out of housing.

(5) Turn steering wheel back to center position.

CAUTION: *Do not turn the steering wheel any farther than necessary or the ball bearings in the rack piston may fall out of the rack piston bearing circuit and drop into the piston chamber.*

(6) Remove and discard end plug O-ring seal.

(7) Lubricate replacement seal with power steering fluid and install seal on end plug.

(8) Install assembled end plug and seal in housing.

(9) Install retaining ring.

(10) Lower vehicle.

(11) Check and correct power steering fluid level as necessary.

Cherokee-Wagoneer-Truck Models

On Cherokee, Wagoneer and Truck models, the position of the steering gear prevents on-vehicle replacement of the end plug O-ring seal (fig. 2L-11). It is necessary to remove the gear to perform seal replacement.

STEERING GEAR REMOVAL

(1) Disconnect pressure and return hoses at gear. Keep hoses raised to avoid excessive fluid loss and cap hoses to prevent dirt entry.

(2) On Cherokee, Wagoneer and Truck models, remove clamp bolt and nut attaching flexible coupling to steering gear stub shaft and disengage coupling from stub shaft.

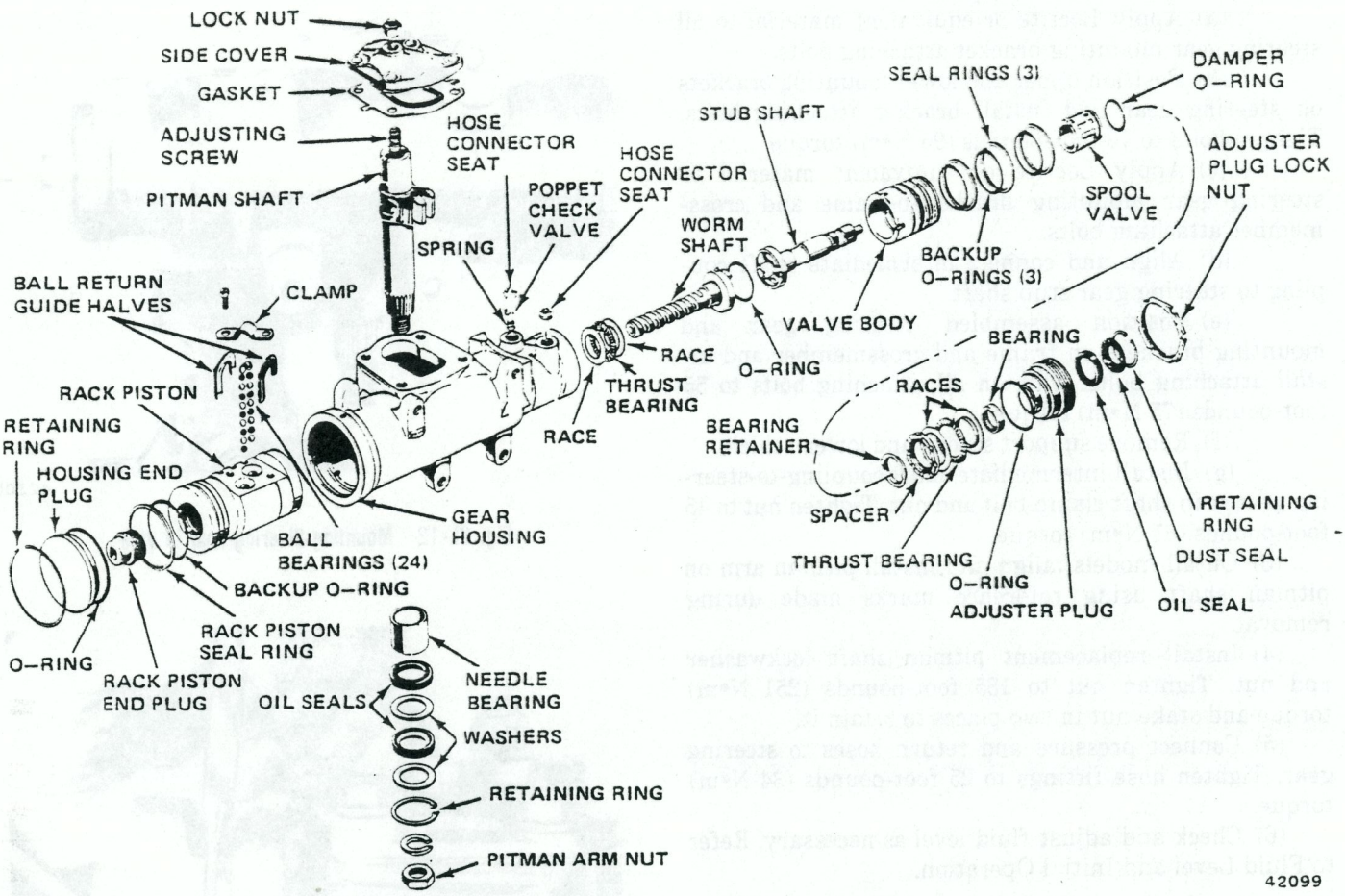

Fig. 2L-11 Power Steering Gear Assembly

(3) On CJ models, remove clamp bolt and nut attaching intermediate shaft coupling to steering gear stub shaft and disconnect intermediate shaft.

(4) Paint alignment marks on pitman shaft and pitman arm for assembly reference.

(5) Remove and discard pitman arm nut and lockwasher.

(6) Remove pitman arm using tool J-6632 (fig. 2L-9).

(7) On Cherokee, Wagoneer and Truck models, remove steering gear-to-frame mounting bolts and remove gear.

(8) On CJ models, remove gear as follows:

(a) Raise left side of vehicle slightly to relieve tension on left front spring and place support stand under frame.

(b) Remove three lower steering gear mounting bracket-to-frame bolts.

(c) Remove two upper steering gear mounting bracket-to-crossmember bolts and remove steering gear and mounting brackets as assembly.

(d) Remove mounting bracket-to-gear attaching bolts and remove upper and lower mounting brackets from steering gear.

STEERING GEAR INSTALLATION

NOTE: *Proper retention of the steering gear is important. Some of the following procedural steps in gear installation require the application of Loctite or equivalent material to attaching bolt threads. Wherever indicated, use Jeep Adhesive Sealant or Loctite 271 Adhesive/Sealant, or equivalent. When applying this material, clean all bolt threads thoroughly to remove dirt and grease and apply the material liberally to the bolt threads no more than five minutes before installation.*

(1) On Cherokee, Wagoneer and Truck models, install gear as follows:

(a) Align and install flexible coupling on steering gear stub shaft and install clamp bolt. Tighten clamp bolt to 30 foot-pounds (41 N•m) torque.

(b) Apply Loctite or equivalent material to steering gear-to-frame mounting bolts.

(c) Position steering gear on frame and install gear mounting bolts. Tighten mounting bolts to 70 foot-pounds (95 N•m) torque.

(2) On CJ models, install gear as follows:

(a) Apply Loctite or equivalent material to all steering gear mounting bracket attaching bolts.

(b) Position upper and lower mounting brackets on steering gear and install bracket attaching bolts. Tighten bolts to 70 foot-pounds (95 N•m) torque.

(c) Apply Loctite or equivalent material to steering gear mounting bracket-to-frame and crossmember attaching bolts.

(d) Align and connect intermediate shaft coupling to steering gear stub shaft.

(e) Position assembled steering gear and mounting brackets on frame and crossmember and install attaching bolts. Tighten all attaching bolts to 55 foot-pounds (75 N•m) torque.

(f) Remove support stands and lower vehicle.

(g) Install intermediate shaft coupling-to-steering gear stub shaft clamp bolt and nut. Tighten nut to 45 foot-pounds (61 N•m) torque.

(3) On all models, align and install pitman arm on pitman shaft using reference marks made during removal.

(4) Install replacement pitman shaft lockwasher and nut. Tighten nut to 185 foot-pounds (251 N•m) torque and stake nut in two places to retain it.

(5) Connect pressure and return hoses to steering gear. Tighten hose fittings to 25 foot-pounds (34 N•m) torque.

(6) Check and adjust fluid level as necessary. Refer to Fluid Level and Initial Operation.

STEERING GEAR DISASSEMBLY

NOTE: *In most cases, complete disassembly of the power steering gear will not be necessary. Only those subassemblies that have malfunctioned should be disassembled. In addition, steering gear repair operations must always be performed on a clean work bench. Cleanliness is very important. The work bench, tools, and steering gear component parts must be kept clean at all times to avoid problems after assembly. Clean the gear exterior thoroughly with solvent before disassembly. Refer to figure 2L-11 for parts nomenclature and disassembly/assembly sequence during service operations.*

(1) Drain fluid from gear.

(2) Cap all openings in gear and clean gear exterior thoroughly.

(3) Mount steering gear in vise so pitman shaft points downward. Clamp unmachined housing boss portion of gear in vise only (fig. 2L-12).

(4) Rotate end plug retaining ring until one end of ring is aligned with hole in side of housing. Unseat ring using punch inserted through hole in housing and remove ring using screwdriver (fig. 2L-13).

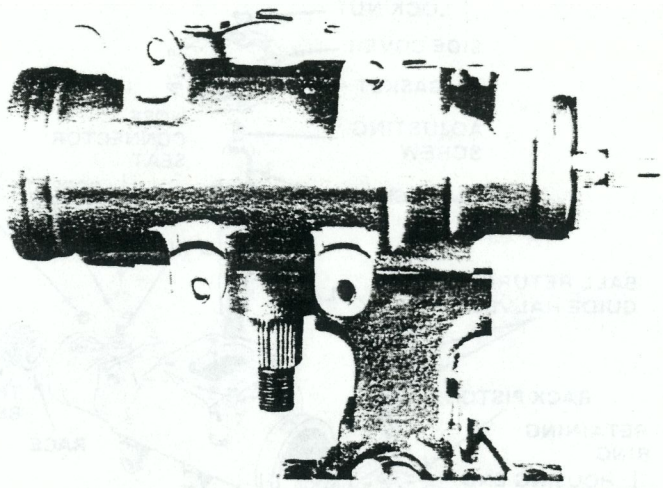

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Fig. 2L-12 Mounting Steering Gear in Vise

A42101

Fig. 2L-13 End Plug Retaining Ring Removal

(5) Remove end plug. Install 12-point deep socket and ratchet handle on stub shaft and slowly rotate shaft counterclockwise until rack piston forces end plug out of housing.

CAUTION: *Do not rotate the stub shaft any farther than necessary or the ball bearings will drop out of the rack piston circuits. This causes the rack piston and pitman shaft sector teeth to disengage preventing removal. If disengagement should occur, remove the side cover and pitman shaft and reengage the teeth.*

(6) Remove and discard O-ring seal from housing end plug.

(7) Turn stub shaft 1/2 turn clockwise.

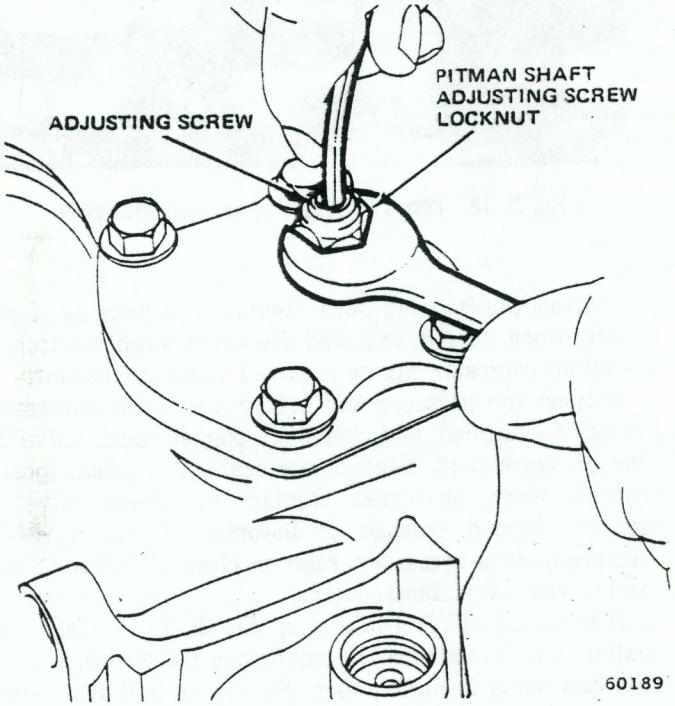
(8) Unseat rack piston end plug by tapping it with plastic mallet.

(9) Remove rack piston end plug.

CAUTION: *Do not attempt to remove the rack piston end plug until it has been unseated as the plug could break.*

(10) Remove and discard pitman shaft adjuster screw locknut. Use Allen wrench to prevent adjuster screw from turning when removing locknut (fig. 2L-14).

NOTE: *The locknut has left-hand threads.*



2L-14 Adjuster Screw Locknut Removal/Installation

(11) Remove side cover bolts and lockwashers.

(12) Remove side cover. Unthread cover from adjuster screw by turning screw clockwise.

(13) Rotate stub shaft until pitman shaft sector teeth are centered in housing.

(14) Remove pitman shaft from housing by tapping threaded end of shaft with plastic mallet.

NOTE: *Do not remove or disassemble any of the pitman shaft component parts. The shaft and component parts are serviced as an assembly only.*

(15) Remove rack piston from housing as follows:

(a) Insert Arbor Tool J-7539-01 or J-21552 into rack piston until tool contacts end of wormshaft.

(b) Hold arbor tool tightly against wormshaft and turn stub shaft counterclockwise to force rack piston onto arbor tool.

(c) Remove rack piston and arbor tool as assembly (fig. 2L-15).

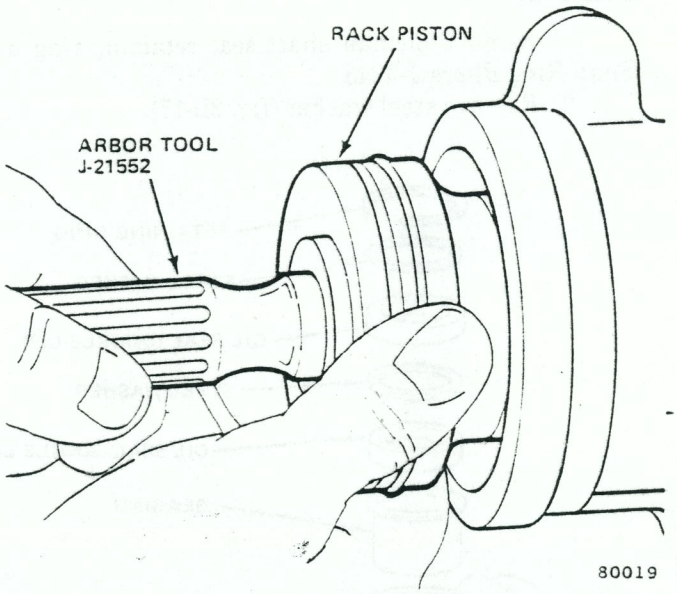


Fig. 2L-15 Rack Piston Removal/Installation

(16) Remove adjuster plug locknut using brass drift and hammer.

(17) Remove adjuster plug using Spanner Tool J-7624 (fig. 2L-16).

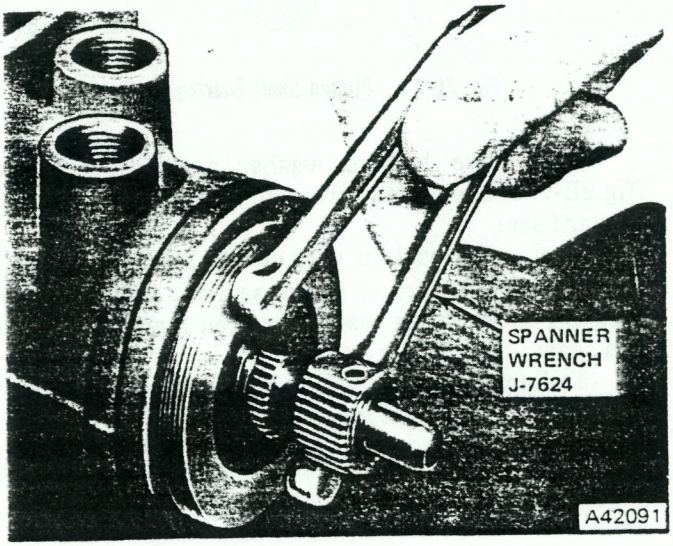


Fig. 2L-16 Adjuster Plug Removal

(18) Remove valve body from housing. Grasp stub shaft and pull outward to remove.

(19) Remove wormshaft lower thrust bearing and bearing races from housing if not removed previously.

STEERING GEAR SUBASSEMBLY OVERHAUL

Gear Housing

Disassembly

(1) Remove pitman shaft seal retaining ring using Snap Ring Pliers J-4245.

(2) Remove steel washer (fig. 2L-17).

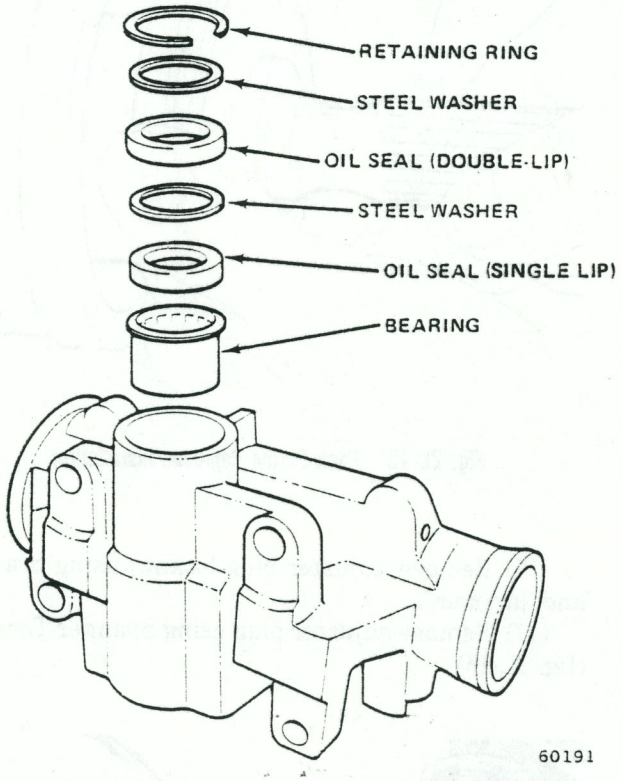


Fig. 2L-17 Pitman Shaft Bearing and Seals

(3) Remove backup washer and double lip seal (fig.2L-17). Use screwdriver to pry seal out of bore. Discard seal.

(4) Remove backup washer and single lip seal (fig. 2L-17). Use screwdriver to pry seal out of bore. Discard seal. Do not damage seal bore when removing washers and seals.

(5) Remove and discard pitman shaft needle bearing using Tools J-8092 and J-21551 (fig. 2L-18).

NOTE: *When removing the bearing, drive the bearing out the end of the pitman shaft bore. Do not attempt to drive the bearing out through the housing.*

Cleaning and Inspection

Clean all components thoroughly with solvent and dry using compressed air or lint free paper towels or shop cloths.

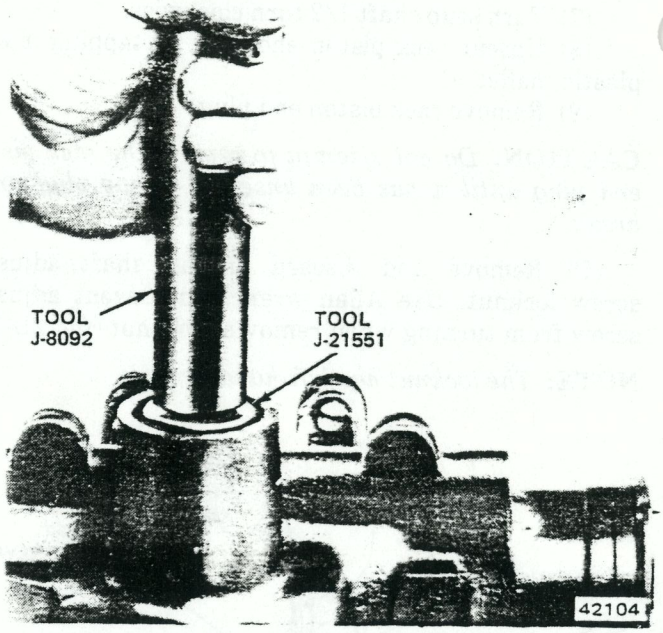


Fig. 2L-18 Pitman Shaft Bearing Removal/Installation

Inspect the housing bore. Replace the housing if severely worn, scored, or pitted. However, slight scratches or minor corrosion can be removed using crocus cloth.

Inspect the pressure and return port hose connector seats, if equipped, and check the poppet check valve in the pressure port. Replace the seats if cracked, loose, cocked, worn, or scored. Replace the check valve if scored, chipped, cracked, or distorted. If seat or valve replacement is necessary, refer to Hose Connector Seat and Check Valve Replacement.

Inspect the housing ball plug (fig. 2L-19). Reseat the ball if fluid leaked past the ball before disassembly. Seat the ball using a blunt punch. Spray the ball area with Loctite Solvent 7559, or equivalent, and dry the area with compressed air. Cover the ball area and ball with Loctite Sealant 290. Allow the sealant to cure for approximately two hours before installing or assembling the gear.

Inspect all retaining ring, bearing, and seal surfaces in the housing. Replace the housing if any surface is worn or damaged.

Hose Connector Seat and Check Valve Replacement

CAUTION: *Some steering gear units have metric thread fittings and hose fittings which use O-ring seals instead of connector seats (fig. 2L-7, View B).*

CAUTION: *If the gear has connector seats, do not attempt connector seat or check valve replacement unless the gear has been removed and disassembled. Connector seat replacement will generate metal chips and shavings which can enter the gear and cause a malfunction after assembly.*

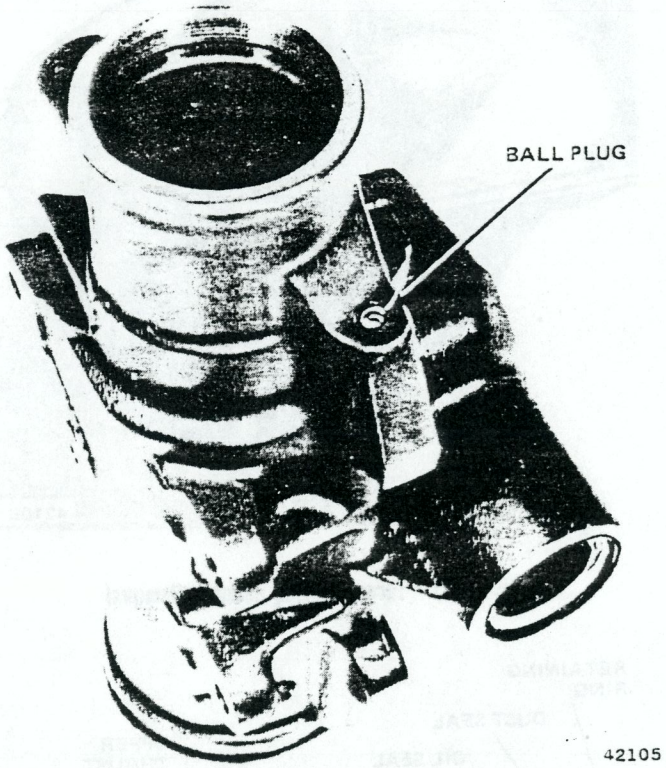


Fig. 2L-19 Housing Ball Plug Location

(1) Pack seats and pressure ports with petroleum jelly to prevent chips from lodging in ports.

(2) Thread connector seats to depth of 2-3 threads (only) using 5/16-18 tap (fig. 2L-20).

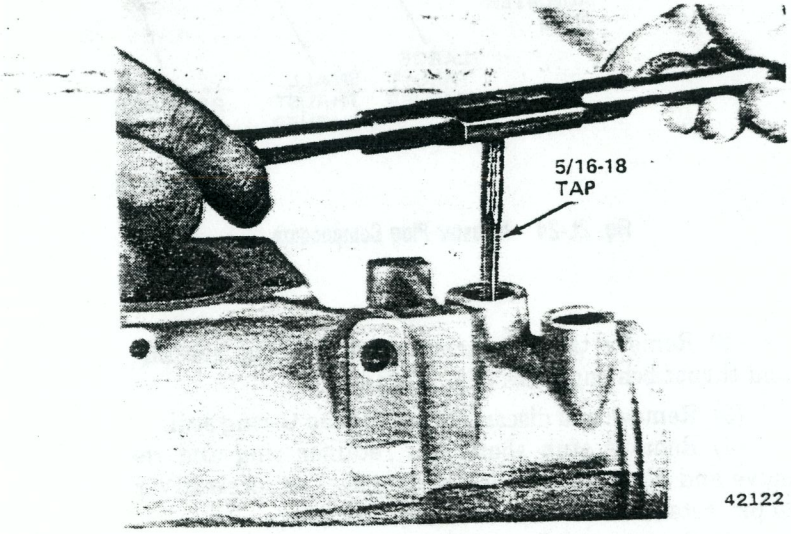


Fig. 2L-20 Threading Hose Connector Seats
(Steering Gear With Non-Metric Fittings Only)

CAUTION: *Do not thread the pressure port seat any more than 2-3 threads deep or the tap may contact the check valve and damage it.*

(3) Assemble 5/16-18 bolt, nut and flat washer and thread bolt into connector seat (fig. 2L-21).

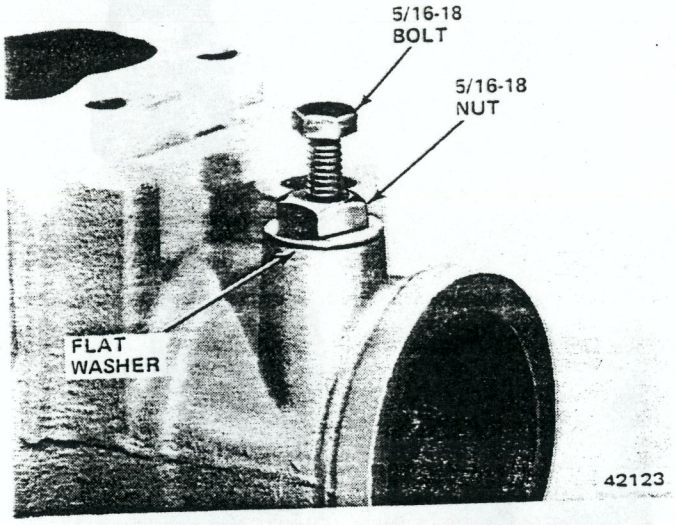


Fig. 2L-21 Hose Connector Seat Removal
(Steering Gears With Non-Metric Fittings Only)

(4) Place wrench on bolt to prevent it from turning and tighten nut against housing to remove seat.

(5) Remove check valve and spring from pressure port and discard both parts, they are not reuseable.

(6) Clean housing thoroughly to remove metal chips and shavings, dirt, and petroleum jelly.

(7) Install replacement check valve spring in pressure port. Be sure spring is seated in pressure port counterbore and large end of spring faces downward.

(8) Install replacement check valve over spring so valve tangs face downward. Be sure valve is centered on small end of spring.

(9) Coat replacement pressure port connector seat with petroleum jelly and position seat on top of check valve.

(10) Insert replacement return port connector seat in port.

(11) Install both seats using Tool J-6217 (fig. 2L-22).

(12) Inspect check valve operation by lightly pressing valve downward with pencil. Valve should reseat itself when pencil pressure is released.

(13) Clean housing with solvent to remove any remaining chips and petroleum jelly.

Assembly

(1) Lubricate housing bores and all replacement bearings and seals with power steering fluid.

(2) Install pitman shaft needle bearing using Tools J-8092 and J-21553 (fig. 2L-18). Install bearing until approximately 1/32 inch (0.79 mm) below shoulder in housing bore.

(3) Install single lip seal and backup washer (fig. 2L-17). Seat washer and seal using tool J-21553. Install seal and washer only far enough to provide clearance for next seal and washer, steel washer and retaining ring, and to provide small clearance between seals.

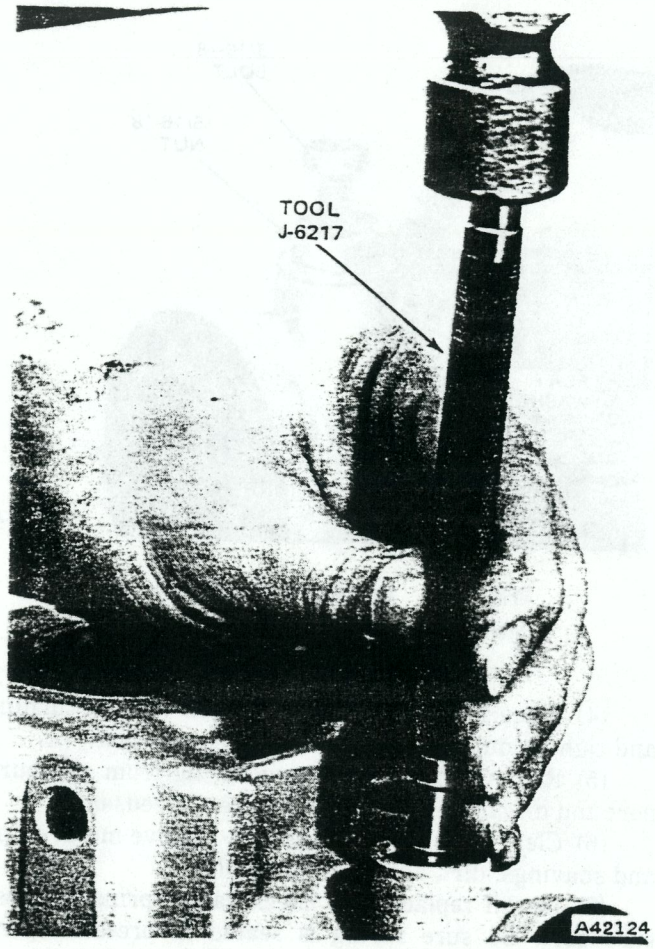


Fig. 2L-22 Hose Connector Seat Installation (Steering Gears With Non-Metric Fittings Only)

CAUTION: *Do not bottom the seal against the housing counterbore.*

(4) Install double lip seal and backup washer using tool J-21553. Install seal and washer only far enough to allow clearance for steel washer and retaining ring.

CAUTION: *To ensure proper seal action, do not allow the seals to contact one another. Be sure there is clearance between them.*

(5) Install steel washer.

(6) Install retaining ring using Snap Ring Pliers J-4245. Be sure ring is seated completely in housing ring groove.

Adjuster Plug

Disassembly

(1) Remove thrust bearing retainer using screwdriver (fig. 2L-23). Discard retainer. Do not damage needle bearing bore when removing retainer.

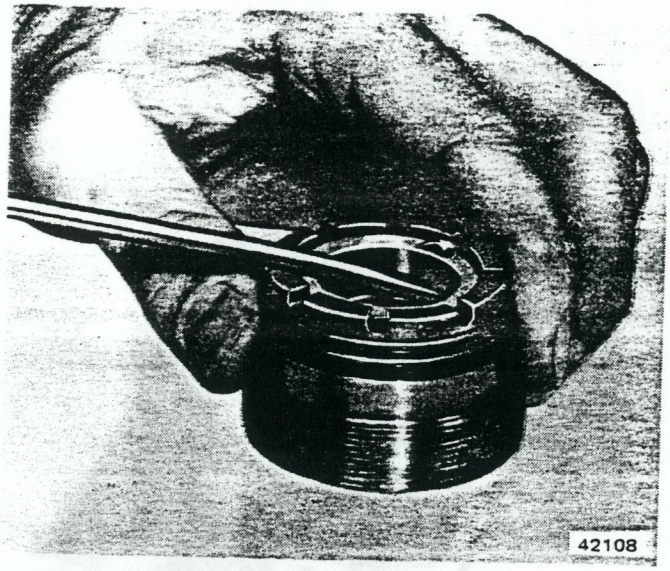


Fig. 2L-23 Thrust Bearing Retainer Removal

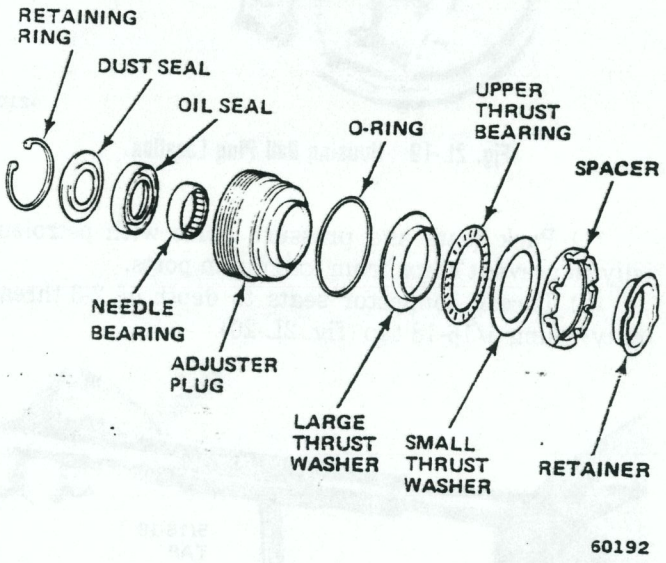


Fig. 2L-24 Adjuster Plug Components

(2) Remove thrust bearing spacer, thrust bearing, and thrust bearing races (fig. 2L-24).

(3) Remove and discard adjuster plug O-ring seal.

(4) Remove stub shaft seal retainer ring and remove and discard stub shaft dust seal. Use screwdriver to pry retainer and seal out of adjuster plug.

(5) Remove needle bearings using tool J-6221 (fig. 2L-25). Discard bearings after removal.

Cleaning and Inspection

Clean the adjuster components with solvent and dry them using compressed air.

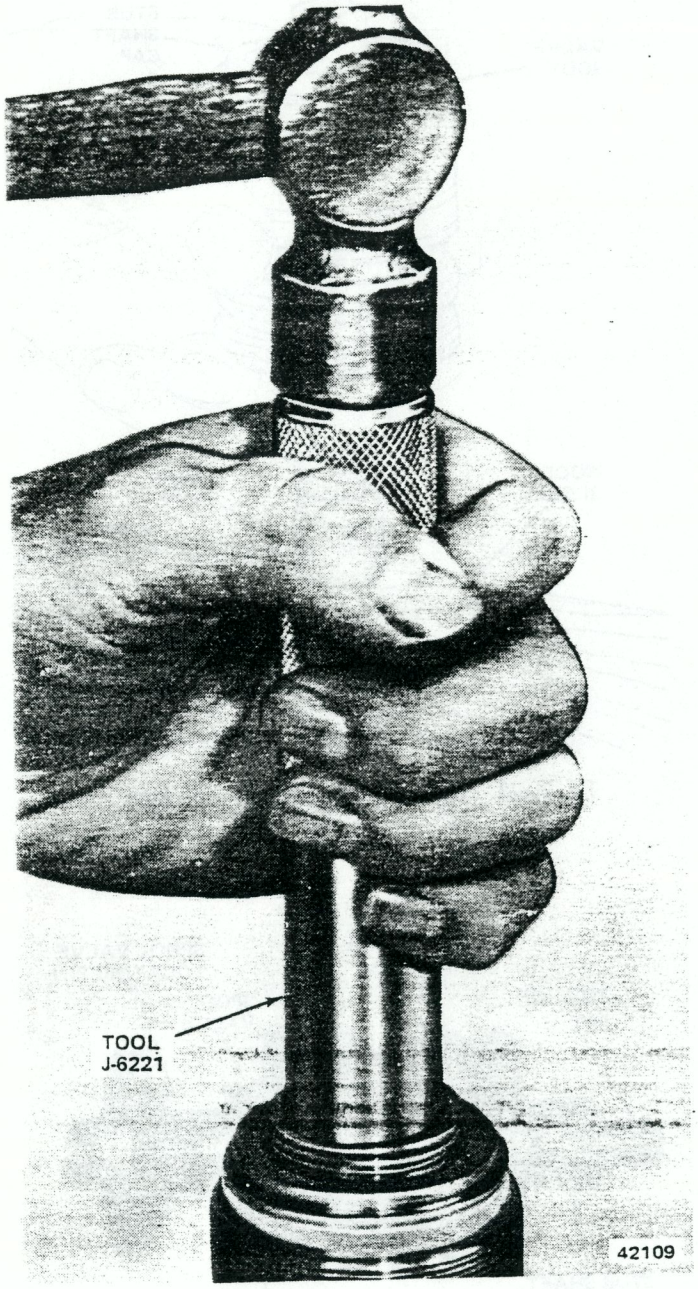


Fig. 2L-25 Adjuster Plug Needle Bearing Removal/Installation

(3) Install bearing in adjuster plug until bearing is flush with bottom surface of stub shaft seal counterbore (fig. 2L-25).

(4) Install stub shaft seal in adjuster plug using Tool J-21554 (fig. 2L-26). Install seal deep enough to provide clearance for dust seal and retaining ring.

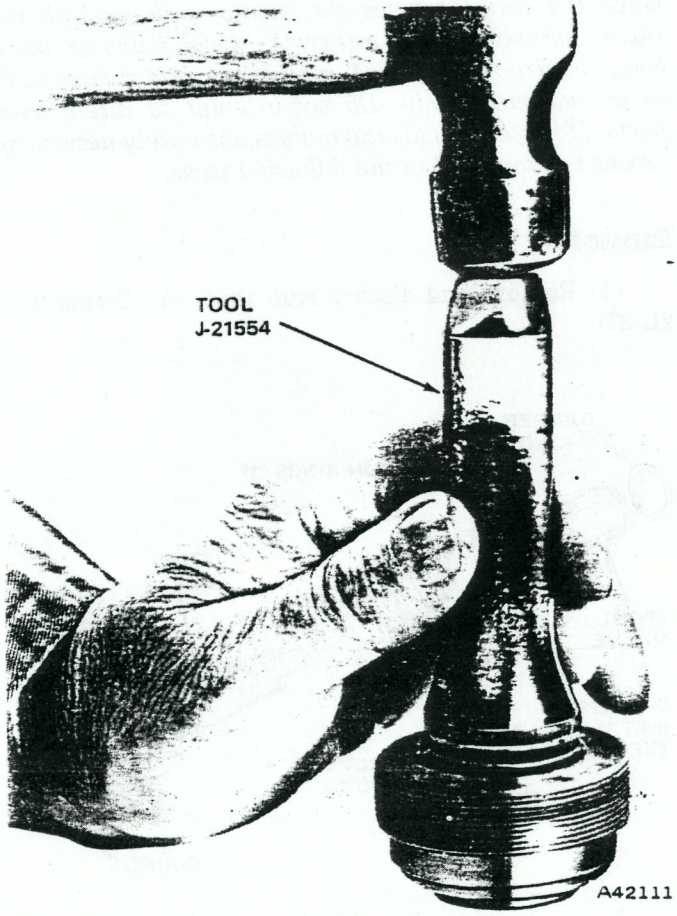


Fig. 2L-26 Stub Shaft Seal Installation

Inspect the adjuster plug bearing and seal surfaces for pitting, nicks, or scoring and inspect the plug threads for damage. Inspect the washers, spacer, and retainer for distortion, and wear. Replace any component that exhibits any of these conditions.

Assembly

(1) Lubricate dust seal and O-ring with petroleum jelly. Lubricate all other components with power steering fluid.

(2) Position needle bearing on Tool J-6221 so bearing manufacturers identification number is facing tool.

(5) Install dust seal in adjuster plug. Rubber face of seal must face away from plug (outward).

(6) Install retaining ring using Snap Ring Pliers J-4245.

(7) Install O-ring in adjuster plug ring groove.

(8) Install large thrust washer, upper thrust bearing, small thrust washer, and spacer in adjuster plug.

(9) Install retainer. Use brass drift to press retainer into plug.

NOTE: *The radial location of the spacer notches are not important. However, do not damage the notches during retainer installation.*

Valve Body

CAUTION: *The valve body assembly is a precision unit with select fit components that are hydraulically matched and balanced during manufacture. Service repairs to the valve are uncommon with the possible exception of the spool valve damper O-ring. Do not disassemble the valve body unless absolutely necessary as improper disassembly could result in damage. If the spool valve damper O-ring requires replacement, remove the valve, replace the O-ring, and reinstall the valve immediately. If either the spool valve or valve body require replacement, replace the entire valve body as an assembly only. Do not attempt to interchange parts. If valve body disassembly is absolutely necessary, proceed as outlined in the following steps.*

Disassembly

(1) Remove and discard stub shaft cap O-ring (fig. 2L-27).

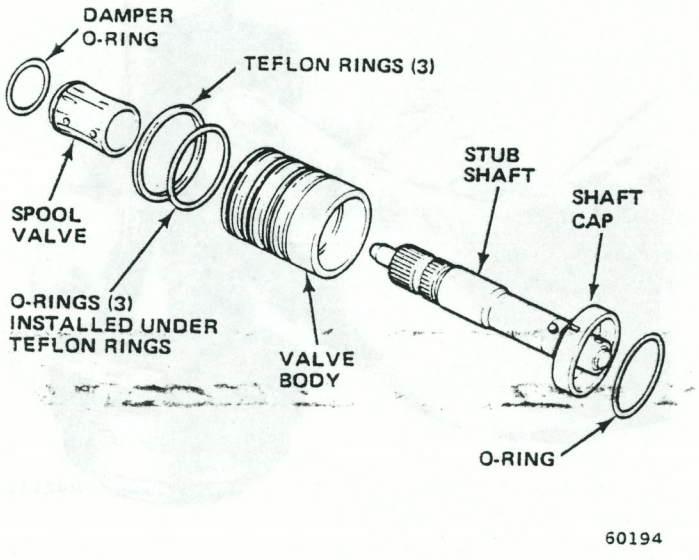


Fig. 2L-27 Valve Body Components

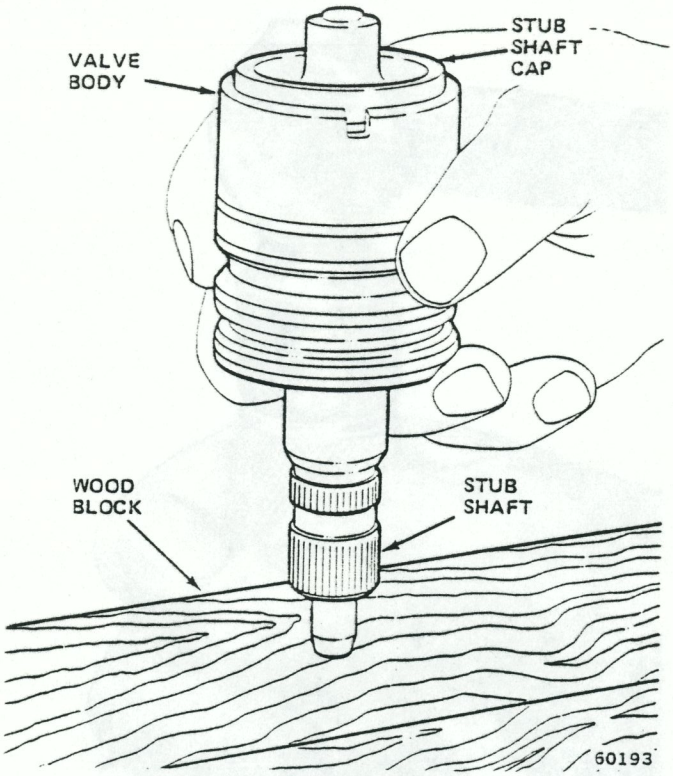


Fig. 2L-28 Separating Stub Shaft and Valve Body

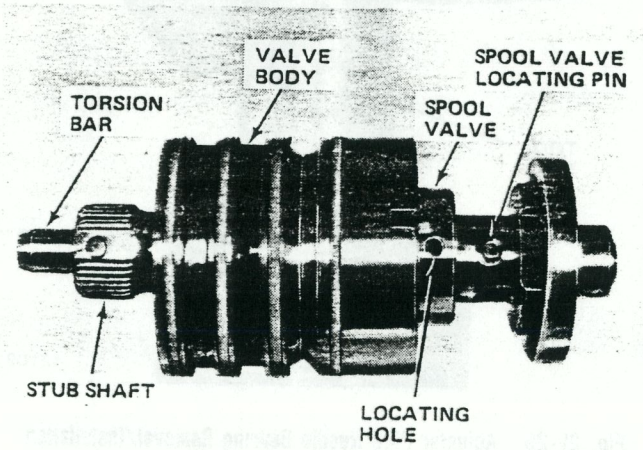


Fig. 2L-29 Valve Body and Spool Valve Disassembly

(2) Hold valve body assembly in both hands with stub shaft pointing downward. Tap end of stub shaft lightly against wood block until shaft cap is free of valve body (fig. 2L-28).

(3) Pull stub shaft outward until shaft cap clears valve body by approximately 1/4 inch (6 mm).

CAUTION: *Do not pull the stub shaft out of the valve body any farther than 1/4 inch (6 mm) or the spool valve may become cocked in the valve body.*

(4) Press spool valve locating pin inward and carefully remove stub shaft from valve body and spool valve (fig. 2L-29).

(5) Remove spool valve from valve body using a push and turn motion. If spool valve becomes cocked, carefully realign valve and try removal again. Do not force spool valve out.

(6) Remove and discard spool valve damper O-ring.

(7) Cut and remove valve body seal rings and backup O-rings (fig. 2L-27). Discard all rings.

Cleaning and Inspection

Wash the valve body components in clean solvent and blow out all fluid passages using filtered, compressed air.

If the torsion bar is broken or loose, or if the torsion seal leaked prior to disassembly, replace the entire valve body as an assembly.

If the spool valve locating pin is broken or the valve body is cracked, worn, or broken, replace the entire valve body as an assembly.

NOTE: *Tiny flat spots on either side of the spool valve locating pin are normal.*

A slightly polished appearance is normal for all valve body assembly surfaces. However, if there are scores, nicks, or burrs on the valve body and stub shaft surfaces that cannot be cleaned up with crocus cloth, replace the entire valve body as an assembly.

Inspect the valve body-to-wormshaft locating notch in the valve body skirt (fig. 2L-30). Replace the entire valve body as an assembly if this notch is damaged or excessively worn.

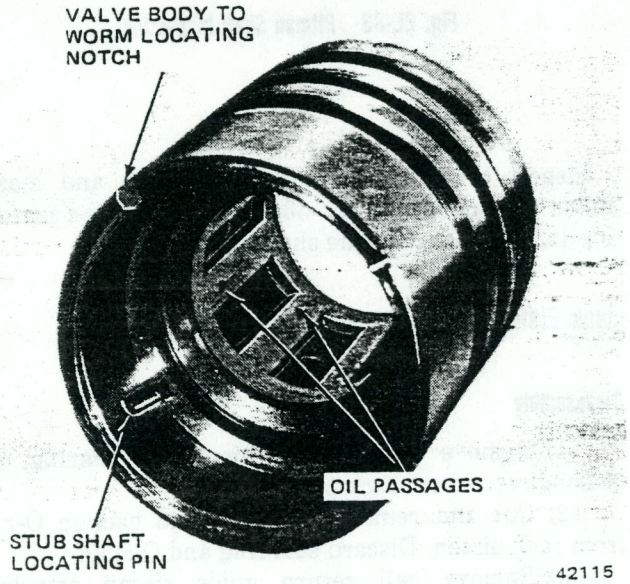


Fig. 2L-30 Valve Body

Inspect the spool valve-to-valve body fit. Lubricate the spool valve with power steering fluid and insert it into the valve body. Replace the entire valve body as an assembly if the spool valve is a loose fit, binds or sticks, or does not rotate freely within the valve body.

Assembly

(1) Lubricate all valve body components with power steering fluid.

(2) Install replacement backup O-rings in seal ring grooves.

(3) Install replacement seal rings over backup O-rings (fig. 2L-31). Take care to avoid damaging seal rings during installation.

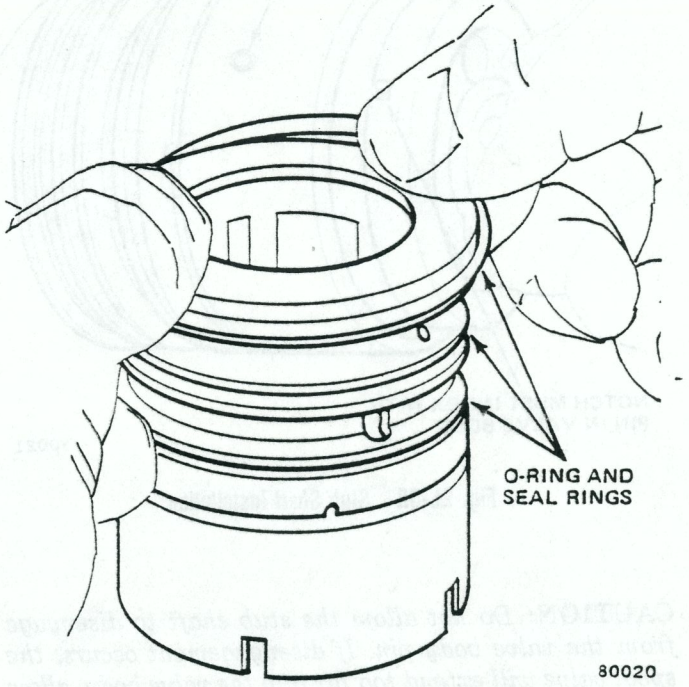


Fig. 2L-31 Valve Body Seal Ring Installation

NOTE: *The teflon seal rings may appear to be distorted after installation. However, the heat generated by power steering fluid during normal operation will straighten them.*

(4) Lubricate replacement spool valve damper O-ring with petroleum jelly and install O-ring on spool valve.

(5) Insert spool valve in valve body. Do not attempt to force spool valve into place.

(6) Push spool valve through valve body until spool valve locating pin hole is visible at opposite end of valve body and spool valve is flush with notched end of valve body.

(7) Install stub shaft in spool valve and valve body. Be sure stub shaft locating pin is aligned with spool valve locating hole (fig. 2L-29).

(8) Align notch in stub shaft cap with stub shaft locating pin in valve body and press stub shaft and spool valve into valve body (fig. 2L-32).

CAUTION: *Before installing the assembled valve body in the gear housing, be sure the valve body stub shaft locating pin is fully engaged in the stub shaft cap notch.*

(9) Lubricate stub shaft cap O-ring with power steering fluid and install O-ring in valve body.

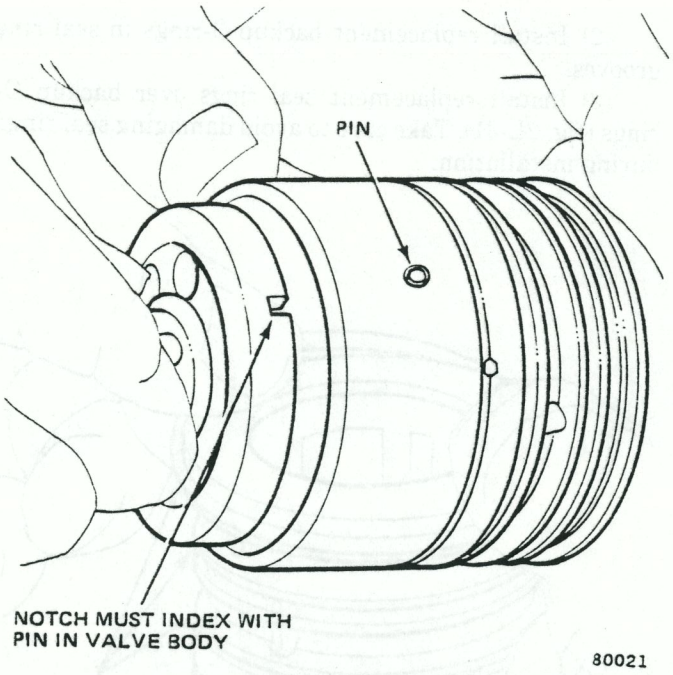


Fig. 2L-32 Stub Shaft Installation

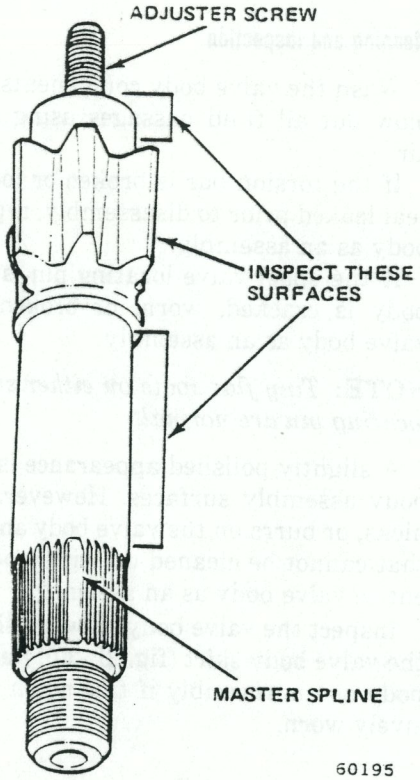


Fig. 2L-33 Pitman Shaft Inspection

CAUTION: *Do not allow the stub shaft to disengage from the valve body pin. If disengagement occurs, the spool valve will extend too far into the valve body, allow the damper O-ring to expand into the valve body grooves and prevent valve withdrawal. If disengagement occurs, attempt to remove the valve using a pull and turn motion. If this fails, proceed as follows: First be sure the spool valve is free to rotate, then place the valve body on a flat surface with the notched end of the valve body facing upward. Tap the spool valve with a wood or plastic rod until the damper O-ring is cut and remove the valve. Replace the damper O-ring and reassemble the valve body. Be sure all pieces of the cut O-ring are removed before assembly.*

Pitman Shaft and Side Cover

Cleaning and Inspection

Clean the shaft and cover with solvent and wipe them dry with lint free cloths.

Inspect the side cover bearing and mating surfaces for wear, distortion, scoring, or distortion. Replace the cover if it exhibits any of these conditions.

Inspect the pitman shaft bearing and seal surfaces and sector teeth for cracks, wear, pitting, or scoring (fig. 2L-33). Inspect the adjuster screw for looseness, damaged threads, or distortion. Replace the pitman shaft if any of these conditions are noted. However, light scoring, corrosion, or scratches on the shaft surfaces may be removed using crocus cloth.

Inspect the pitman shaft nut threads and master spline for damage (fig. 2L-33). If either of these surfaces are damaged, replace the shaft.

Rack Piston and Wormshaft

Disassembly

(1) Remove wormshaft, lower thrust bearing, and bearing races from rack piston.

(2) Cut and remove seal ring and backup O-ring from rack piston. Discard seal ring and O-ring.

(3) Remove ball return guide clamp attaching screws and remove return guide clamp.

(4) Place rack piston on clean cloth and remove two-piece ball return guide, arbor tool, and ball bearings.

Cleaning and Inspection

Clean all components with solvent and dry them using filtered compressed air.

Inspect the wormshaft for wear, scoring, pitting, distortion, nicked threads, or cracks. Replace the wormshaft if it exhibits any of these conditions. Inspect the rack piston for scored, pitted, or nicked ball bearing grooves. Replace the wormshaft and rack piston as an assembly if either part is damaged.

Inspect the exterior surface of the rack piston for wear or scoring and be sure the seal ring seat is clean and free from burrs.

Inspect the rack piston teeth for chips, cracks, dents, or scoring. If either the wormshaft or rack piston are damaged, replace both parts as a matched set only.

Inspect each of the ball bearings for dents, nicks, excessive wear, flaking, or flat spots and replace as necessary. Inspect the ball return guides. Be sure the guide ends, where the bearings enter and leave the guides, are free of burrs or distortion.

Inspect the lower thrust bearing and bearing races for wear or scoring. Replace any parts that are damaged or worn.

Assembly

(1) Lubricate all components with power steering fluid.

(2) Install backup O-ring in rack piston seal ring groove.

(3) Install seal ring over backup O-ring (fig. 2L-34).

NOTE: *The seal ring may appear slightly loose after installation, however, this is normal. The seal ring will tighten when exposed to system fluid at operating temperature.*

Fig. 2L-34 Rack Piston Seal Ring Installation

(4) Install wormshaft in rack piston.

(5) Align ball return guide holes with wormshaft grooves.

(6) Alternately install 18 ball bearings in rack piston bearing circuit hole adjacent to seal ring (fig. 2L-35). Install silver ball bearing followed by black ball bearing until 18 bearings have been installed. Rotate wormshaft slowly in counterclockwise direction when installing bearings and press each bearing downward to make room for following bearing.

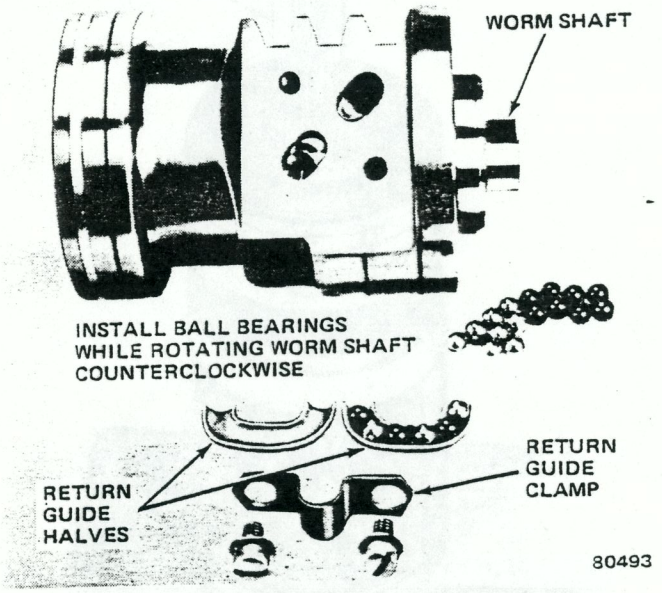


Fig. 2L-35 Rack Piston Ball Bearing Installation

NOTE: *The wormshaft will back out of the rack piston when rotated during bearing installation. Do not allow the wormshaft to back completely out of the rack piston.*

(7) Fill one ball return guide half with petroleum jelly and install six remaining ball bearings in guide (fig. 2L-35). Be sure bearings in guide are in sequence with bearings in rack piston and that total of 24 ball bearings are installed (18 in rack piston and 6 in return guide).

(8) Assemble both ball return guide halves and insert guides in rack piston. Guides should fit loosely.

(9) Position ball return guide clamp over guides and install clamp attaching bolts and washers. Tighten bolts to 10 foot-pounds (14 N•m) torque.

(10) Insert Arbor Tool J-21552 into rack piston until it contacts wormshaft.

(11) Apply steady pressure against arbor tool to maintain contact with wormshaft and back wormshaft out of rack piston.

NOTE: *Do not allow the arbor tool and wormshaft to separate during wormshaft removal. The ball bearings could drop out of their circuits and fall inside the rack piston making another disassembly/assembly procedure necessary.*

(12) Position assembled rack piston and arbor tool on end and support assembly on wood blocks until ready to install in housing (fig. 2L-36).

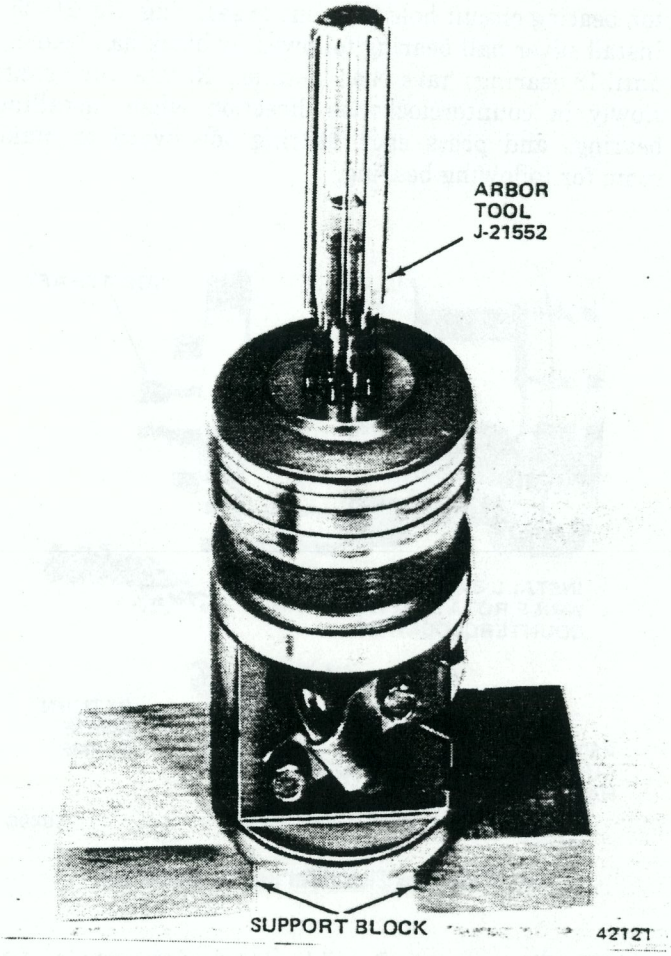


Fig. 2L-36 Arbor Tool Installed in Rack Piston

NOTE: *Do not allow the arbor tool to separate from the rack piston.*

STEERING GEAR ASSEMBLY AND ADJUSTMENT

(1) Lubricate all components with power steering fluid.

(2) Remount steering gear in vise (fig. 2L-12). Clamp unmachined boss portion of housing in vise only.

(3) Install wormshaft lower thrust bearing and bearing races on wormshaft. Installation sequence is: race—bearing—race (fig. 2L-37). Coned sides of races must face rack piston when installed.

(4) Install stub shaft cap O-ring in valve body (if not installed previously). Be sure O-ring is seated against edge of stub shaft cap.

(5) Insert wormshaft into valve body. Rotate wormshaft until drive lugs engage in stub shaft cap and wormshaft locating pin engages in valve body notch (fig. 2L-38).

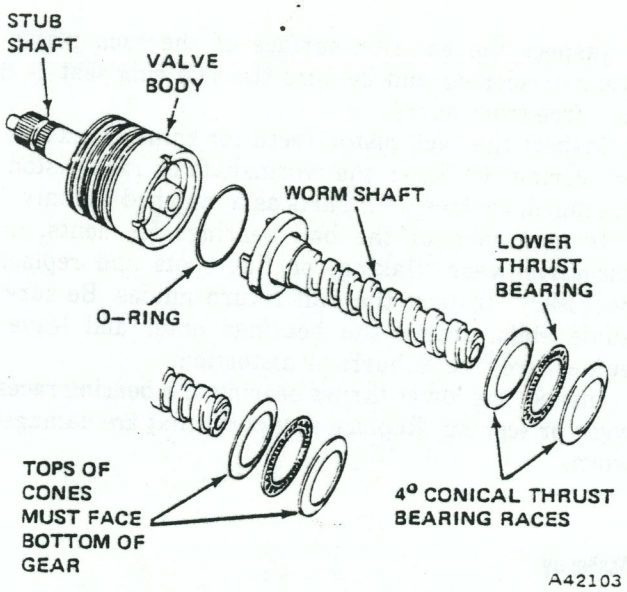


Fig. 2L-37 Wormshaft and Valve Body Assembly

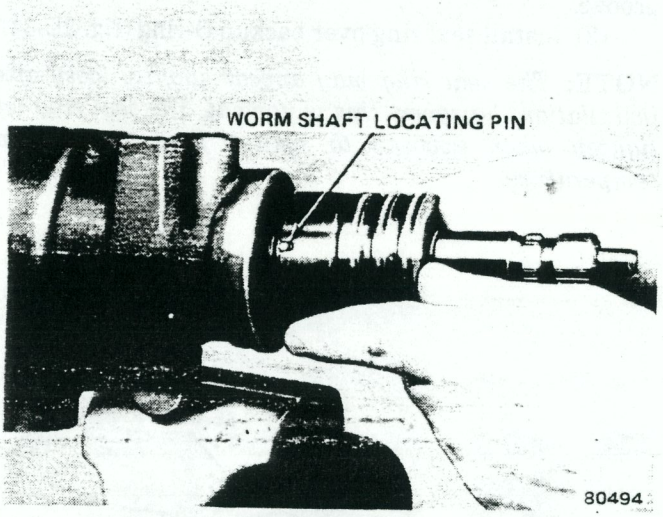


Fig. 2L-38 Valve Body-Wormshaft Installation

(6) Install assembled valve body and wormshaft in housing. Be sure wormshaft locating pin is still fully engaged in valve body notch before installing (fig. 2L-38).

CAUTION: *Do not press against the stub shaft to install the valve body and wormshaft. This could cause the stub shaft to disengage from the valve body allowing the spool valve O-ring to slip into the valve body oil grooves. Perform installation by pressing directly on the valve body with the fingertips only (fig. 2L-38). In addition, be sure the valve body is properly seated before installing the adjuster plug. When the valve body is seated correctly, the fluid return port in the gear housing will be fully visible (fig. 2L-39). If the port is not visible, the valve body and wormshaft are misaligned or the thrust bearing and races are improperly installed.*

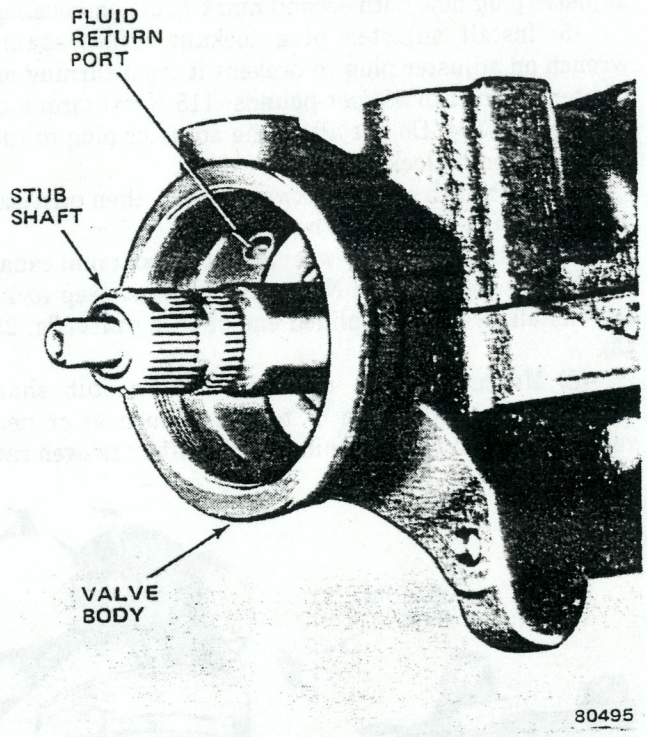


Fig. 2L-39 Seating Valve Body

(7) Place Seal Protector Tool J-6222 over end of stub shaft and install adjuster plug in housing (fig. 2L-40). Tighten adjuster plug to 20 foot-pounds (27 N•m) torque.

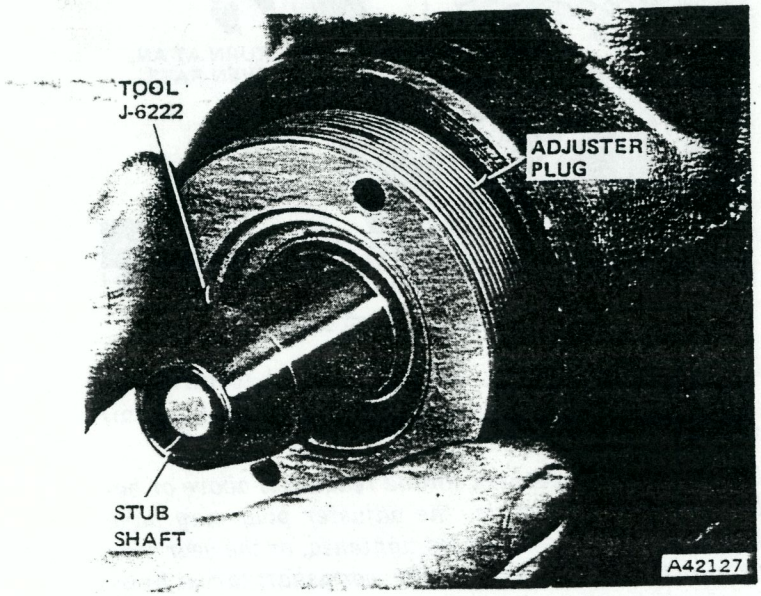


Fig. 2L-40 Adjuster Plug Installation

(8) Remove seal protector tool from stub shaft.

(9) Install rack piston in housing. Be sure wormshaft remains engaged with stub shaft. Do not damage rack piston seal ring during installation.

(10) Align wormshaft with rack piston and turn stub shaft clockwise to engage wormshaft in rack piston. Maintain steady pressure on arbor tool until wormshaft is fully engaged in rack piston.

(11) Remove arbor tool when rack piston seal ring is inside housing.

(12) Rotate stub shaft until center tooth groove in rack piston is aligned with center of pitman shaft bore.

(13) Install side cover gasket on side cover. Be sure gasket rubber seal is seated in cover groove.

(14) Install side cover on pitman shaft.

(15) Thread side cover onto pitman shaft adjuster screw until cover bottoms against shaft.

(16) Install pitman shaft in housing and mesh center sector tooth of shaft with center tooth groove in rack piston.

(17) Align side cover on housing and install cover attaching bolts. Tighten bolts to 45 foot-pounds (61 N•m) torque. Be sure cover gasket is properly seated before installing cover bolts.

(18) Thread adjuster screw locknut half-way onto pitman shaft adjuster screw. Use hex wrench to prevent adjuster screw from turning while installing locknut.

NOTE: *The locknut has left-hand threads.*

(19) Install end plug in rack piston and tighten plug to 75 foot-pounds (102 N•m) torque.

(20) Lubricate housing end plug O-ring with petroleum jelly.

(21) Install housing end plug and seat plug against O-ring. If necessary, tap end plug lightly with plastic mallet to seat it. Do not displace O-ring during installation.

(22) Install housing end plug retainer ring. Position ring end gap one inch (25.4 mm) away from hole in side of housing. Tap end plug lightly to be sure plug and retainer ring are seated.

(23) Adjust wormshaft bearing preload and pitman shaft overcenter drag torque as outlined in Steering Gear Adjustment.

Steering Gear Adjustment

The steering gear requires two adjustments which are: wormshaft bearing preload and pitman shaft over center drag torque.

Wormshaft bearing preload is controlled by the amount of compression force exerted on the conical wormshaft thrust bearing races by the adjuster plug.

Pitman shaft overcenter drag torque is controlled by the pitman shaft adjuster screw which determines the clearance between the rack piston and pitman shaft sector teeth.

CAUTION: *The following adjustment procedures must be performed exactly as described and in the sequence outlined. Failure to do so can result in damage to*

the gear internal components and poor steering response. Always adjust wormshaft bearing preload first; then adjust pitman shaft overcenter drag torque last.

Wormshaft Bearing Preload

(1) Seat adjuster plug in housing using Spanner Wrench J-7624 (fig. 2L-16). Approximately 20 foot-pounds (27 N•m) torque is required to seat plug.

(2) Place index mark on gear housing in line with one of the holes in adjuster plug (fig. 2L-41).

(3) Measure back (counterclockwise) 1/2 inch (13 mm) from first index mark and remark housing (fig. 2L-42).

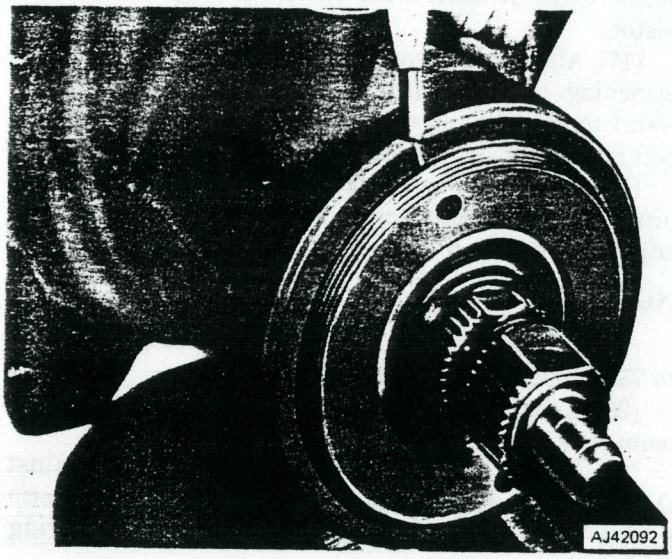


Fig. 2L-41 Marking Housing

Fig. 2L-42 Remarking Housing

(4) Turn adjuster plug counterclockwise and align adjuster plug hole with second mark made on housing.

(5) Install adjuster plug locknut. Place spanner wrench on adjuster plug to prevent it from turning and tighten locknut to 85 foot-pounds (115 N•m) torque using tool J-25194. Do not allow the adjuster plug to turn while tightening locknut.

(6) Turn stub shaft clockwise to stop, then turn stub shaft back one-quarter turn.

(7) Assemble torque wrench with maximum capacity of 50 inch-pounds (6 N•m) and 12-point deep socket and install wrench on splined end of stub shaft (fig. 2L-43).

(8) Measure torque required to turn stub shaft. Take reading with beam of torque wrench at or near vertical position while turning stub shaft at an even rate (fig. 2L-43).

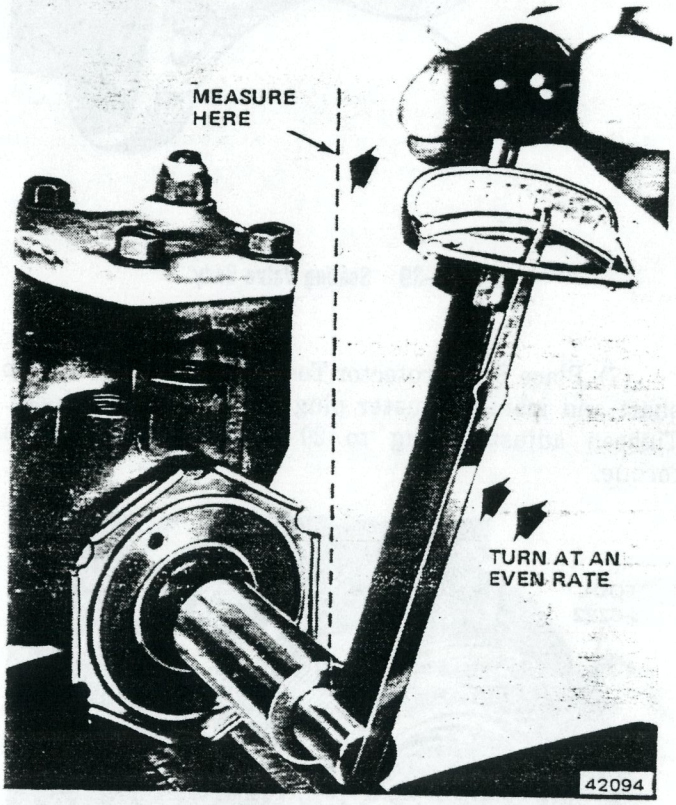


Fig. 2L-43 Measuring Wormshaft Bearing Preload

(9) Record reading. Torque required to turn stub shaft should be 4 to 10 inch-pounds (0.45 to 1.1 N•m) torque.

NOTE: *If the measured torque reading is above or below the specified limits, the adjuster plug may have turned when the locknut was tightened, or the gear may be incorrectly assembled, or the wormshaft thrust bearings and races may be defective. Repair as required and remeasure preload.*

Pitman Shaft Overcenter Drag Torque

(1) Loosen adjuster screw locknut. Turn pitman shaft adjuster screw counterclockwise until screw is

fully extended; then turn screw back one full turn in clockwise direction.

(2) Rotate stub shaft from stop-to-stop and count total number of turns.

(3) Starting from either stop, turn stub shaft back 1/2 total number of turns. This is gear center.

NOTE: *When the gear is centered, the flat on the stub shaft should face upward and be parallel with the side cover (fig. 2L-44). In addition, the master spline on the pitman shaft should be in line with the adjuster screw (fig. 2L-45).*

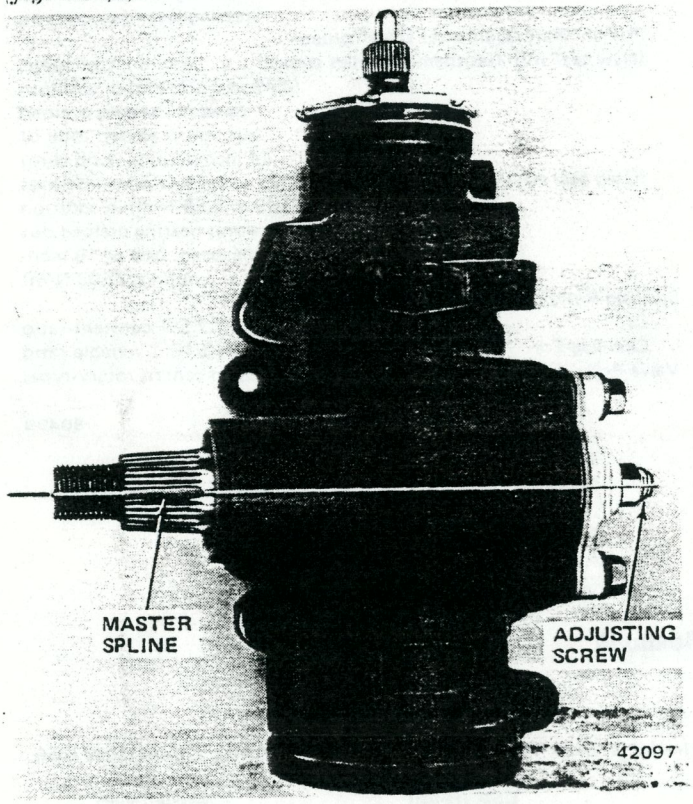


Fig. 2L-44 Stub Shaft Position with Gear Centered

(4) Install 50 inch-pound (6 N•m) torque wrench and deep socket on stub shaft and place wrench in vertical position to take reading (fig. 2L-46).

(5) Rotate torque wrench 45 degrees each side of center and record highest drag torque measured on or near center (fig. 2L-46). Record drag torque reading.

(6) Adjust drag torque by turning pitman shaft adjuster screw clockwise until desired drag torque is obtained. Adjust drag torque to following limits:

On new gears, add 4 to 8 inch-pounds (0.45 to 0.90 N•m) torque to previously measured wormshaft bearing preload **but do not exceed a combined total of 14 inch-pounds (2 N•m) drag torque.**

On used gears (400 or more miles), add 4 to 5 inch-pounds (0.5 to 0.6 N•m) torque to previously measured wormshaft bearing preload **but do not exceed a combined total of 14 inch-pounds (2 N•m) drag torque.**

(7) Tighten pitman shaft adjuster screw locknut after adjusting overcenter drag torque. Tighten locknut to

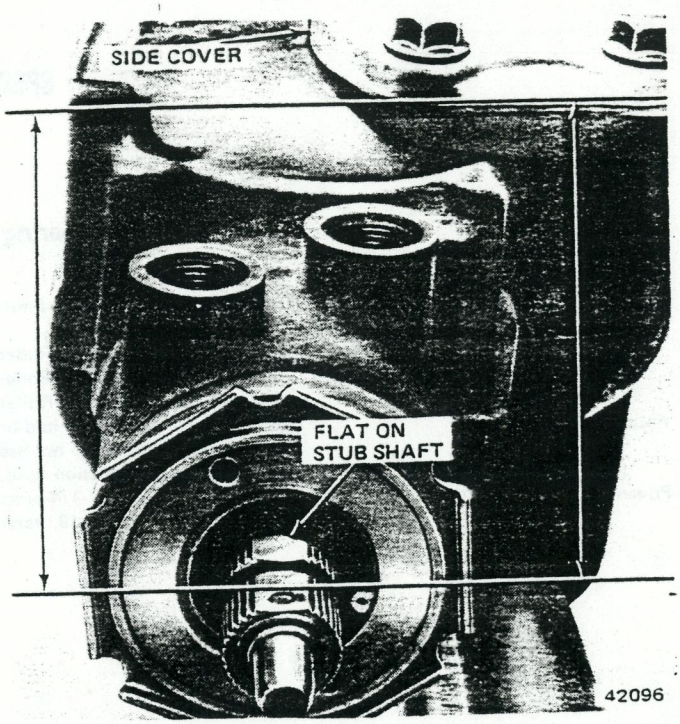


Fig. 2L-45 Pitman Shaft Master Spline Position with Gear Centered

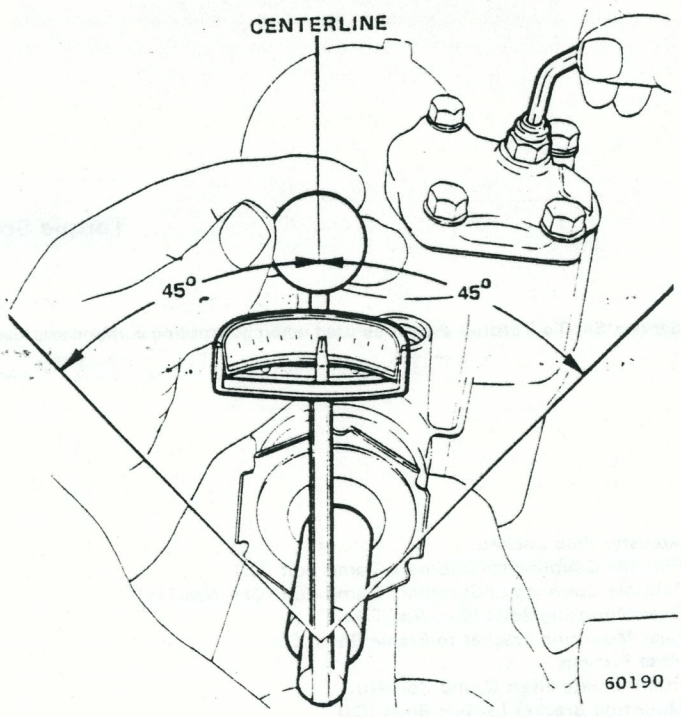


Fig. 2L-46 Measuring Pitman Shaft Overcenter Drag Torque

20 foot-pounds (27 N•m) torque. Use hex wrench to prevent adjuster from turning while tightening adjuster screw (fig. 2L-14).

(8) Install steering gear and fill power steering pump reservoir with Jeep Power Steering Fluid, or equivalent.

(9) Bleed air from power steering system. Refer to Fluid Level and Initial Operation in Power Steering Pump section.

SPECIFICATIONS

Power Steering Gear Specifications

Type . . . . . Recirculating Ball, worm and nut.
Bearings
Wormshaft Upper . . . . . .Needle Roller
Lower . . . . . .Needle Roller
Pitman Shaft. . . . . .Needle Roller
Fluids. . . . . Use Jeep Power Steering Fluid or equivalent only. Do not use transmission fluid.
Power Steering System Fluid Capacity . . . . . 1-1/4 pints (0.59 liters)

Steering Gear Adjustment:
Worm Bearing Preload . . . 4 to 10 inch-pounds (0.45 to 1.13 N·m) rotating torque. Refer to Steering Gear Adjustment.
Pitman Shaft Overcenter Drag Torque
(New gear with less than 400 miles service) . . . .4 to 8 inch-pounds (0.45 to 0.90 N·m) in addition to worm bearing preload but not to exceed total of 14 inch-pounds (1.58 N·m)
(Used gear with over 400 miles service) . . . . . .4 to 5 inch-pounds (0.45 to 0.56 N·m) in addition to worm bearing preload but not to exceed total of 18 inch-pounds (2.03 N·m)

Steering Ratio
CJ. . . . . 17.5:1 constant ratio
Cke-Wag-Trk. . . . . .13/16:1 variable ratio
Valve Body . . . . . Three-way, open center, rotary-type.

80499

Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft-lbs)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Adjuster Plug Locknut	85	75-95	115	102-129
Flexible Coupling-to-Stubshaft Clamp Bolt (CJ)	45	40-50	61	54-68
Flexible Coupling-to-Stubshaft Clamp Bolt (Cke-Wag-Trk)	30	25-35	41	34-47
Gear Mounting Bolts (Cke-Wag-Trk)	70	60-80	95	81-108
Gear Mounting Bracket-to-Frame Bolts (CJ)	55	50-65	75	68-88
Hose Fittings	30	25-35	41	34-47
Intermediate Shaft Clamp Bolt/Nut	30	25-35	31	34-47
Mounting Bracket-to-Gear Bolts (CJ)	70	60-80	95	81-108
Pitman Arm Nut	185	170-210	251	230-285
Pitman Shaft Adjuster Screw Locknut	20	18-22	27	24-30
Return Guide Clamp Bolt	6	4-10	8	5-14
Rack-Piston End Plug	75	72-77	102	98-104
Side Cover Bolts	40	30-45	54	41-61

All torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

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POWER STEERING PUMP

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In-Vehicle Service	2L-37
Pump Assembly	2L-41
Pump Disassembly	2L-40
Pump Installation	2L-40
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IN-VEHICLE SERVICE

Pump Shaft Seal and Pump Pulley

Removal

(1) Loosen pump belt adjusting bolts, push pump toward engine, and remove pump belt.

(2) Remove pump pulley using tool J-25034 (fig. 2L-47).

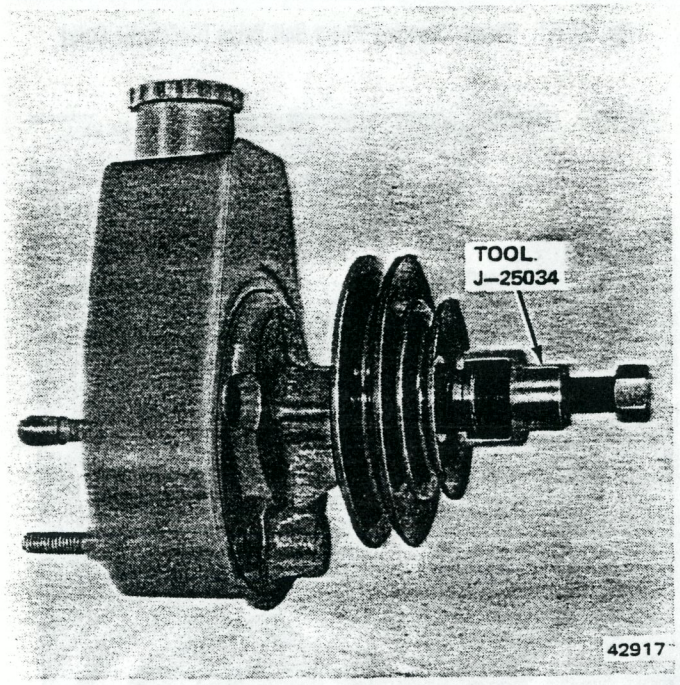


Fig. 2L-47 Pump Pulley Removal

(3) Remove shaft seal using tool J-8842. Or, if seal remover tool is not available, remove seal as follows:

(a) Wrap length of 0.005-inch (0.12 mm) thick shimstock, approximately 2-1/2 inches (6.35 cm) long, around pump shaft. Work shimstock under and past shaft seal until shimstock bottoms in seal bore (fig. 2L-48).

(b) Cut metal body of shaft seal using sharp chisel and pry seal out of pump body using screwdriver (fig. 2L-48). Do not scratch or nick pump shaft or seal bore during seal removal.

(4) Remove any small nicks, scratches, or corrosion from pump shaft with crocus cloth.

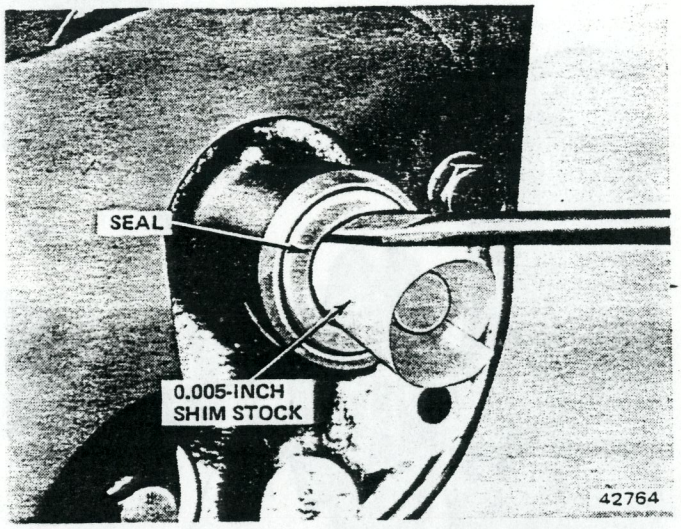


Fig. 2L-48 Pump Shaft Seal Removal

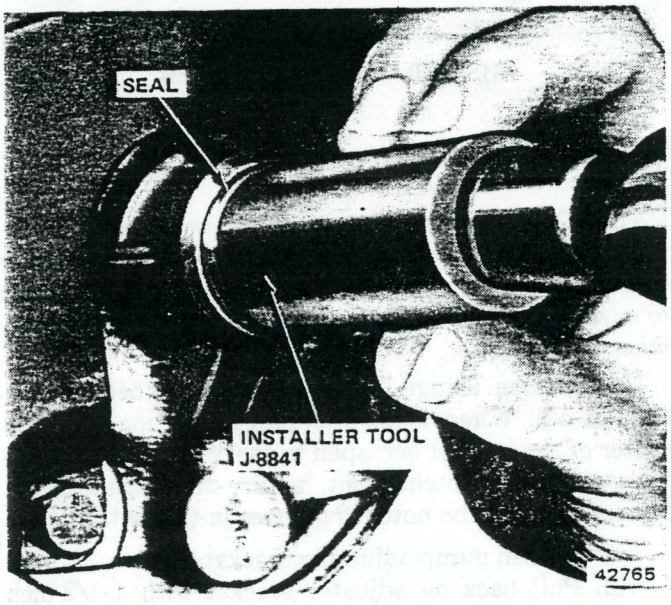


Fig. 2L-49 Pump Shaft Seal Installation

Installation

(1) Lubricate pump shaft and replacement seal with power steering fluid.

(2) Install seal on pump shaft and insert seal into pump body seal bore. Be sure spring side of seal faces toward pump body.

(3) Seat seal using tool J-7728 (fig. 2L-49).

(4) Install pump pulley using Tool J-25033 (fig. 2L-50).

(5) Install pump belt and adjust belt tension. Refer to Belt Tension Adjustment.

(6) Fill pump reservoir with power steering fluid and bleed air from system. Refer to Fluid Level and Initial Operation.

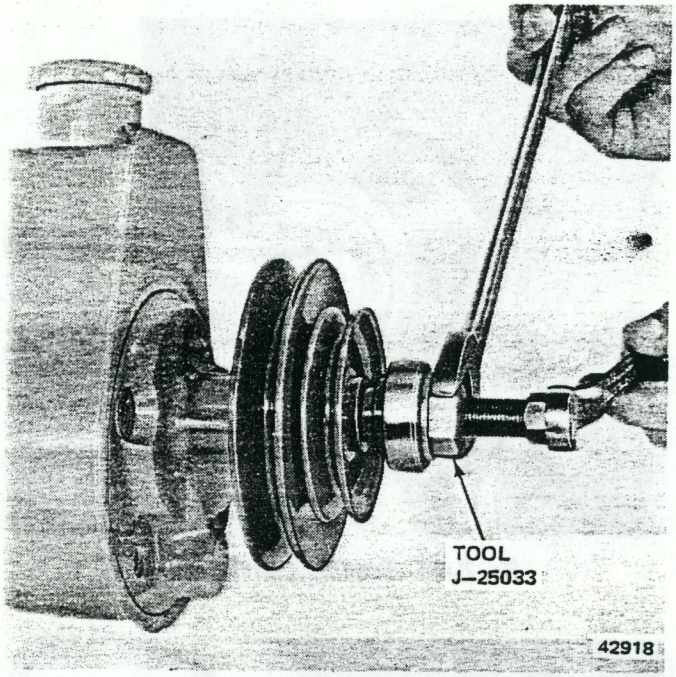


Fig. 2L-50 Pump Pulley Installation

Belt Tension Adjustment

CAUTION: *The power steering pump on all automobiles built for sale in California is driven by a Serpentine drive belt. The pump should not be moved in an attempt to adjust the belt. Refer to Chapter 1C for belt adjustment instructions.*

Use Tension Gauge J-23600 to measure belt tension (fig. 2L-52). When using the gauge, position it at the center of the longest belt span to check tension. If checking tension on a notched belt, be sure the gauge finger is seated in one of the notched grooves in the belt.

(1) Loosen pump adjusting bracket bolts.

(2) Pull back on adjuster bracket with a 1/2-inch drive breaker bar until belt is tight. Tighten adjusting bracket bolts.

(3) Measure belt tension with Gauge J-23600 (fig. 2L-52).

(4) Tighten or loosen pump belt until desired belt tension is obtained. Refer to Specifications for belt tension figures for various models.

(5) Tighten all pump mounting and adjusting bracket bolts to 30 foot-pounds (41 N•m) torque after adjusting belt tension.

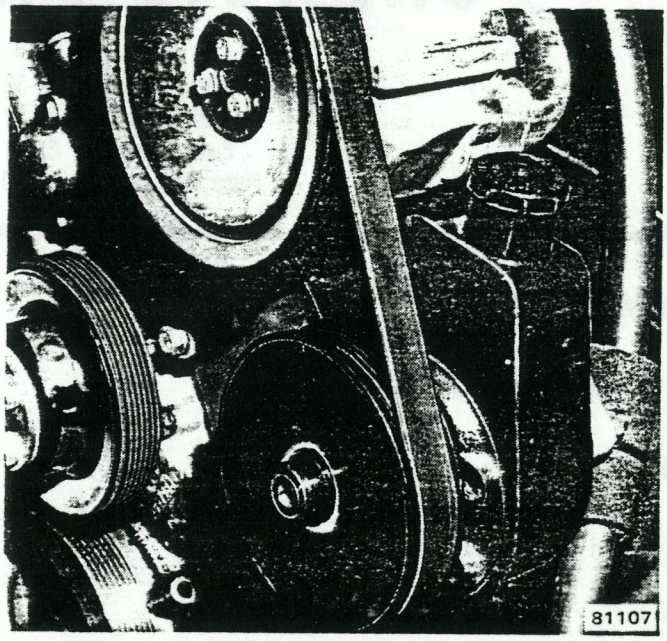


Fig. 2L-51 Power Steering Pump Belt Drive (California Only)

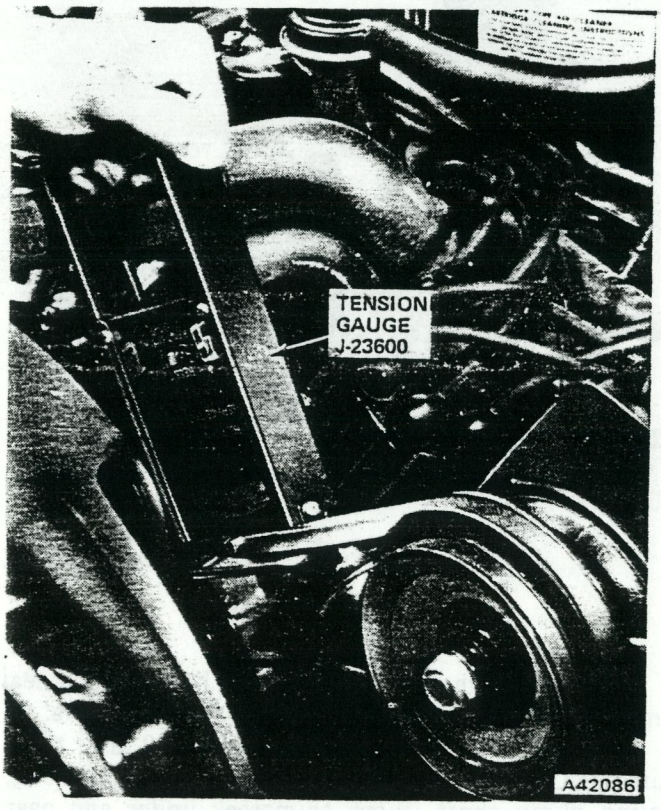


Fig. 2L-52 Checking Belt Tension

Flow Control Valve

Removal

(1) Position drain pan under engine.

(2) Disconnect pressure hose at pump. Cap hose to prevent dirt entry and excessive fluid loss.

NOTE: *Some power steering pump units may have a metric thread pressure port fitting. This fitting is designed for use with a pressure hose that uses an O-ring seal (fig. 2L-7, View B).*

(3) Remove pump union fitting and O-ring (fig. 2L-53). Discard O-ring.

(4) Remove flow control valve and spring using pencil-type magnet.

Installation

(1) Lubricate replacement flow control valve and union fitting O-ring with power steering fluid.

(2) Insert hex-end of flow control valve in replacement valve spring.

(3) Install assembled valve and spring in pump bore, spring-end first.

(4) Install replacement O-ring seal on pump union fitting and install fitting in pump. Tighten fitting to 35 foot-pounds (47 N•m) torque.

(5) If pump pressure hose has metric fitting that uses an O-ring seal, check seal condition before connecting hose to pump. Replace seal if damaged or worn.

(6) Connect pressure hose to pump. Tighten hose fitting to 35 foot-pounds (47 N•m) torque.

(7) Fill pump reservoir with power steering fluid.

(8) Start engine and check for leaks. Repair any leaks as necessary.

(9) Bleed air from power steering system. Refer to Fluid Level and Initial Operation.

(10) Remove drain pan.

FLUID LEVEL AND INITIAL OPERATION

The power steering system must be purged of air whenever service procedures involving pump or gear disassembly or hose removal have been performed. Air must be removed from the system in order to obtain normal steering action and response. When necessary, bleed the power steering system as follows:

(1) Fill pump reservoir with power steering fluid.

(2) Operate engine until fluid reaches normal operating temperature of 170°F (76°C).

(3) Stop engine.

(4) Check and correct pump reservoir fluid level as necessary.

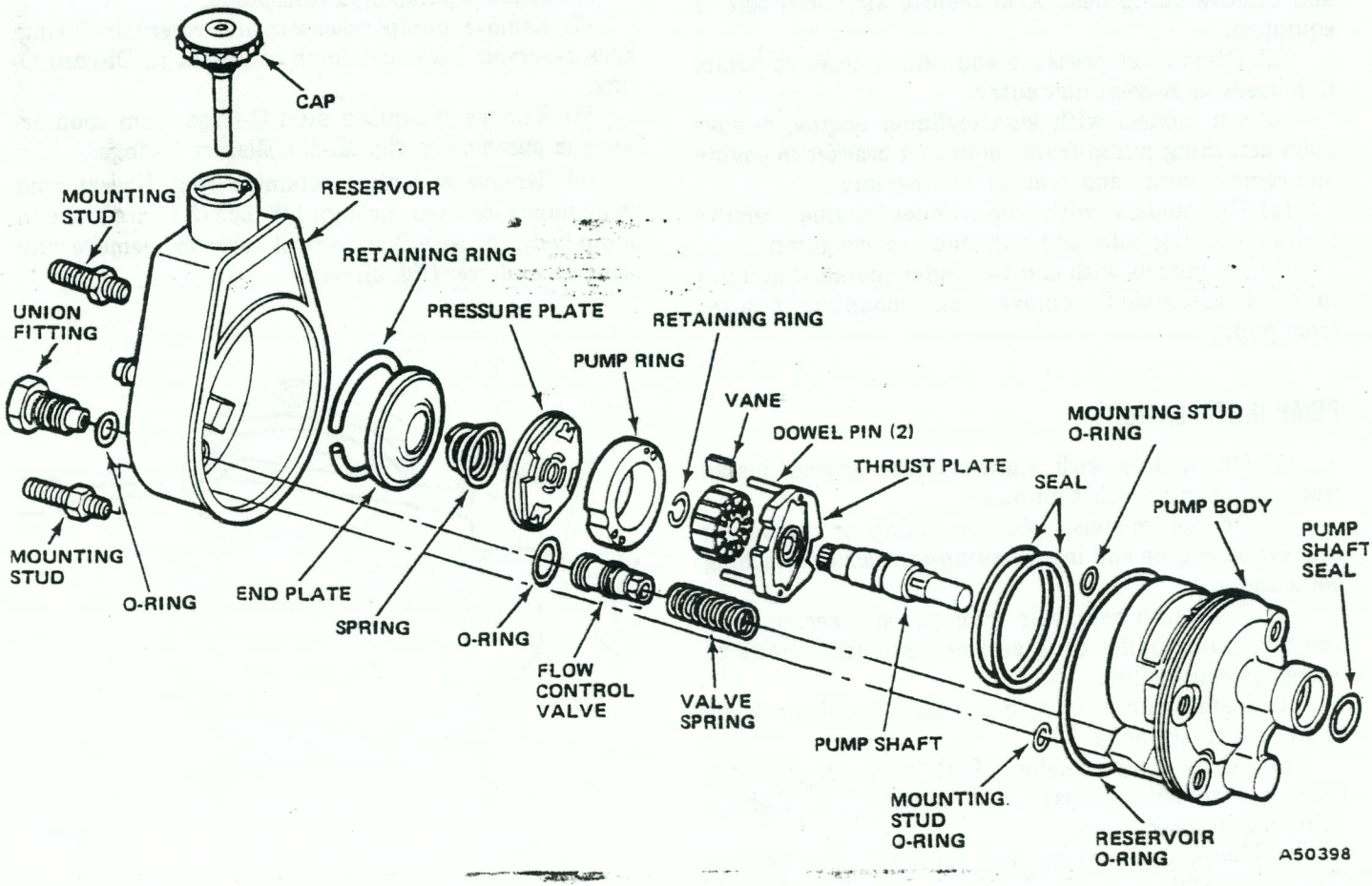


Fig. 2L-53 Power Steering Pump

(5) Turn wheels to full left turn position and add fluid to reservoir until at FULL COLD mark on dipstick.

(6) Start and operate engine at fast idle speed.

(7) Recheck reservoir fluid level and add fluid until at COLD mark on dipstick.

(8) Bleed air from system by turning wheels from side to side without contacting steering stops in either direction. Maintain fluid level just above pump body. Fluid with air in it will be full of bubbles and have light tan or tan-orange coloration.

(9) Continue turning wheels side to side until all air has been bled from system. Air must be eliminated before normal steering action can be obtained.

(10) When air has been purged from system, return wheels to straight-ahead position and operate engine for additional 2-3 minutes then stop engine.

(11) Road test vehicle to check steering action and response.

(12) Recheck fluid level. Level should be at HOT mark on dipstick after system has stabilized at normal operating temperature. Add fluid if necessary but do not overfill.

PUMP REMOVAL

(1) Loosen pump adjusting bracket bolts and nuts and remove pump belt. Also remove air pump belt, if equipped.

(2) Disconnect pressure and return hoses at pump. Cap hoses to prevent dirt entry.

(3) On models with eight-cylinder engine, remove bolts attaching pump front mounting bracket to engine and remove pump and bracket as assembly.

(4) On models with six-cylinder engine, remove pump mounting bolts and nuts and remove pump.

(5) On models with eight-cylinder engine, if pump is to be disassembled, remove front mounting bracket from pump.

PUMP INSTALLATION

(1) On models with eight-cylinder engine, install front mounting bracket on pump.

(2) On all models, position pump in mounting bracket on engine and install pump-to-bracket attaching bolts and nuts.

(3) Fill pump reservoir with power steering fluid and turn pump pulley counterclockwise until bubbles no longer appear in fluid.

(4) Install pump drive belt. Also install air pump drive belt, if equipped.

(5) Adjust belt tension. Pull back on adjuster bracket with breaker bar until belt is tight. Tighten adjusting bracket bolts.

(6) Check and adjust belt tension using Tension Gauge J-23600 (fig. 2L-52). Refer to Belt Tension Adjustment.

(7) Tighten all pump mounting bolts to 30 foot-pounds (41 N•m) torque.

(8) Fill pump reservoir and bleed air from power steering system. Refer to Fluid Level and Initial Operation.

PUMP DISASSEMBLY

(1) Remove reservoir filler cap and drain fluid from pump.

(2) Reinstall filler cap and clean pump with solvent to remove exterior dirt.

(3) Remove pump pulley using tool J-25034 (fig. 2L-47).

CAUTION: *Inspect the exposed surface of the pump shaft. Remove all traces of corrosion or nicks and scratches with crocus cloth before disassembling the pump. This will avoid damaging the pump bushing during disassembly—which might necessitate replacement of the entire pump body.*

(4) Mount pump in vise so pump shaft is pointing downward. Do not overtighten vise as pump body could be distorted.

(5) Remove pump union fitting and O-ring (fig. 2L-53). Discard O-ring.

(6) Remove pump mounting studs.

(7) Remove pump reservoir and reservoir O-ring. Rock reservoir back and forth to unseat it. Discard O-ring.

(8) Remove mounting stud O-rings from counterbores in pump body (fig. 2L-53). Discard O-rings.

(9) Remove end plate retaining ring. Unseat ring using punch inserted through 1/8-inch (3.17 mm) hole in pump body opposite flow control valve and remove ring using screwdriver (fig. 2L-54).

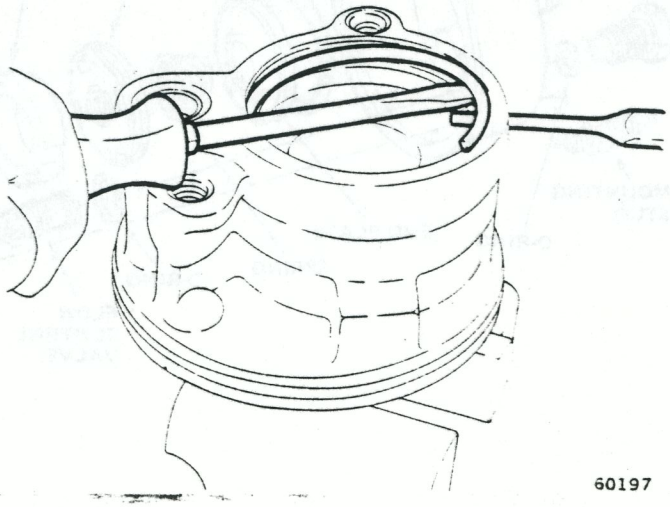


Fig. 2L-54 End Plate Retaining Ring Removal

(10) Remove end plate and spring (fig. 2L-53). If plate sticks in pump body, tap plate lightly with plastic mallet to free it.

(11) Remove flow control valve and valve spring from pump using pencil-type magnet. Or, remove pump from vise, invert pump, and allow valve and spring to slide out of pump bore.

(12) Remove pump shaft, thrust plate, rotor and vanes, pump ring, and pressure plate as assembly. Remount pump in vise so shaft bore faces downward and tap end of pump shaft with plastic mallet to remove assembly (fig. 2L-55).

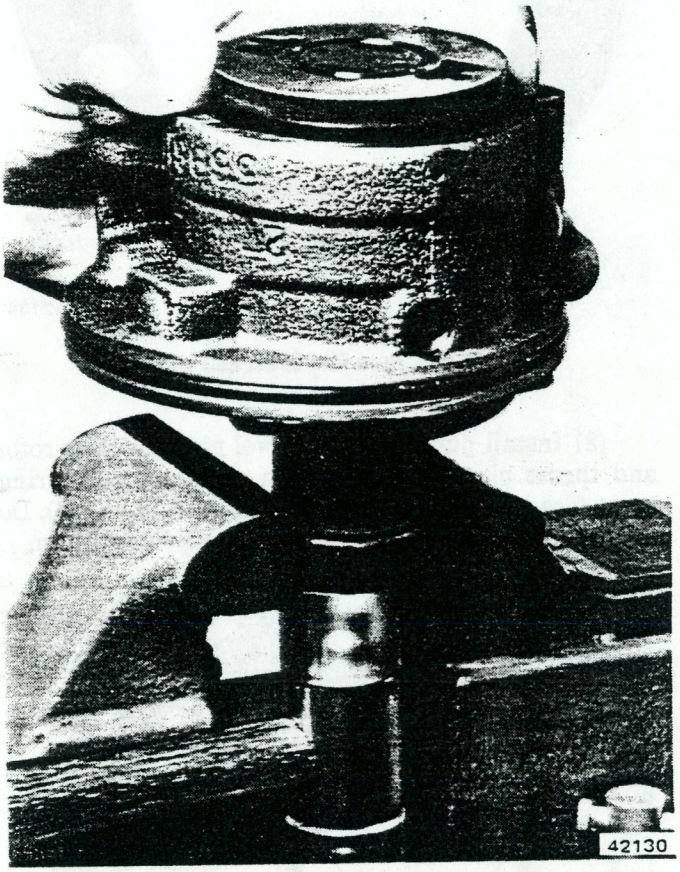


Fig. 2L-55 Pump Shaft Assembly Removal

(13) Remove pump shaft snap ring and remove pressure plate, pump ring, rotor and vanes, and thrust plate from shaft.

(14) Remove end plate O-rings from pump body bore. Discard O-rings.

(15) Remove pump shaft seal from pump shaft bore using tool J-8842.

Cleaning and Inspection

Clean all parts in solvent and dry them using filtered compressed air.

Inspect the flow control valve and valve bore for pitting, scoring, or wear and inspect the valve spring for distortion or loss of tension. Insert the valve in the valve bore and check for free movement. The valve must not stick or bind. Replace the valve and spring as an assembly only if either part exhibits any of the above conditions. Replace the pump body if the valve bore is damaged.

Check the capscrew located in the end of the flow control valve. If loose, tighten it but take care to avoid scratching or scoring the valve surfaces. Minor surface irregularities can be removed using crocus cloth (only).

NOTE: *The flow control valve and spring are serviced as an assembly only. Do not attempt to disassemble the flow control valve at any time.*

Inspect the pressure plate, pump ring, and thrust plate surfaces for wear, cracks, scoring, or pitting. Also check the surfaces for flatness and for being parallel with the pump ring. Replace any part that is worn or damaged.

NOTE: *A high polish will always be present on the pressure plate surfaces as a result of normal operating contact with the rotor. Do not confuse this polish with wear or scoring.*

Inspect the rotor surfaces for pitting, wear, cracks, or scoring and check all the rotor vanes for free movement in the rotor slots. The vanes must not stick or bind. Replace the rotor if damaged or worn and replace the vanes if scored, worn, cracked, chipped, or if they stick or bind.

Inspect the pump shaft for nicks, scoring, wear, cracks, or worn splines. Replace the shaft if it exhibits any of these conditions.

Inspect the pump body and reservoir for cracks, porosity, or distortion and check the pump body bores and O-ring counterbores for damage. Replace either part if any of these conditions are noted.

PUMP ASSEMBLY

CAUTION: *Do not allow dirt to enter the pump during assembly. All parts must be clean and lubricated before installation. Perform all assembly operations on a clean work surface or a surface covered with clean, lint free shop towels only. Install replacement O-rings, seals, and snap rings only during assembly. Used or worn seals will cause leaks, noise and rapid wear after assembly.*

(1) Lubricate pressure plate, end plate, and all replacement O-ring seals with petroleum jelly. Lubricate all other parts with power steering fluid.

(2) Install one end plate O-ring seal in third (bottom) groove in pump body bore (fig. 2L-56).

(3) Install dowel pins in thrust plate (fig. 2L-57).

(4) Position rotor on thrust plate and align shaft bores in rotor and plate.

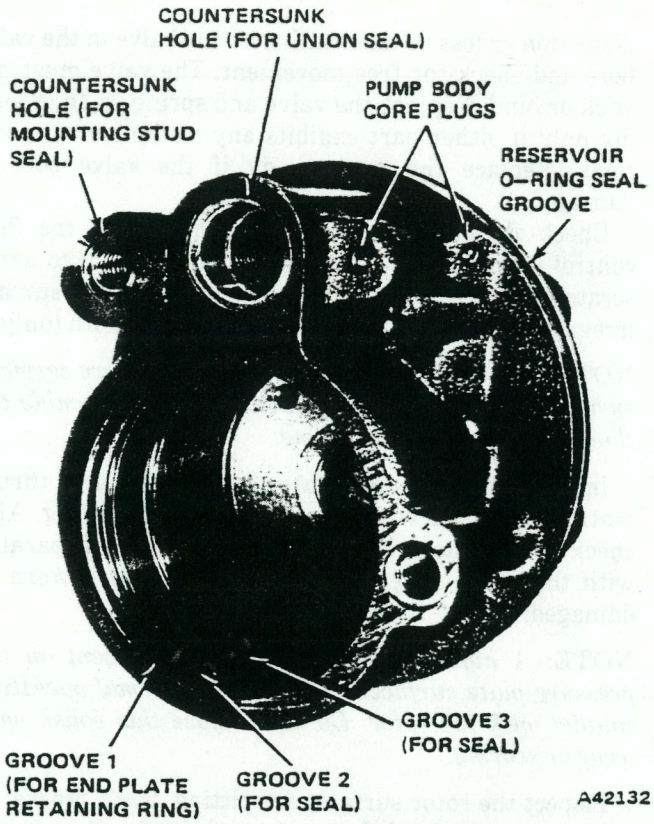


Fig. 2L-56 Pump O-Ring Seal Locations

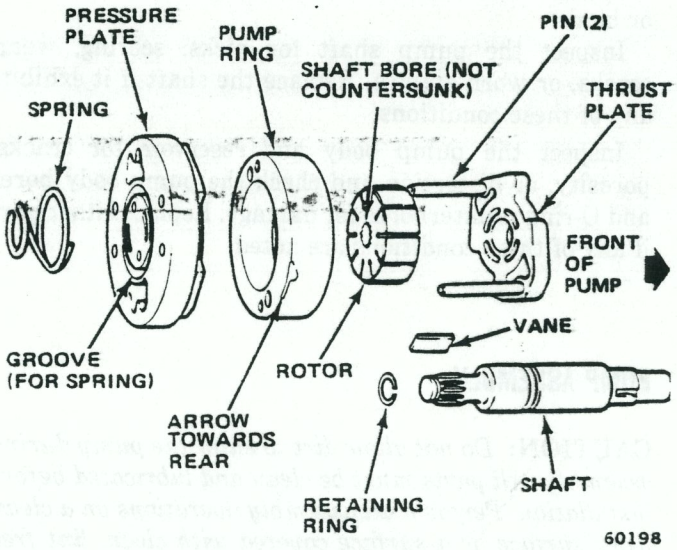


Fig. 2L-57 Pump Shaft Assembly Sequence

(5) Assemble pump shaft, thrust plate, and rotor. Insert splined end of shaft through thrust plate and rotor and install shaft snap ring (fig. 2L-57). Do not overspread snap ring. Open it only enough to install it.

(6) Install assembled thrust plate, rotor, and pump shaft in pump body bore.

(7) Align thrust plate dowel pins with dowel holes in pump ring (fig. 2L-58).

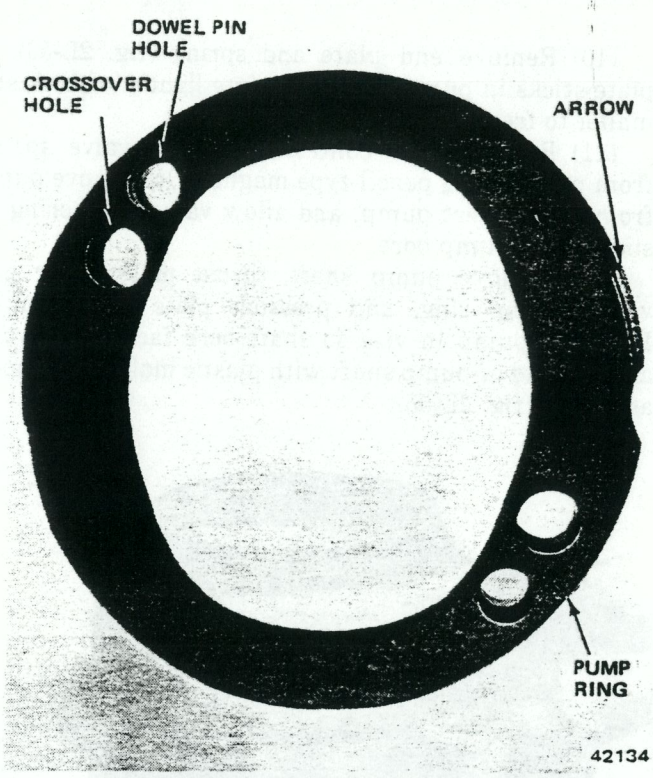


Fig. 2L-58 Pump Ring Dowel Hole Locations

(8) Install pump ring on dowel pins and over rotor and thrust plate. Pump rotation arrow on pump ring must face upward when ring is installed (fig. 2L-59). Do not displace end plate O-ring during ring installation.

Fig. 2L-59 Pump Ring Installation

(9) Install rotor vanes in rotor slots (fig. 2L-60). Rounded edges of vanes must face outward.

(10) Lubricate pressure plate outside diameter and chamfered surface with petroleum jelly.

(11) Install pressure plate on thrust plate dowel pins. Spring groove in plate must face upward when installed (fig. 2L-57).

(12) Seat pressure plate using large socket. Position socket on plate and press downward approximately 1/16 inch (1.58 mm) to seat plate.

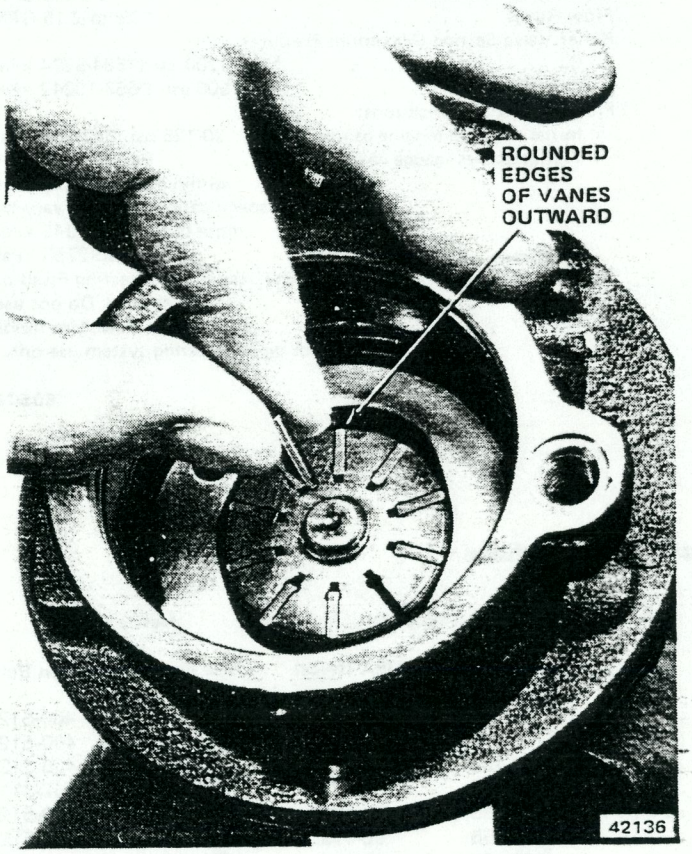


Fig. 2L-60 Rotor Vane Installation

(13) Lubricate remaining end plate O-ring seal with petroleum jelly and install O-ring in second (center) groove in pump body bore (fig. 2L-56).

(14) Install pressure plate spring on pressure plate. Be sure spring is seated in plate spring groove (fig. 2L-57).

(15) Lubricate end plate outside diameter with petroleum jelly and install plate in pump body bore.

(16) Press end plate downward and install end plate retaining ring (fig. 2L-61).

(17) Insert hex-end of flow control valve in valve spring and install assembled valve and spring in pump body valve bore (fig. 2L-62). Install assembly in valve spring-end first.

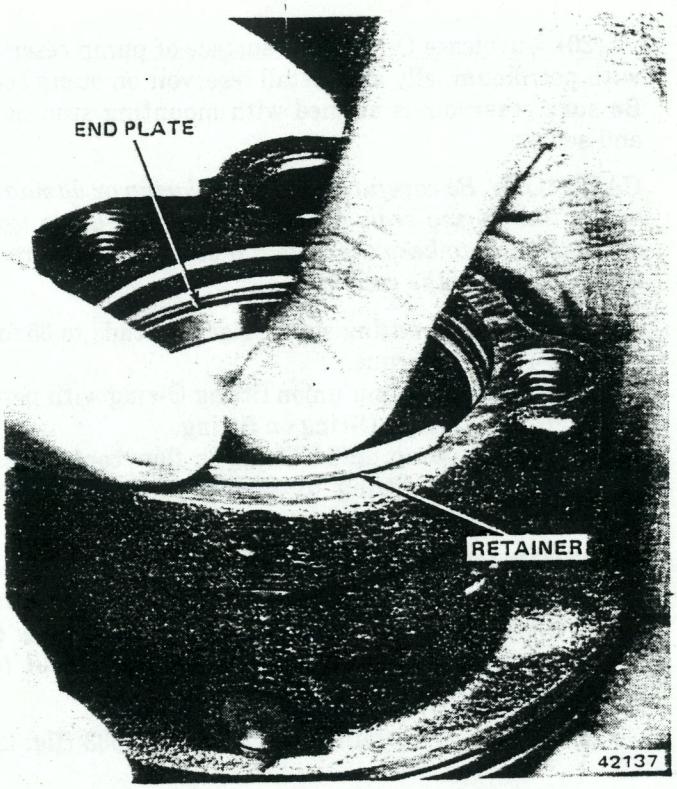


Fig. 2L-61 End Plate and Retaining Ring Installation

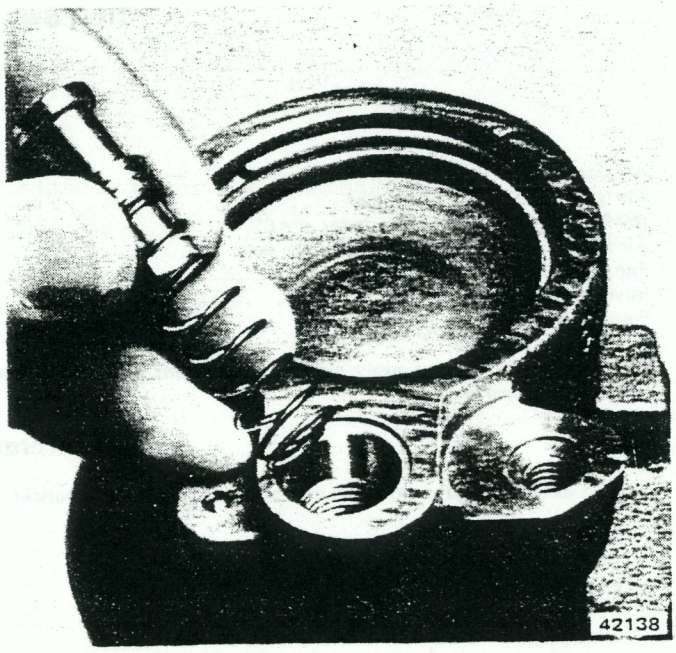


Fig. 2L-62 Flow Control Valve and Spring Installation

(18) Install mounting stud O-ring seals in pump body counterbores (fig. 2L-56). Lubricate O-rings with petroleum jelly before installation.

(19) Lubricate reservoir O-ring seal with petroleum jelly and install seal in pump body seal groove.

(20) Lubricate O-ring seal surface of pump reservoir with petroleum jelly and install reservoir on pump body. Be sure reservoir is aligned with mounting stud bores and seals.

CAUTION: *Be careful to avoid displacing or damaging any of the O-ring seals during installation. Use a wood or plastic tool to keep the reservoir seal in its seal groove when installing the reservoir.*

(21) Install mounting studs. Tighten studs to 35 foot-pounds (47 N•m) torque.

(22) Lubricate pump union fitting O-ring with petroleum jelly and install O-ring on fitting.

(23) Install pump union fitting in flow control valve bore and tighten fitting to 35 foot-pounds (47 N•m) torque.

CAUTION: *Some pump units have metric thread union fittings which are designed for use with metric hose fittings that use an O-ring seal (fig. 2L-7, View B). If the union is to be replaced, be sure to install the correct thread-type fitting.*

(24) Install pump pulley using tool J-25033 (fig. 2L-50).

(25) Install pump. Refer to Pump Installation.

(26) Fill pump reservoir and bleed air from system. Refer to Fluid Level and Initial Operation.

SPECIFICATIONS

Power Steering Pump Specifications

Pump Type	Vane-type, constant displacement, belt-driven hydraulic pump.
Capacity at 465 RPM	1.25 GPM
Flow Range	1.25 to 2.15 GPM
Relief Valve Setting (Maximum Pressure):	
CJ	1100-1200 psi (7584-8274 kPa)
Cke-Wag-Trk	1400-1500 psi (9653-10342 kPa)
Pressure Test Specifications:	
Initial pressure (engine at idle speed)	80-125 psi (552-862 kPa)
Test pressures (gauge valve closed)	Pressures must be within maximum pressure specifications and not vary by more than 50 psi (345 kPa)
Turning	400 psi (2758 kPa)
Fluids	Use Jeep Power Steering Fluid or equivalent only. Do not use transmission fluid. Use fluids designed for power steering system use only.

80502

Drive Belt Tension Specifications

	USA (pounds)		Metric (N)	
	New Belt*	USA (ft-lbs)	New Belt*	Used Belt
Air Conditioner, Six-Cylinder	125-155	90-115	556-689	400-512
Air Conditioner, Eight-Cylinder	125-155	90-115	556-689	400-512
Air Pump (All except Six-Cylinder w/AC)	125-155	90-115	556-689	400-512
Air Pump Six-Cylinder w/AC (3/8 inch belt)	65-75	60-70	291-334	267-311
Fan	125-155	90-115	556-689	400-512
Idler Pulley	125-155	90-115	556-689	400-512
Power Steering Pump	125-155	90-115	556-689	400-512

*New belt specifications apply only to replacement belts. Once a belt has been tensioned and run, it is considered a used belt and should be adjusted to used belt specifications.

80503

Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft. lbs.)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Hose Fittings	30	25-35	41	34-47
Pump Adjusting Bolts-Nuts	35	30-40	47	41-54
Pump Mounting Bracket Bolts	35	30-40	47	41-54
Pump Mounting Studs	35	30-40	47	41-54
Pump Union Fitting	35	30-40	47	41-54

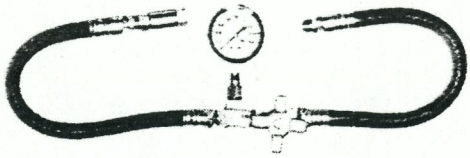
All torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

80504

Tools

J-4245
SNAP-RING PLIERS

J-21553
PITMAN SHAFT SEAL
INSTALLER



J-21567
PRESSURE TESTING GAUGE
ASSEMBLY

J-21552
RACK-PISTON ARBOR

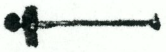
J-6222
ADJUSTER PLUG
SEAL PROTECTOR

J-21554
ADJUSTER PLUG
SEAL
INSTALLER

J-6221
ADJUSTER PLUG
BEARING REMOVER
AND INSTALLER

J-6217
CONNECTOR
SEAT INSTALLER

J-8092
HANDLE



J-7754
TORQUE WRENCH
(0-25 INCH POUNDS)

J-21551
PITMAN SHAFT
BEARING REMOVER
AND INSTALLER

J-6632
PITMAN ARM
PULLER

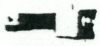
J-7624
SPANNER
WRENCH

80501

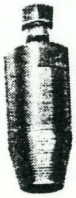
J-8642
SHAFT SEAL
PROTECTOR

J-23600
BELT TENSION
GAUGE

J-8841
SEAL INSTALLER



J-25034
REMOVER



J-8842
SEAL REMOVER

J-25033
INSTALLER

70356

STEERING LINKAGE 2M

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GENERAL

The steering linkage consists of a steering gear pitman arm, a connecting rod, a tie rod, a steering damper, and an integral steering arm and steering knuckle. Ball ends and adjusting tubes are used on the tie rod and connecting rod for toe-in adjustment and steering wheel alignment (figs. 2M-1 and 2M-2).

The connecting rod is attached to the pitman arm at one end and to the tie rod at the opposite end. The tie rod ends are connected to the steering knuckle arms. The steering damper is attached to the tie rod on one end and to a bracket on the left spring tie plate at the opposite end.

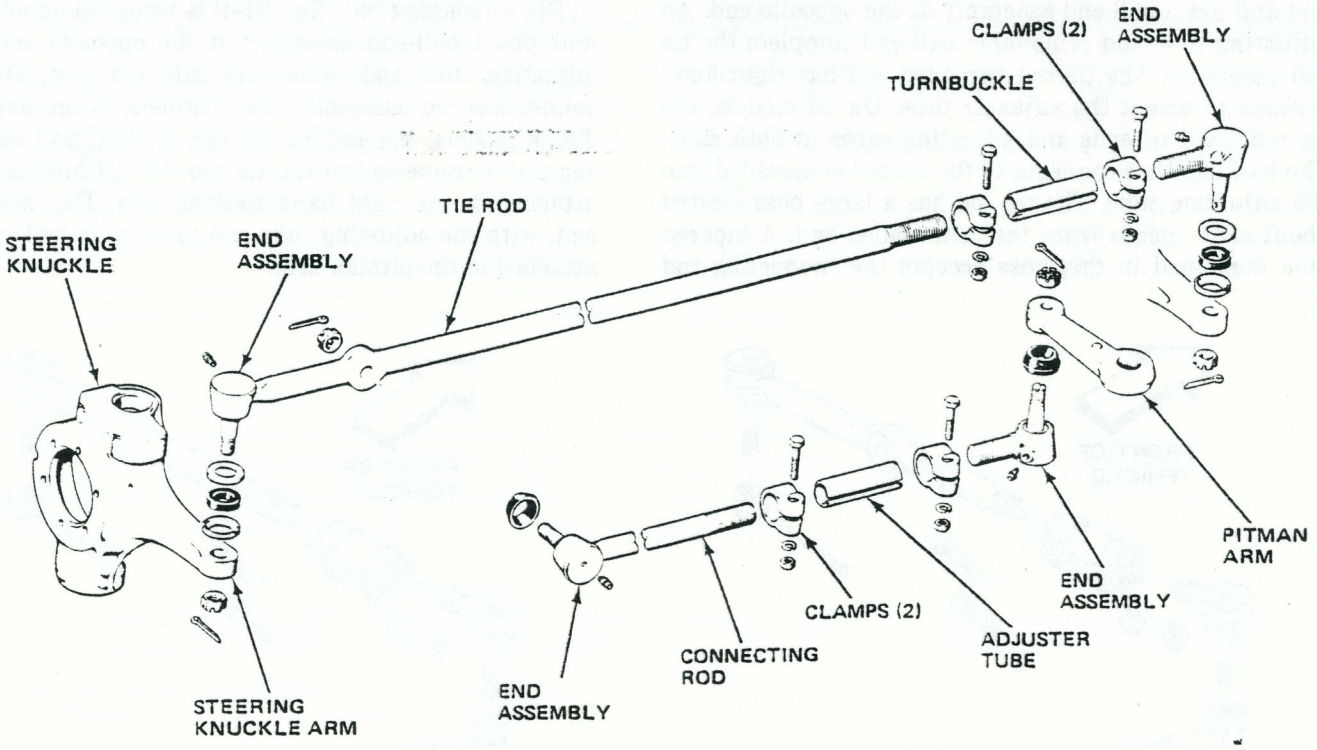

Fig. 2M-1 Steering Linkage—Cherokee-Wagoneer-Truck Models

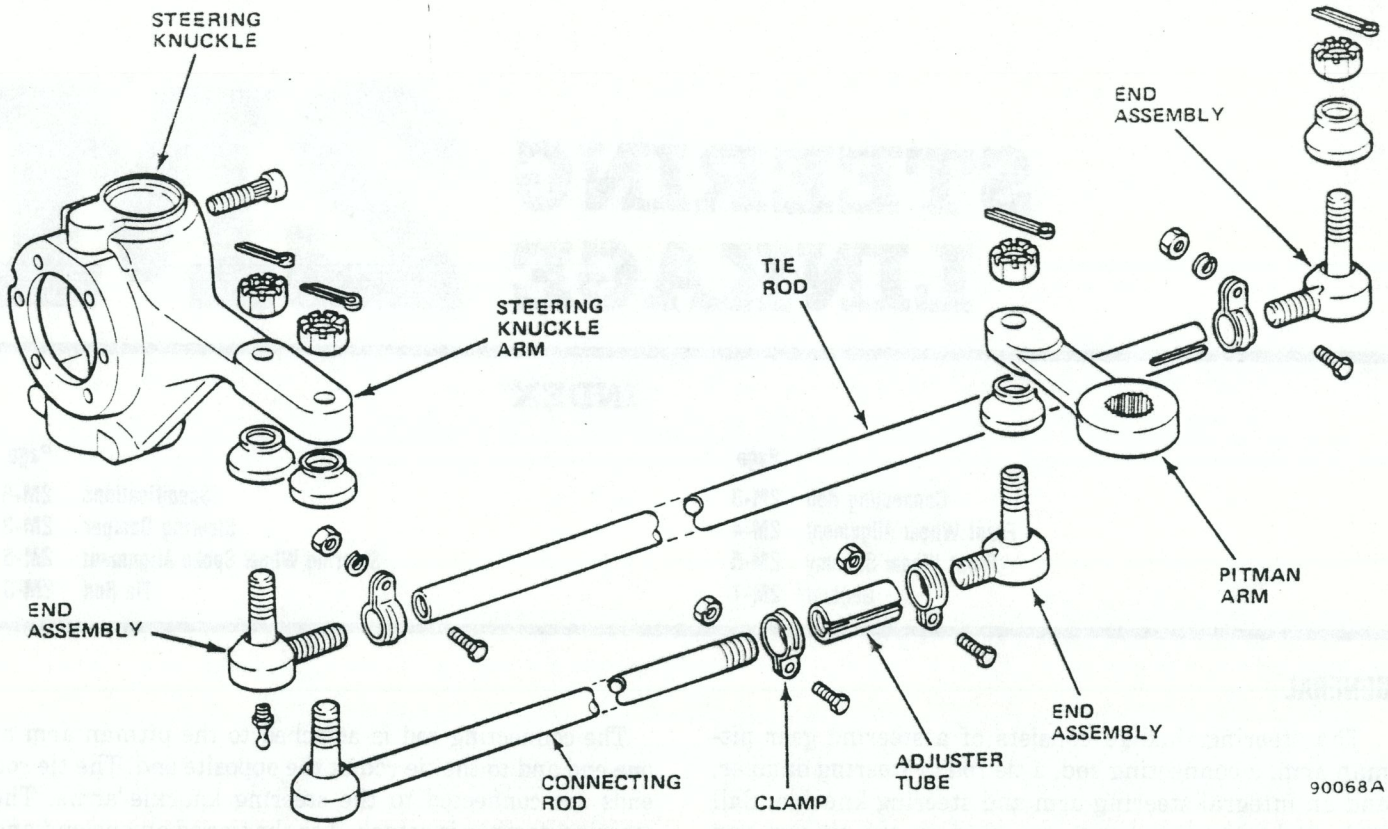

Fig. 2M-2 Steering Linkage—CJ Models

On Cherokee, Wagoneer and Truck models, the tie rod (fig. 2M-3) consists of a solid rod that is threaded on one end and has a ball end assembly at the opposite end. An adjusting tube and removable ball end complete the tie rod assembly. The tie rod threaded end has right-hand threads to accept the adjuster tube. On CJ models, the tie rod has ball ends and adjusting tubes at both ends. The ball end that connects to the tie rod is threaded into the adjusting tube. The tie rod has a large boss located about eight inches from the unthreaded end. A tapered hole machined in this boss accepts the connecting rod end. The steering damper is connected to a bracket clamped to the center of the tie rod.

The connecting rod (fig. 2M-4) is threaded on one end and has a ball-end assembly at the opposite end. An adjusting tube and removable ball end complete the connecting rod assembly. On Cherokee, Wagoneer and Truck models, the end having the integral ball end assembly is connected to the tie rod. On CJ models, it is attached to the right hand steering arm. The threaded end, with the adjusting tube and removable ball end, is attached to the pitman arm.

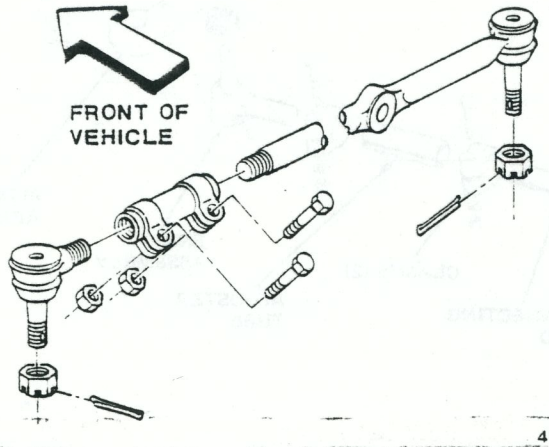

Fig. 2M-3 Tie Rod Assembly

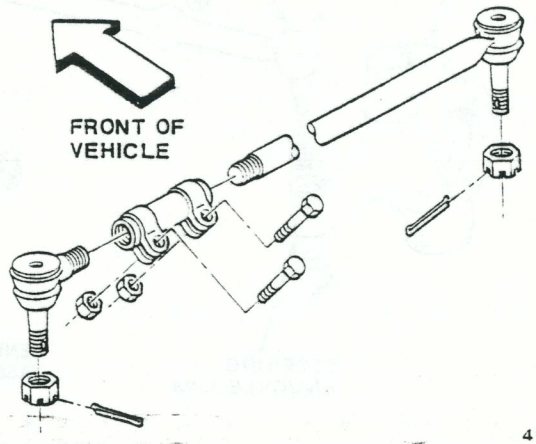

Fig. 2M-4 Connecting Rod Assembly

TIE ROD

Removal

(1) Remove cotter pins and retaining nuts at both ends of tie rod and from end of connecting rod where it attaches to tie rod.

(2) Remove nut attaching steering damper push rod to tie rod bracket and move damper aside.

(3) Remove tie rod ends from steering arms and connecting rod using puller.

NOTE: *After removal, the tie rod ends can be removed by loosening the adjusting tube clamp bolts and unthreading the ends.*

Installation

(1) Attach tie rod ends to steering arms. Tighten nuts to 50 foot-pounds (68 N•m) torque and install replacement cotter pins.

(2) Attach connecting rod to tie rod. Tighten nut to 60 foot-pounds (81 N•m) torque on CJ models and 70 foot-pounds (95 N•m) torque on Cherokee, Wagoneer and Truck. Install replacement cotter pin in retaining nut.

(3) Attach steering damper to tie rod bracket.

(4) Adjust toe-in as necessary.

CONNECTING ROD

The steering connecting rod can be removed by removing the cotter pins and nuts from both ball ends and removing the rod. The steering connecting rod ball stud ends cannot be disassembled for service.

When installing the steering connecting rod, place the wheels in the straight-ahead position and place the steering arm parallel to the centerline of the vehicle. The steering gear pitman arm must be indexed with the alignment marks on the pitman arm and steering gear shaft and the steering gear must be centered. When the steering arm is correctly positioned, install the connecting rod.

STEERING DAMPER

The steering damper used on Cherokee, Wagoneer and Truck models has mounting eyelets at each end (fig. 2M-5). The damper used on CJ models has a mounting eyelet at the body end only as the push rod is threaded to accept a mounting bracket retaining nut (fig. 2M-6). The body end of the damper attaches to a stud on a bracket mounted between the left axle spring and axle spring pad. The push rod end is attached to a bracket that is clamped to the tie rod.

The steering damper is serviced as an assembly only. If damaged or leaking, replace the damper. However, the rubber mounting bushings used in the damper eyelets or on the push rod can be replaced individually if necessary.

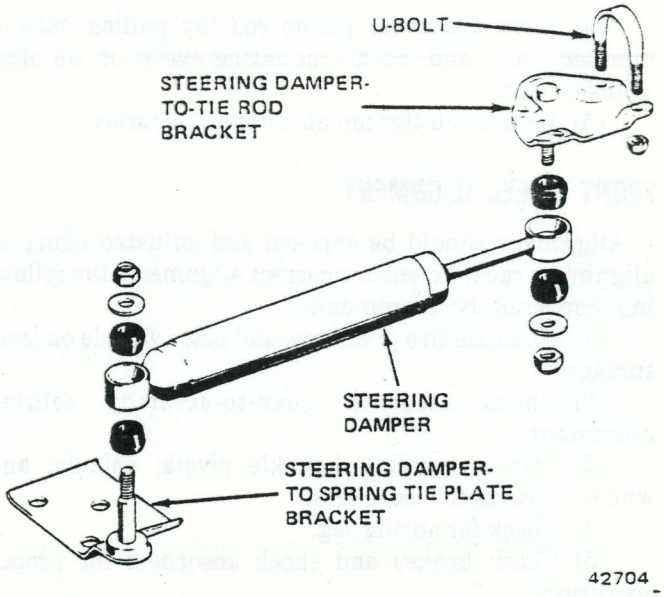

Fig. 2M-5 Steering Damper—Cherokee-Wagoneer-Truck Models

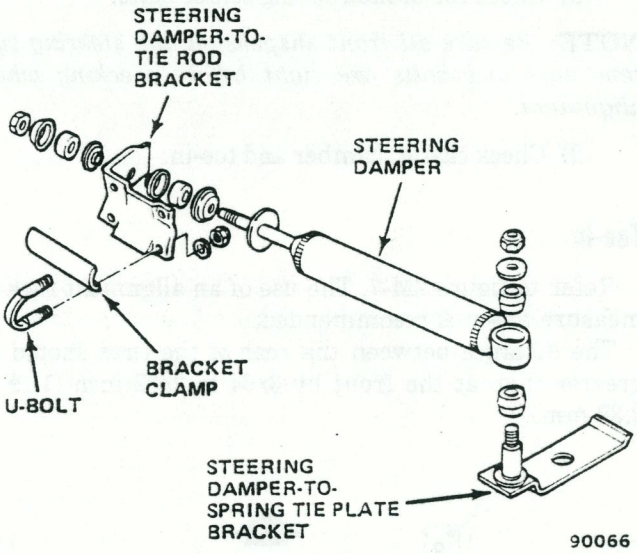

Fig. 2M-6 Steering Damper—CJ Models

Removal

(1) Place front wheels in straight-ahead position.

(2) Remove locknut attaching damper to tie plate bracket and lift damper off stud.

(3) Remove locknut attaching push rod end to tie rod bracket and remove damper assembly.

Installation

(1) Insert rubber bushings in damper eyelets or on push rod.

(2) Position push rod on tie rod bracket stud and install attaching parts.

(3) Install rubber bushings in damper body mounting eyelet.

(4) Extend damper piston rod (by pulling back on damper body) and install mounting eyelet on tie plate bracket stud.

(5) Install and tighten all locknuts securely.

FRONT WHEEL ALIGNMENT

Alignment should be checked and adjusted using an alignment rack. To ensure correct alignment, the following inspection is recommended.

(1) Equalize tire pressures and place vehicle on level surface.

(2) Check steering gear-to-steering column alignment.

(3) Inspect steering knuckle pivots, spindle, and wheel bearings for looseness.

(4) Check for spring sag.

(5) Check brakes and shock absorbers for proper operation.

(6) Check steering gear adjustment.

(7) Check front and rear wheel tracking.

(8) Check for broken spring center bolts.

NOTE: *Be sure all front suspension and steering system nuts and bolts are tight before checking wheel alignment.*

(9) Check caster, camber and toe-in.

Toe-In

Refer to figure 2M-7. The use of an alignment rack to measure toe-in is recommended.

The distance between the rear of the tires should be greater than at the front by 3/64 to 3/32 inch (1.19 to 2.38 mm).

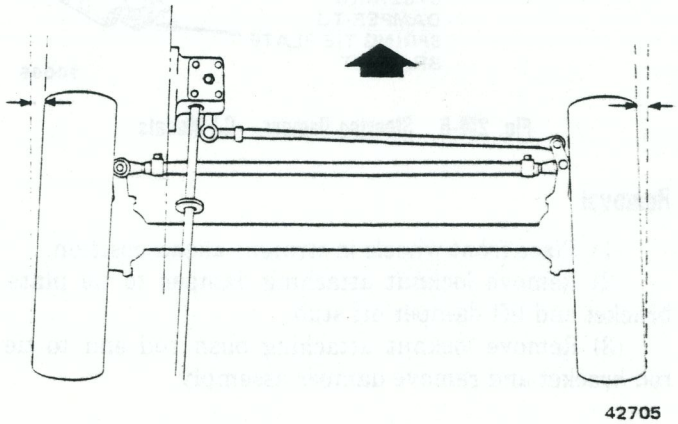

Fig. 2M-7 Front Wheel Toe-In (Top View)—Typical

To adjust toe-in, loosen the adjuster tube clamp bolts and turn the tie rod in or out with a small pipe wrench. The tie rod has both right- and left-hand threads to provide equal adjustment at each wheel. After adjustment, tighten the clamp bolts to specified torque.

Camber

Refer to figure 2M-8. Correct wheel camber of 0° is preset in the front axle at the time of manufacture and cannot be altered by adjustment. It is important that camber be the same on both front wheels. Camber angle should be checked using wheel alignment equipment.

CAUTION: *Do not attempt to adjust the camber angle by heating or bending the axle or any suspension components. If camber is incorrect, the component(s) causing an incorrect camber angle should be replaced.*

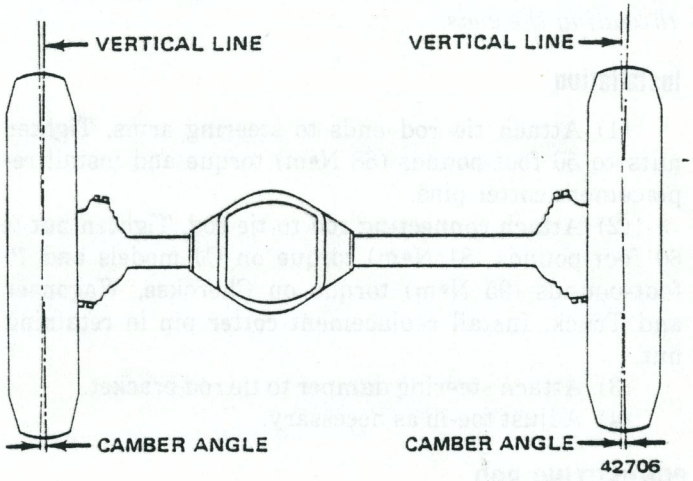

Fig. 2M-8 Front Wheel Camber

Caster

Refer to figure 2M-9. Axle caster is preset at + 6° for CJ models and + 4° for Cherokee, Wagoneer and Truck models. Caster should be checked using wheel alignment equipment. If caster is incorrect, adjustment can be made by installing tapered shims between the axle pad and suspension springs.

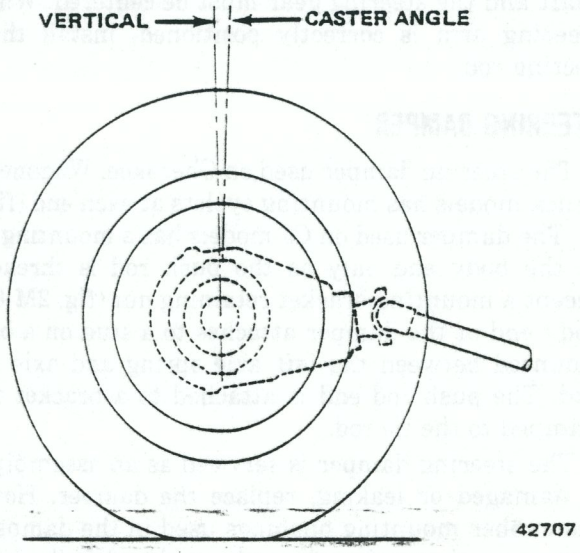

Fig. 2M-9 Front Wheel Caster

If caster is correct and the axle is not bent or twisted, a satisfactory check may be made by road testing the vehicle and checking steering wheel return.

Before road testing, check and correct tire inflation pressures. Be particularly careful to inflate both front tires to exactly the same pressure.

During the road test, turn the steering wheel from side-to-side and make turns to both the left and right. If the vehicle turns easily to either side and the steering wheel returns to center unassisted, caster is correct. However, if the vehicle turns to either side easily but the steering wheel does not return to center unassisted, incorrect caster is indicated.

STEERING WHEEL SPOKE ALIGNMENT

After checking and adjusting front wheel alignment, align the steering wheel spokes as follows:

(1) Turn steering wheel until spokes are in centered position and clamp steering wheel in place.

(2) Loosen connecting rod adjusting tube clamps and turn tube until front wheels are in straight ahead position.

(3) Tighten adjusting tube clamps.

(4) Road test and check steering wheel alignment.

FRONT WHEEL SHIMMY

Front wheel shimmy can be caused by one or more of the following conditions:

- Loose front wheel bearings
- Worn, unbalanced, or out-of-round front tires
- Loose steering damper bracket
- Steering damper malfunction
- Worn or loose tie rod ends
- Worn, loose, or incorrectly preloaded steering knuckle ball studs
- Incorrect tire inflation pressures

The following procedure outlines a method for determining and correcting the causes of wheel shimmy:

(1) Raise vehicle front end.

(2) Inspect front tire condition and check and correct inflation pressures. Check tires for evidence of unbalance such as cupping, scalloping, flat spots, or bald spots. Balance or replace tires exhibiting these conditions.

(3) Check and correct front wheel bearing adjustment if necessary. Refer to Chapter 2H for procedure.

(4) Inspect steering damper mounting brackets or retaining nuts for being loose. If loose, tighten nuts or center bracket on tie rod and tighten attaching bolts.

(5) Check steering damper operation. Disconnect damper at tie rod bracket and alternately compress and extend damper piston fully. Piston action should be smooth and uniform throughout each stroke. Higher resistance on extension stroke than compression stroke is normal condition. Replace damper if lack of resistance is evident.

(6) Inspect tie rod ends. Replace any tie rod end that exhibits excessive play.

(7) Inspect steering knuckle ball studs. Insert pry bar between knuckle and yoke, adjacent to ball stud, and pry against each stud. If studs do not move or appear to be loose in stud socket, proceed to next step. If any stud moves or appears loose, reseat both studs in that side of axle as follows:

(a) Remove wheels and axle shafts.

(b) Loosen lower ball stud jamnut and remove cotter pin and slotted nut from upper ball stud.

(c) Unseat both ball studs by striking them with lead hammer and remove upper ball stud split ring seat using tool J-25158. Discard seat after removal.

(d) Remove lower ball stud jamnut and remove steering knuckle. Discard jamnut after removal.

(e) Clean split ring seat threads and lower stud taper in steering knuckle. Clean threads and tapered surfaces of bo[illegible]ball studs and clean threads in upper ball stud retain[illegible]nut.

(f) Posi[illegible] knuckle on axle yoke and install replacement lowe[illegible]ll stud jamnut finger tight (only).

(g) Install [illegible].d tighten upper ball stud slotted nut to 10-20 foot-p[illegible]nds (13-27 N•m) torque to draw lower ball stud into tapered hole in axle yoke. Do not install upper ball stud split ring seat at this time.

(h) Tighten replacement lower ball stud jamnut to 80 foot-pounds (108 N•m) torque.

(i) Remove upper ball stud slotted nut and install replacement split ring seat using tool J-25158. Tighten seat to 50 foot-pounds (68 N•m) torque. Install and tighten upper ball stud slotted nut to 100 foot-pounds (136 N•m) torque. Align and install cotter pin without loosening slotted nut.

(j) Loosely install axle shafts and steering spindles and measure turning effort of each steering knuckle. Refer to Ball Stud Preload Measurement in Chapter 2F—Axles. If turning effort is less than 10 foot-pounds (14 N•m) torque, proceed to next substep. If turning effort is more than 10 foot-pounds (14 N•m) torque, replace upper and lower ball studs and repeat Ball Stud Preload Correction procedure in Chapter 2F—Axles.

(k) Install axle shafts and repeat procedure outlined in step (7).

(l) Install wheels and lower vehicle.

(8) On CJ models not equipped with steering damper, install steering damper kit if steering components are OK.

(9) Lower vehicle.

(10) Road test vehicle to verify effectiveness of repairs.

SPECIFICATIONS

Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft. lbs.)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Connecting Rod Clamp Bolt – CJ	12	10-15	16	14-20
Connecting Rod Clamp Bolts – Cke, Wag, Trk	30	25-35	41	34-47
Connecting Rod End-to-Tie Rod Nut (5/8-18)	70 minimum		95 minimum	
Connecting Rod End-to-Pitman Arm Nut (9/16-18)	60 minimum		81 minimum	
Pitman Arm to Pitman Shaft Nut	185	160-210	251	217-285
Steering Damper Locknuts – Cke, Wag, Trk	30	24-36	41	33-49
Steering Damper Bracket U-Bolts – CJ	12	8-15	16	11-20
Steering Damper Locknut (3/8-24) CJ	22	16-28	30	22-38
Steering Damper Locknut (7/16-20) CJ	30	24-36	41	33-49
Upper Ball Stud Retaining Nut	100	–	136	–
Lower Ball Stud Jamnut	80	–	108	–
Upper Ball Stud Split Ring Seat	50	–	68	–
Tie Rod Clamp Bolt (5/16-24) CJ	12	10-15	16	14-20
Tie Rod Clamp Bolt (7/16-14) Cke, Wag, Trk	30	25-35	41	34-47
Tie Rod Stud Nuts – CJ	40 minimum		54 minimum	
Tie Rod Stud Nuts – Cke, Wag, Trk	60 minimum		81 minimum	
Wheel Nuts – CJ	75	65-90	102	88-122
Wheel Nuts – Cke, Wag, J-10 Trk	75	65-80	102	88-108
Wheel Nuts – J-20 Trk	130	110-150	176	149-203

All torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

***Tightened to castellated nut slot only. Do not loosen nut to obtain desired torque.**

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Front Wheel Alignment Specifications

Steering Axis Inclination	8-1/2°
Caster	
CJ	+6°(+1°)
Cherokee, Wagoneer, and Truck	+4°(+1°)
Camber	0° (+1/2°)
Toe-In	3/64 to 3/32-inch (1.19 to 2.38 mm)
Turning Angle	
CJ	31° to 32°
Cherokee, Wagoneer, and Truck	37° to 38°

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SUSPENSION 2N

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GENERAL

Jeep vehicles are equipped with semi-elliptic leaf springs and dual-action hydraulic shock absorbers at front and rear. A front axle stabilizer bar is standard on Cherokee, Wagoneer, and Truck models and CJ models with the molded hard top. A front stabilizer bar is optional on all other CJ models.

Front and rear suspension springs are mounted parallel to the frame side rails. The forward end of the front springs and the rear end of the rear springs are attached to the frame by pivoting shackles. The opposite spring ends are attached to the frame by fixed pivot bolts. All spring ends have silent-block type rubber bushings which do not require lubrication.

The front springs are mounted below the axle on all Jeep vehicles. CJ models use multi-leaf front springs (fig. 2N-1). Cherokee, Wagoneer, and Truck models use tapered-leaf or multi-leaf front springs (fig. 2N-2).

The multi-leaf rear springs used on CJ models are mounted below the axle (fig. 2N-3).

The rear springs used on Cherokee, Wagoneer, and Truck models are either multi-leaf or tapered-leaf springs and are mounted above the axle (figs. 2N-4 and 2N-5).

The leaf springs on all Jeep models are attached to the axle by U-bolts and tie plates and are positioned on the axle by spring saddles welded to the axle tubes. Spring center bolts and spring clips are used to align and hold the spring leaves in position. If the vehicle is used for severe, off-road operation, the springs should be examined periodically for broken or shifted leaves, loose or missing clips, and broken center bolts.

Squeaking noises can be generated when movement between the spring bushings and metal parts occurs. This noise can usually be eliminated by tightening the spring attaching bolts to the specified torque. However, if squeak noises persist after bolt tightening, check for a bushing that is loose in the spring eye, or misaligned (not centered in spring eye), or spring misalignment caused by damaged suspension components. Repair as necessary if any of these conditions are discovered.

The spring eye bushings do not require any type of lubrication. Do not attempt to eliminate bushing noises by lubricating them. Grease and mineral oil-base lubricants can cause deterioration of the bushing rubber.

SUSPENSION JOUNCE AND WINDUP BUMPERS

A front axle windup bumper is used on CJ models only. The bumper consists of a stamped bracket with a rubber bumper attached to it (fig. 2N-6). The bracket is attached to the inner side of the right frame rail adjacent to and just above the front axle housing. During severe operation when extreme spring movement and front axle travel occurs, the bumper contacts a pad on the front axle housing to prevent excessive housing movement.

All models are equipped with frame-mounted jounce bumpers located at the front and rear of the vehicle suspension. The bumpers are attached to the underside of the frame rails and are positioned over and in line with the axle tubes.

SHOCK ABSORBERS

The hydraulic, dual-action shock absorbers used on Jeep vehicles are designed to control suspension spring movement. The shock absorber upper ends are attached to brackets located on the frame rails. The lower ends are attached to the spring tie plate or axle tube. Rubber bushings are installed in the shock mounting eyes to damp out road shock and noise.

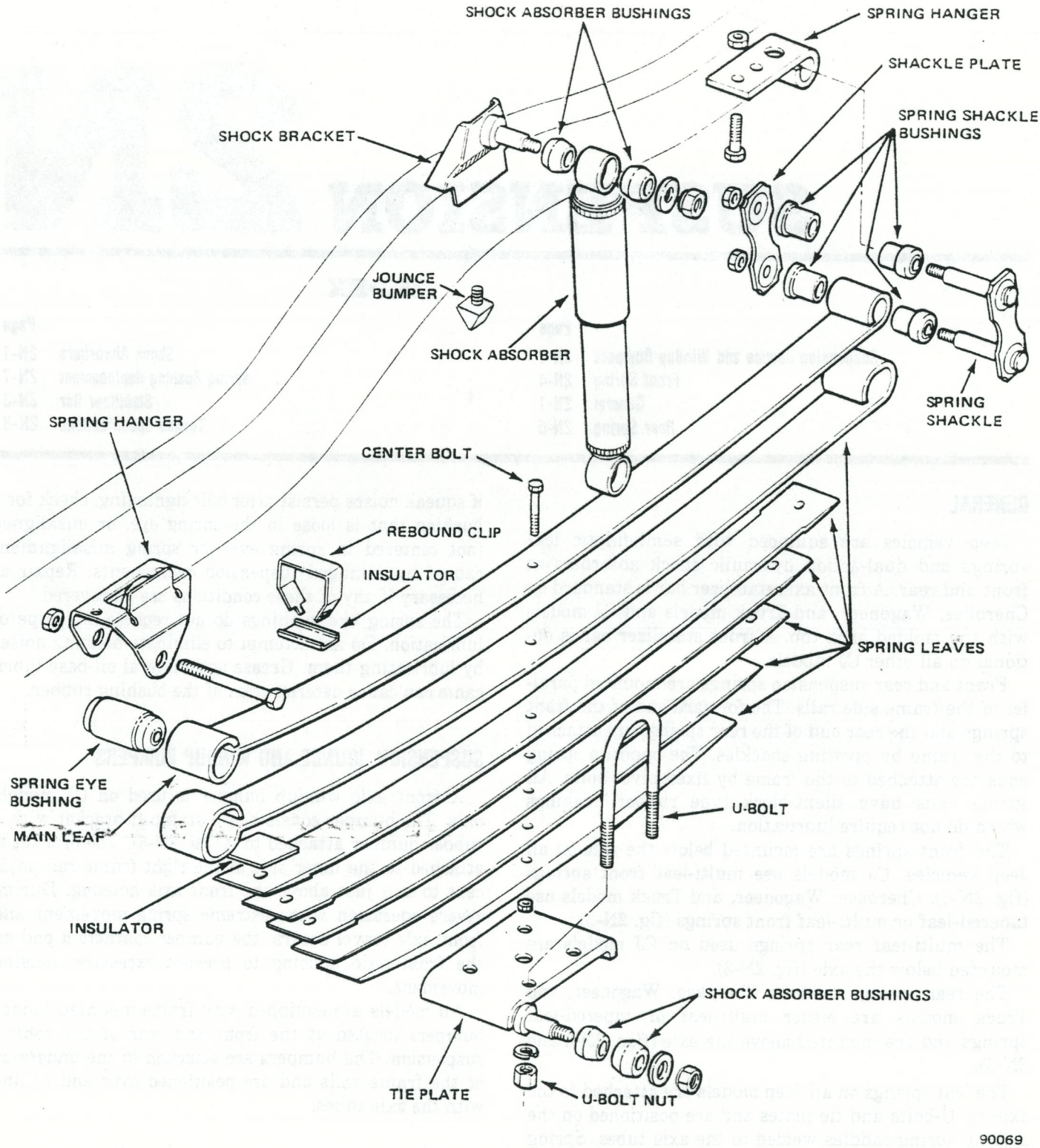

Fig. 2N-1 Front Spring and Shock Absorber—CJ

Dual front shock absorbers are available as an option on Cherokee and J-10 Truck models. The internal valving of these shock absorbers is designed to increase the damping forces needed to cushion the loads encountered in off-road operation.

Squeak noises from the shock bushings can be generated if movement between the bushings and metal parts occurs. This noise can usually be eliminated by tightening the shock mounting nuts. However, if squeak noises persist, check for damaged or worn bushings or

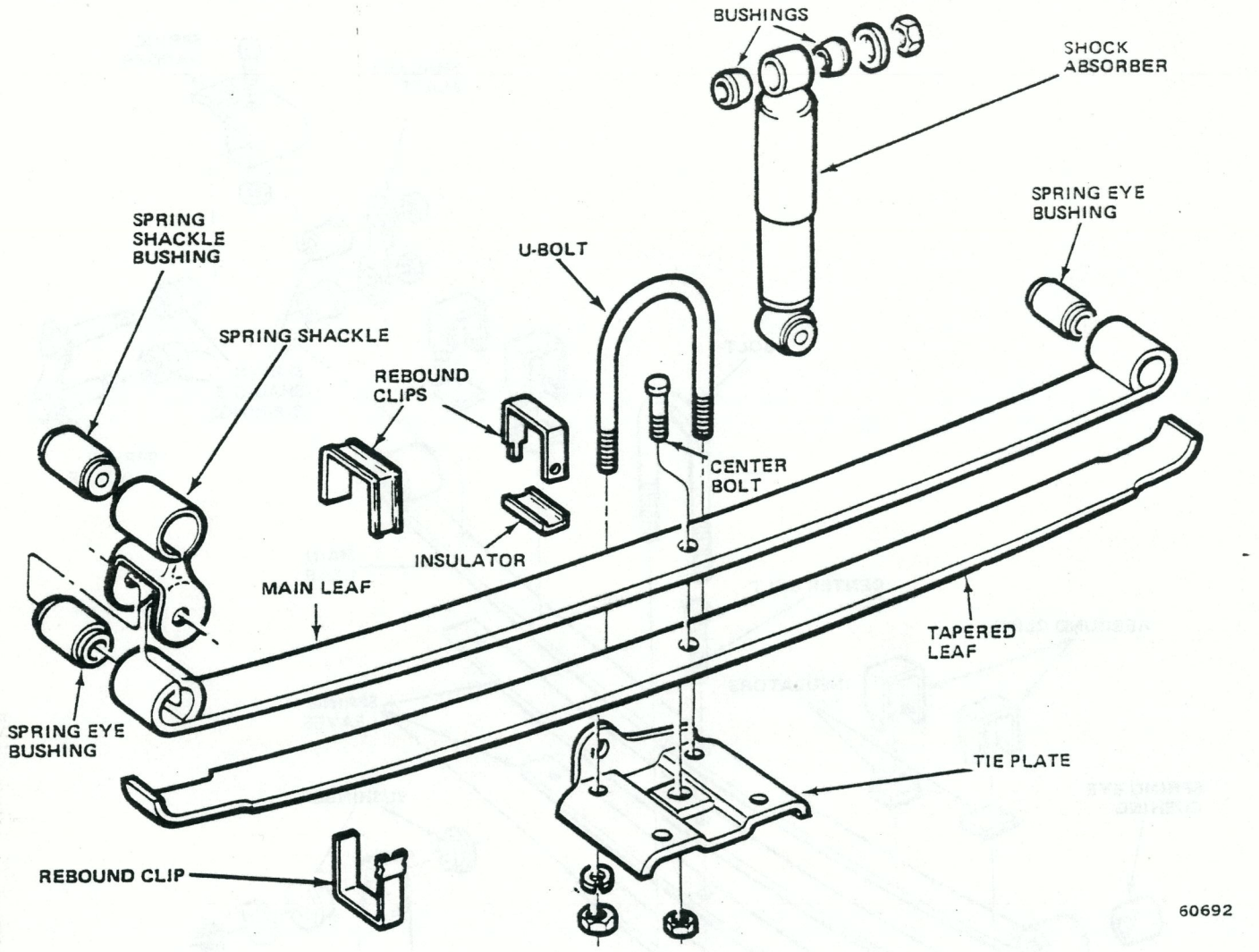

Fig. 2N-2 Front Spring and Shock Absorber—Cherokee-Wagoneer-Truck

damaged shock mounting components. Repair as necessary if any of these conditions are discovered.

The shock absorber bushings do not require any type of lubrication. Do not lubricate the bushings in an attempt to reduce bushing noises. Grease or mineral oil-base lubricants can cause deterioration of the bushing rubber.

The shock absorbers are not refillable or adjustable. If a malfunction occurs, the shock absorber must be replaced as an assembly. To test a unit, hold it in an upright position and work the shock piston up and down four or five times. Shock action throughout each stroke should be smooth and produce an equal amount of resistance in each direction.

Shock Absorber Replacement

(1) Raise vehicle.

(2) Position hydraulic jack under axle and raise axle to relieve springs of axle weight.

(3) Remove washers and locknuts attaching shock absorber to upper and lower mounting pins.

(4) Remove shock absorber and remove bushings from shock mounting eyes.

(5) Install replacement bushings in shock mounting eyes. Do not lubricate bushings, install them dry.

(6) Position replacement shock absorber on mounting pins.

(7) Install shock absorber attaching washers and locknuts. Tighten locknuts to specified torque.

(8) Lower vehicle and remove hydraulic jack.

STABILIZER BAR

The stabilizer bar extends across the front underside of the frame and is attached to the frame rails by clamps and rubber bushings (fig. 2N-7). The bar ends extend rearward to a position above the front springs and are connected to the axle and springs by connecting links (fig. 2N-8).

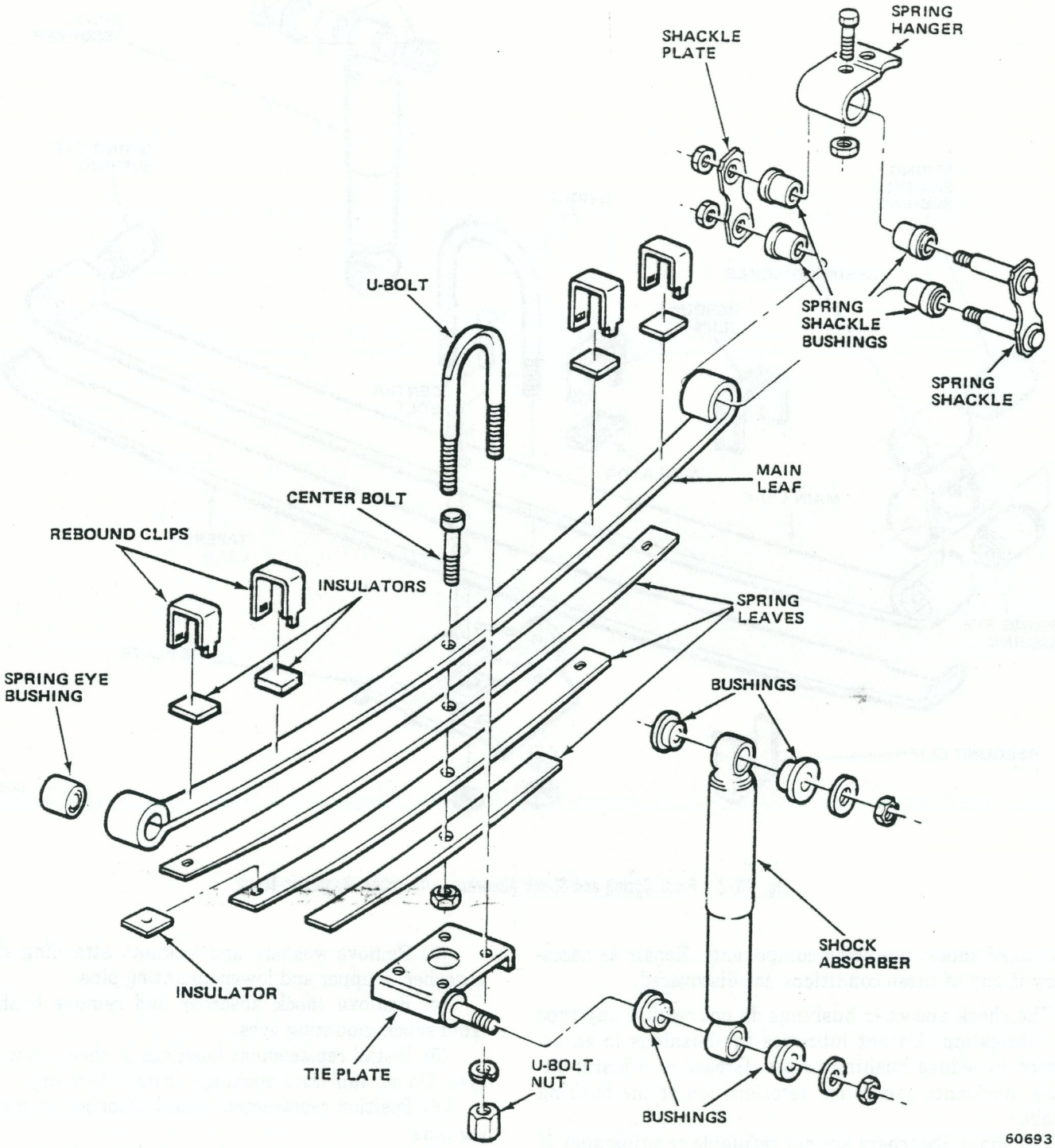

Fig. 2N-3 Rear Spring and Shock Absorber—CJ

FRONT SPRING

Removal

(1) Raise vehicle.

(2) Support vehicle using safety stands placed under frame rails.

(3) Position hydraulic jack under axle and raise axle to relieve springs of axle weight.

(4) Disconnect stabilizer bar, if equipped.

(5) Remove spring U-bolts and tie plates.

(6) Remove bolt attaching spring front eye to shackle.

(7) Remove bolt attaching spring rear eye to spring hanger.

(8) Remove spring.

NOTE: *The spring can be disassembled by removing the spring rebound clips and spring center bolt. If the spring bushings are to be removed, refer to Spring Bushing Replacement.*

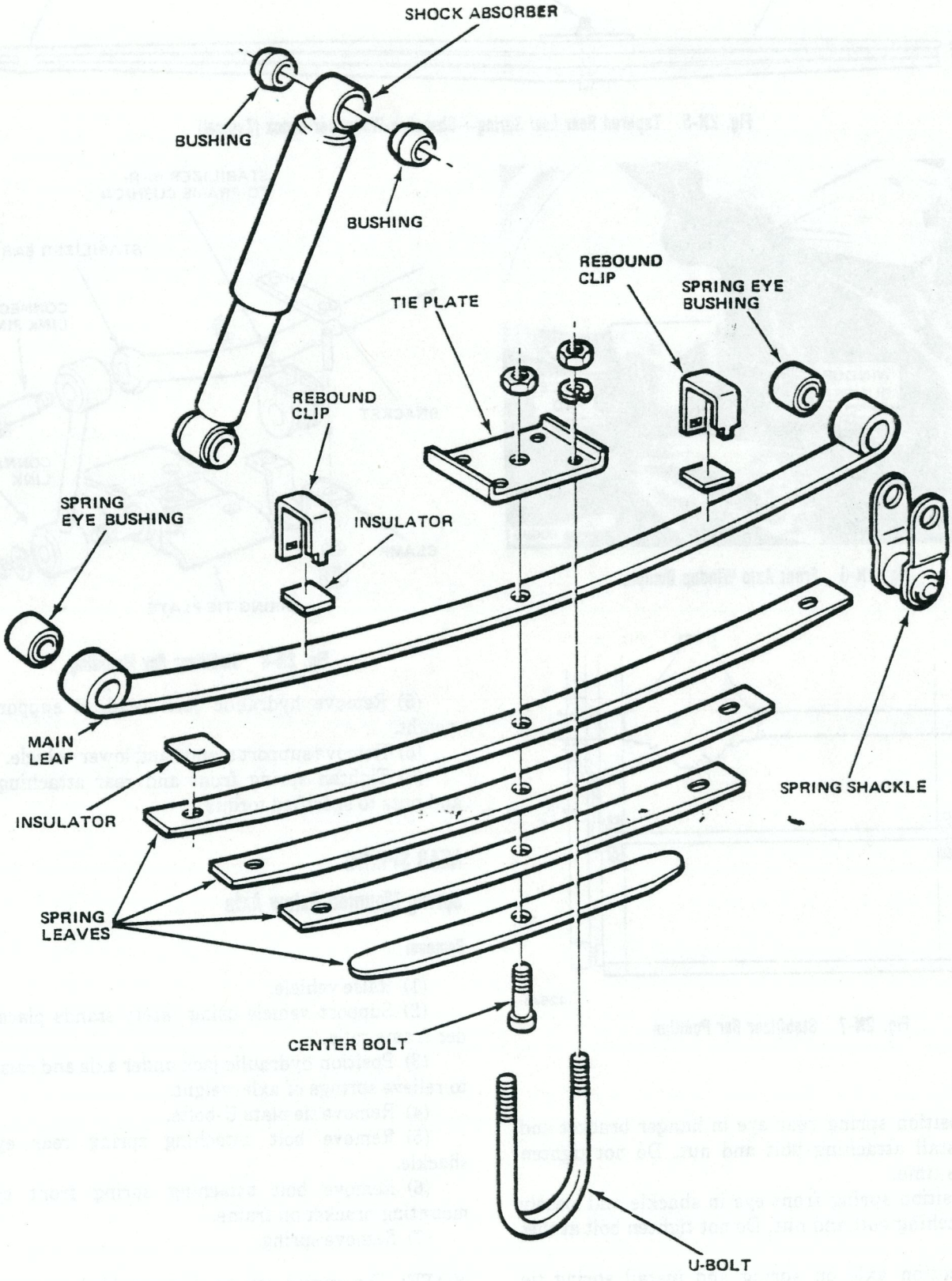

Fig. 2N-4 Rear Spring and Shock Absorber—Cherokee-Wagoneer-Truck

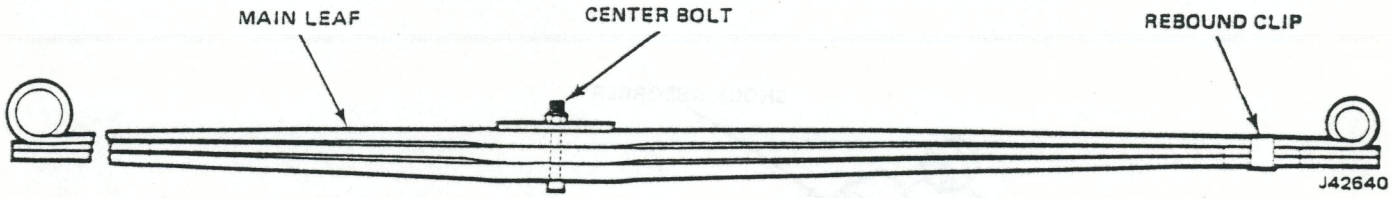

Fig. 2N-5 Tapered Rear Leaf Spring—Cherokee-Wagoneer-Truck (Typical)

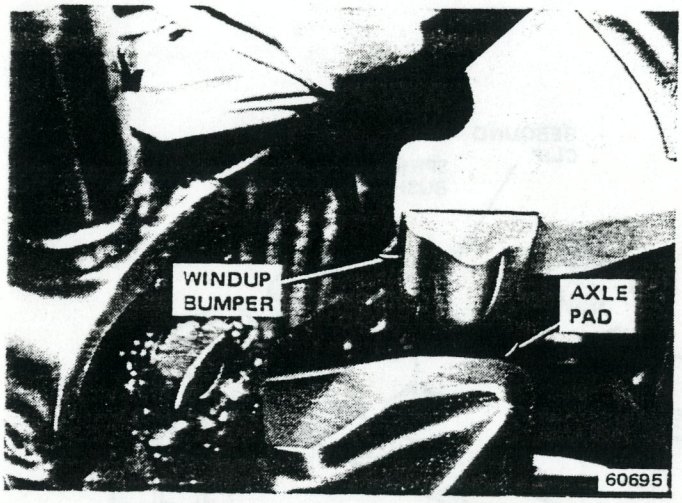

Fig. 2N-6 Front Axle Windup Bumper

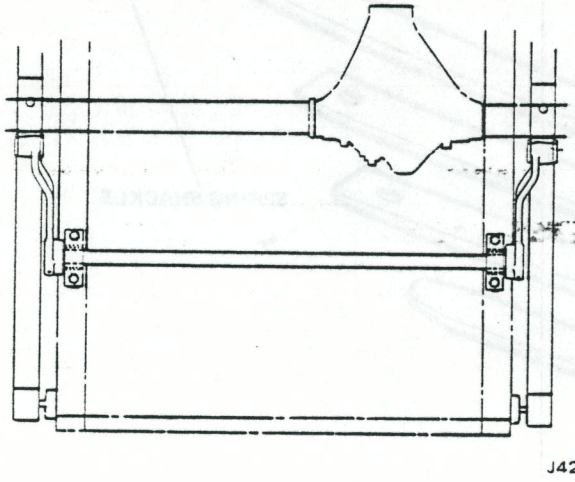

Fig. 2N-7 Stabilizer Bar Position

Installation

(1) Position spring rear eye in hanger bracket and loosely install attaching bolt and nut. Do not tighten bolt at this time.

(2) Position spring front eye in shackle and loosely install attaching bolt and nut. Do not tighten bolt at this time.

(3) Position axle on spring and install spring tie plate and U-bolts. Tighten U-bolt nuts to specified torque.

(4) Connect stabilizer bar, if equipped.

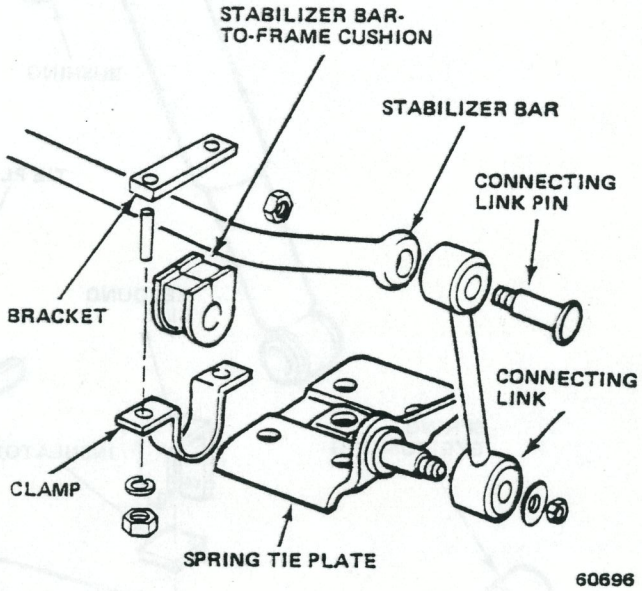

Fig. 2N-8 Stabilizer Bar Mounting

(5) Remove hydraulic jack used to support axle weight.

(6) Remove support stands and lower vehicle.

(7) Tighten spring front and rear attaching bolts and nuts to specified torque.

REAR SPRING

Spring Mounted Below Axle

Removal

(1) Raise vehicle.

(2) Support vehicle using safety stands placed under frame rails.

(3) Position hydraulic jack under axle and raise axle to relieve springs of axle weight.

(4) Remove tie plate U-bolts.

(5) Remove bolt attaching spring rear eye to shackle.

(6) Remove bolt attaching spring front eye to mounting bracket on frame.

(7) Remove spring.

NOTE: *The spring can be disassembled by removing the spring rebound clips and spring center bolt. If the spring bushings are to be removed, refer to Spring Bushing Replacement.*

Installation

(1) Position spring front eye in frame mounting bracket and loosely install attaching bolt and nut. Do not tighten bolt at this time.

(2) Position spring rear eye in shackle and loosely install attaching bolt and nut. Do not tighten bolt at this time.

(3) Install spring tie plate and U-bolts. Tighten U-bolt nuts to specified torque.

(4) Remove hydraulic jack used to support axle.

(5) Remove support stands and lower vehicle.

(6) Tighten spring eye mounting bolts and nuts to specified torque.

Spring Mounted Above Axle

Removal

(1) Raise vehicle.

(2) Support vehicle using safety stands placed under frame rails.

(3) If left-side spring is to be serviced, remove fuel tank skid plate.

(4) Position hydraulic jack under axle and raise axle to relieve springs of axle weight.

(5) Disconnect shock absorber at axle.

(6) Remove wheel.

(7) Remove tie plate U-bolts and tie plate.

(8) Remove bolt attaching spring rear eye to spring shackle.

(9) Remove bolt attaching spring front eye to spring hanger on frame rail.

(10) Remove spring.

NOTE: *The spring can be disassembled by removing the spring rebound clips and center bolt. If the spring bushings are to be removed, refer to Spring Bushing Replacement.*

Installation

(1) Position spring front eye in spring hanger and loosely install attaching bolt and nut. Do not tighten bolt at this time.

(2) Position spring rear eye in shackle and loosely install attaching bolt and nut. Do not tighten nut at this time.

(3) Position axle on spring and install spring tie plate and U-bolts. Tighten U-bolt nuts to specified torque.

(4) Connect shock absorber to axle.

(5) Install wheel.

(6) Install fuel tank skid plate if removed.

(7) Remove hydraulic jack.

(8) Remove support stands and lower vehicle.

(9) Tighten spring attaching bolts to specified torque.

SPRING BUSHING REPLACEMENT

Small Bushing

(1) Insert 3/8 by 8 inch (0.95 by 20.3 cm) length of threaded rod halfway through bushing.

(2) Place suitable size socket on one end of rod with open end of socket toward bushing. Socket will serve as bushing driver.

NOTE: *The socket must be large enough in diameter to bear against the metal outer sleeve on the bushing but still be small enough to pass through the spring eye.*

(3) Install one flat washer and one hex nut on rod behind socket (fig. 2N-9).

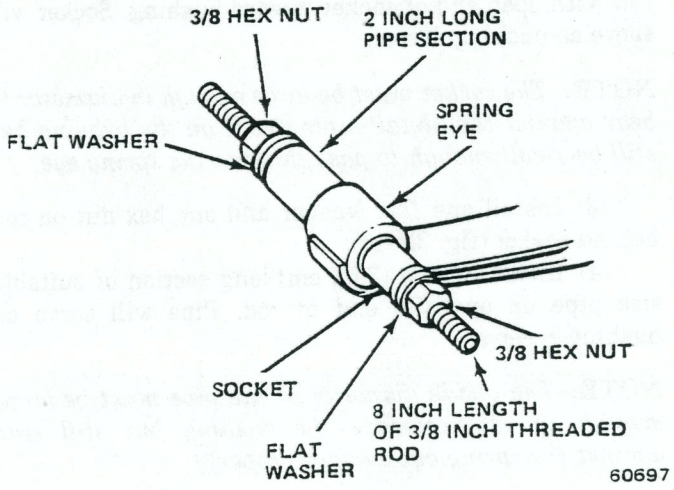

Fig. 2N-9 Bushing Replacement Tools—Small Bushing

(4) Install 2 inch (5.08 cm) long section of suitable size pipe on opposite end of threaded rod. Pipe will serve as bushing receiver.

NOTE: *The inside diameter of the pipe must be large enough to accommodate the bushing but still seat against the spring eye surface properly.*

(5) Install flat washer and hex nut on rod to secure pipe section. Be sure flat washer is large enough in diameter to support and maintain alignment of pipe section.

(6) Tighten both hex nuts finger-tight and align all components.

NOTE: *Be sure socket is positioned in the spring eye and aligns with the bushing. The pipe section must butt against the spring eye surface so the bushing can pass through it. The socket will act as a press ram and press the bushing out of the spring eye.*

(7) Tighten nut at socket end of rod until bushing is pressed out of spring eye.

(8) Remove bushing tools and old bushing.

(9) Install replacement bushing on threaded rod.

(10) Assemble and align bushing tools as outlined in previous steps.

(11) Align bushing with spring eye and press bushing into eye.

(12) Loosen bushing tools and check bushing position. Bushing must be centered in spring eye. Ends of bushing must be flush or slightly below side surfaces of spring eye.

(13) If bushing is not centered, reinstall bushing tools and correct bushing position as necessary.

Large Bushing

(1) Insert 1/2 by 11 inch (1.27 by 27.9 cm) length of threaded rod halfway through bushing.

(2) Install suitable size deep socket on one end of rod with open end of socket toward bushing. Socket will serve as bushing driver.

NOTE: *The socket must be large enough in diameter to bear against the metal outer sleeve on the bushing but still be small enough to pass through the spring eye.*

(3) Install one flat washer and one hex nut on rod behind socket (fig. 2N-10).

(4) Install 3 inch (7.62 cm) long section of suitable size pipe on opposite end of rod. Pipe will serve as bushing receiver.

NOTE: *The inside diameter of the pipe must be large enough to accommodate the bushing but still seat against the spring eye surface properly.*

(5) Install flat washer and one hex nut on rod behind pipe section. Be sure flat washer is large enough in diameter to support and maintain alignment of the pipe section.

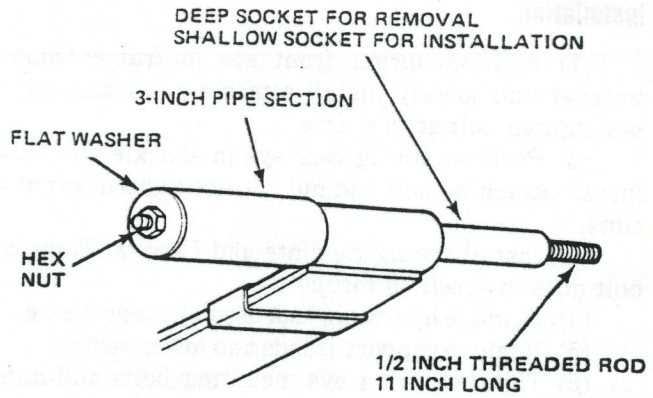

Fig. 2N-10 Bushing Replacement Tools—Large Bushing

(6) Tighten both nuts finger-tight and align all components.

NOTE: *Be sure the socket is positioned in the spring eye and aligns with the bushing. The pipe section must butt against the spring eye so that bushing can pass through it. The socket will act as a press ram and press the bushing out of the spring eye and into the section of pipe.*

(7) Tighten nut at socket and press bushing out of spring eye.

(8) Remove tools and old bushing.

(9) Install replacement bushing on threaded rod and assemble bushing tools as outlined in previous steps.

(10) Align bushing with spring eye and press bushing into eye.

(11) Loosen tools and check bushing position. Bushing must be centered in spring eye. Ends of bushing must be flush with or slightly below side surfaces of spring eye.

(12) If bushing is not centered, reinstall tools and correct bushing position as necessary.

SPECIFICATIONS

Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft. lbs.)		Metric (N-m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Shock Absorber Upper Locknut (7/16-20)	35	25-40	47	34-54
Shock Aborber Lower Locknut (1/2-20)	45	35-50	61	47-68
Spring Pivot Bolts (CJ)	100	80-120	136	108-163
Spring Shackle Nuts (CJ)	24	18-30	33	24-41
Spring U-Bolt Nuts (9/16-18)	100	85-105	136	115-142
Spring U-Bolt Nuts (1/2-20)	55	45-65	75	61-88
Spring Shackle and Pivot Bolts/Nuts (Cke-Wag-Trk)	100	80-120	136	108-163
Stabilizer Bar Mounting Bracket Bolts (All)	35	27-45	47	37-61
Wheel Nuts (CJ)	85	65-90	115	88-122
Wheel Nuts (Cke-Wag-J10 Trk)	85	65-90	115	88-122
Wheel Nuts (J20 Trk)	130	110-150	176	149-203
Spring Center Bolts	35	25-40	47	34-54
Stabilizer Bar Link Nuts	55	48-62	75	65-84

All torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

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PART 3

BODY

CHAPTER INDEX

PART 3 BODY

WATER LEAK/ WIND NOISE DIAGNOSIS AND REPAIR 3A

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GENERAL

The problem of water leaks is closely related to dust leakage due to the fact that, under certain conditions, water can enter the vehicle body at any point where dirt and dust can enter.

The key to correcting any water leak problem is complete and accurate diagnosis. To do this a thorough check of the following five general causes of leakage must be accomplished:

- Maladjusted components
- Improperly installed, misrouted or faulty weatherstrips
- Omission of sealers
- Misfitted panels
- Missing body plugs

Leaks can be deceiving. The point where water is detected may not be the point where it entered the vehicle.

Spray Test

The first thing to do on any water leak problem, is to pin-point the leak. The best way to do this is to perform a water spray test.

Sit inside the vehicle and have someone spray water over the suspected leak area. **Always start spraying along the bottom. By starting at the bottom, the exact level at which the leaks occur will be determined.** If water was sprayed at the highest point, water would be at all suspect areas and it would be difficult to determine the exact problem area.

Do not rush the water spray test. The water may have to flow awhile before it shows up. Try to simulate as close as possible the effect of wind-driven water.

Ultrasonic Test

Another way to test the vehicle for water leaks is use the Listener Tool J-23455-01. This tool makes use of the fact that ultrasonic energy (high frequency sound) has certain properties that are similar to those of fluids (liquids and gases). Ultrasonic energy does not penetrate solids, such as glass or metal. It is, however, transmitted through cracks and openings, such as those that cause water or air leaks.

An operating ultrasonic generator placed inside vehicle body will fill the vehicle with sound energy. **This energy will leak at the same locations that permit water and air leaks.** The water path or opening must be dry since the ultrasonic sound will be blocked if an opening or hole is full of water.

An ultrasonic generator and detector gun form an ideal combination for determining the location and magnitude of water and air leaks. The ultrasonic leak detector can be used effectively as a diagnostic tool realizing it is not an exact tool and has certain limitations.

Light Test

Another method of finding water leaks is the light test. This method is good for finding sealer skips in the sheet metal joints and seams, particularly in the wheelhouse area. Sit inside the vehicle and have someone pass

a bright light along the seams and joints from under the vehicle.

Water/Rust Streaks

Another thing to look for in diagnosing water leaks is a pattern of rust or water streaks on interior sheet metal and trim. For instance, a symptom of rear window leakage or inadequately sealed coach joint is water dripping into the rear compartment. This will show up as water or rust streaks on the rear compartment trim or wheelhouse.

Adhesive, Sealant and Coating Materials

- Adhesives join or bond materials together
- Sealants close gaps or seams between sheet metal or materials and prevent the passage of water, dust, air, etc.
- Coatings protect against corrosion and abrasion, and dampen sound or vibration—and may also be used to seal out water and dust

Bonding Surface Preparation

For the various materials to adhere and form an effective bond, it is essential that they are applied to clean, dry surfaces. After a water test, dry the joint or seam with clean dry compressed air then wipe the joint, or seam, with a cloth dampened in 3M General Purpose Adhesive Cleaner, or equivalent.

WATER IN FRONT PASSENGER COMPARTMENT

Windshield

Leaks can occur between the windshield glass and rubber weatherstrip or between the rubber weatherstrip and body pinchweld flange. Leaks between the windshield glass and rubber weatherstrip will be indicated by water which is visible on the inside of the glass or on the front floor. Leaks between the rubber weatherstrip and body pinchweld flange will track down to appear on the front floor. Also, water can enter at the weld studs or burn holes in the body pinchweld flange.

Spray Diagnosis and Repair

(1) Remove windshield reveal mouldings, as described in Chapter 3N.

(2) Perform the following spray test using guidelines described under Spray Test above.

(a) Starting at base of windshield A-pillar on one side of vehicle, spray water onto glass across the bottom between the dash panel assembly and glass.

(b) Test vertical section of A-pillar and across top of glass.

(c) Repeat steps (a) and (b) for other side of vehicle.

(3) If leaks are noted, dry out suspect area as described under Bonding Surface Preparation.

(4) Seal windshield as described in detail in Chapter 3N.

(5) Repeat spray test to ensure that an effective repair has been made.

(6) Install windshield reveal mouldings.

Ultrasonic Diagnosis and Repair

(1) Dry suspect areas thoroughly. If an opening or hole is full of water, the ultrasonic sound will be blocked.

(2) Remove windshield reveal mouldings, as described in Chapter 3N.

(3) Using Listener Tool J-23455-01, perform Ultrasonic Test as follows:

(a) Place transmitter in vehicle adjacent to windshield and turn switch on.

(b) Close all doors, windows and air vents.

(c) Slowly pass listener all around windshield opening.

(d) Mark any area where a meter reading of approximately 5 is obtained, as a indication of a possible leak.

(4) Clean suspect area as described above under Bonding Surface Preparation.

(5) Seal windshield as described in detail in Chapter 3N.

(6) Repeat ultrasonic test to ensure that an effective repair has been made.

(7) Install windshield reveal mouldings.

Dash Panel Assembly

Water leaks can occur at the inside of dash panel assembly due to spot weld burn holes or excessive gaps and/or lack of sealer at the dash panel joints. Water leaks from these burn holes or joints will result in water puddles forming on the front carpet or floorpan. Water can also enter through the many holes stamped into the dash panel assembly due to, loose grommets and/or incorrectly installed components and attaching hardware. Water will appear on the front carpet or floorpan having tracked down the inside of the dash panel assembly.

Spray Diagnosis and Repair

(1) Pull back carpet and sound insulation material, if equipped.

(2) Open hood.

(3) Perform the following spray test using guidelines described under Spray Test above.

(a) Starting at bottom of dash panel on one side of vehicle spray water onto suspect joints, grommets and components.

(b) Spray water across top of dash panel.

(c) Repeat spray test on other side of vehicle.

(4) If leaks are noted, dry out suspect area as described above under Bonding Surface Preparation.

(5) Straighten any distorted flanges.

(6) Seal suspect spot weld burn holes and dash panel joints using 3M All-Around Autobody Sealant, or equivalent.

NOTE: *Use care not to direct sealer into air ducts.*

(7) Seal interior plenumn chamber leaks by attaching a length of flexible plastic hose to nozzle of applicator gun specified for use with 3M Joint and Seam Sealer, or equivalent.

(8) Check all grommets to be sure they are correctly installed. If necessary, apply sealant to ensure a water tight seal.

(9) Make sure that all suspect components and attaching hardware are properly installed. If necessary, apply sealant to ensure a water tight seal.

(10) Repeat spray test to ensure that an effective repair has been made.

(11) Properly position sound insulation material and carpet, if equipped.

(12) Close hood.

Ultrasonic Diagnosis and Repair

(1) Dry suspect areas thoroughly. If an opening or hole is full of water, the ultrasonic sound will be blocked.

(2) Pull back carpet and sound insulation material, if equipped.

(3) Open hood.

(4) Close all windows, doors and air vents.

(5) Using Listener Tool J-23455-01, perform ultrasonic test as follows:

(a) Place transmitter in vehicle adjacent to dash panel assembly and turn switch on.

(b) Slowly pass listener over each joint, grommet and component.

(c) Mark any area where a meter reading of approximately 5 is obtained, as an indication of a possible leak.

(6) Clean suspect area as described above under Bonding Surface Preparation.

(7) Straighten any distorted flanges or seams.

(8) Seal suspect spot weld burn holes and dash panel joints using 3M All-Around Autobody Sealant, or equivalent.

NOTE: *Use care not to direct sealer into air ducts.*

(9) Seal interior plenumn chamber leaks by attaching a length of flexible plastic hose to nozzle of applicator gun specified for use with 3M Joint and Seam Sealer, or equivalent.

(10) Check all grommets to be sure they are correctly installed. If necessary, apply sealant to ensure a water tight seal.

(11) Make sure that all suspect components and attaching hardware are properly installed. If necessary, apply 3M All-Around Autobody Sealant, or equivalent, to ensure a water tight seal.

(12) Repeat ultrasonic test to ensure that an effective repair has been made.

(13) Properly position sound insulation material and carpet, if equipped.

(14) Close hood.

Front Floorpan, Side Sills, Cowl Side Panels or Front Hinge Pillars

Water can enter at dash panel assembly-to-front floorpan seams due to gaps, distorted panels and/or lack of sealer. Water appears under the front carpet or on front floorpan.

Leaks can occur between the side sills, front floorpan, cowl side panels or front hinge pillars due to excessive gaps and/or lack of sealer at the panel joints. Water leaks from these joints will result in a wet front carpet, sound insulation material or front floorpan.

Also, leaking floorpan plugs will allow water to enter the front floorpan area or under the carpet and sound insulation material.

Spray Diagnosis and Repair

(1) Remove front seat(s).

(2) Remove front carpet and sound insulation material, if equipped.

(3) Open hood.

(4) Perform the following spray test using guidelines described under Spray Test above.

(a) Spray water from under front fender at joint of floorpan and cowl side panel or front hinge pillar.

(b) Next spray across floorpan-to-dash panel seam and towards rear of vehicle at floorpan plugs.

(c) Move spray slowly upwards until water is directed at joint of dash panel-to-cowl side panel.

(d) Repeat spray test on other side of vehicle.

(e) If leaks are noted, dry out suspect area as described above under Bonding Surface Preparation.

(5) Straighten any distorted panels.

(6) Seal suspect joints or seams using 3M All-Around Autobody Sealant, or equivalent.

(7) Examine suspect area for loose or missing body plugs.

(a) Check that hardened sealer or road dirt is not preventing the plug from seating.

(b) Check hole to be sure that it is not distorted.

(c) If necessary, reshape floorpan at plug hole and add a bead of 3M All-Around Autobody Sealant, or equivalent, around hole to ensure a satisfactory water tight seal.

(8) Repeat spray test to ensure that an effective repair has been made.

(9) Close hood.

(10) Install sound insulation material and front carpet, if equipped.

(11) Install front seat(s).

Ultrasonic Diagnosis and Repair

(1) Make sure suspect areas are thoroughly dry. If an opening or hole is full of water, ultrasonic sound will be blocked.

(2) Remove front seat(s).

(3) Remove front carpet and sound insulation material, if equipped.

(4) Close all windows, doors and air vents.

(5) Using Listener Tool J-23455-01, perform ultrasonic test as follows:

(a) Place transmitter in vehicle adjacent to suspect area and turn switch on.

(b) Slowly pass listener over each joint, plug and seam.

(c) Mark any area where a meter reading of approximately 5 is obtained, as an indication of a possible leak.

(6) Clean suspect area as described above under Bonding Surface Preparation.

(7) Straighten any distorted panels.

(8) Seal suspect joints or seams using 3M All-Around Autobody Sealant, or equivalent.

(9) Examine suspect area for loose or missing body plugs.

(a) Check that hardened sealer or road dirt is not preventing plug from seating.

(b) Check hole to be sure that it is not distorted.

(c) If necessary, reshape floorpan at plug hole and add a bead of 3M All-Around Autobody Sealant, or equivalent, around hole to ensure a satisfactory water tight seal.

(10) Repeat ultrasonic test to ensure that an effective repair has been made.

(11) Install sound insulation material and front carpet, if equipped.

(12) Install front seat(s).

Front Doors and Glass

An improperly adjusted door or defective sealing system will allow water to leak onto the front carpet or floor.

NOTE: *Before starting door leak diagnosis, ensure that the door is correctly set within the body opening paying particular attention to the door flushness relative to surrounding surfaces. The mating surfaces of body opening and door rubber sealer must be wiped clean and dried. Also, make sure that the door glass is properly adjusted.*

Spray Diagnosis and Repair

(1) Perform the following spray test using guidelines described under Spray Test above.

(a) Starting at front lower corner of door, spray water between door lower edge to rocker panel.

(b) Move slowly up door to roof level.

(c) Move to door lower rear corner and spray water between door rear edge and adjacent panel.

(d) Move slowly up door to roof level.

(e) Test door top edge to roof section.

(f) Repeat spray test on other side of vehicle.

(2) If leaks are noted, dry suspect area as described above under Bonding Surface Preparation.

(3) Examine rubber sealers for damage, distortion or incorrect location. Damaged or distorted rubber sealers should be replaced, as outlined in Chapter 3J.

(4) Correct improperly installed rubber sealers as outlined in Chapter 3J.

(5) Repeat spray test to ensure that an effective repair has been made.

Ultrasonic Diagnosis and Repair

(1) Make sure suspect areas are thoroughly dry. If an opening or hole is full of water, ultrasonic sound will be blocked.

(2) Close all windows, doors and air vents.

(3) Using Listener Tool J-23455-01, perform ultrasonic test as follows:

(a) Place transmitter in vehicle near suspect door and turn switch on.

(b) Slowly pass listener around all door edges and sealers.

(c) Mark any area where a meter reading of approximately 5 is obtained, as an indication of a possible leak.

(4) Clean suspect area as described above under Bonding Surface Preparation.

(5) Examine rubber sealers for damage, distortion or incorrect location. Damaged or distorted rubber sealers should be replaced as outlined in Chapter 3J.

(6) Correct improperly installed rubber sealers as outlined in Chapter 3J.

(7) Repeat ultrasonic test to ensure that an effective repair has been made.

WATER ON FRONT OR REAR SEATS

Front and Rear Doors and Glass

Improperly adjusted doors or defective sealing systems will allow water to leak onto the front or rear seats.

NOTE: *Before starting door leak diagnosis, ensure that the door is correctly set within the body opening paying particular attention to the door flushness relative to surrounding surfaces. The mating surfaces of body opening and door rubber sealer must be wiped clean and dried. Also, make sure that the door glass is properly adjusted.*

Spray Diagnosis and Repair

Repeat Front Doors and Glass Spray Diagnosis and Repair procedures for both front and rear doors.

Ultrasonic Diagnosis and Repair

Repeat Front Doors and Glass Ultrasonic Diagnosis and Repair procedures for both front and rear doors.

Rear Quarter Windows and Sun Roofs

The stationary and opening rear quarter window seals can leak water that may appear on the rear seats. The sun roof seals can leak water that may appear on front seats.

NOTE: *Before starting rear quarter window leak diagnosis, make sure that the rear quarter windows are properly adjusted. Also ensure that the sun roof seal is properly cleaned and lubricated with petroleum jelly.*

Spray Diagnosis and Repair

(1) Close and/or lock the windows.

(2) Perform the following spray test using guidelines described under Spray Test above.

(a) Start spray test along lower edge.

(b) Spray water all around edges of window and opening.

(c) Repeat spray test on other side of vehicle.

(3) If leaks are noted, dry suspect area as described above under Bonding Surface Preparation.

(4) In instances of leakage from stationary quarter window or sun roof, apply 3M Windshield Sealer, or equivalent, between glass and sealer or sealer and body flange.

(5) Open rear quarter windows or sun roof and examine rubber sealers for damage, distortion or incorrect position. Damaged or distorted rubber sealers should be replaced.

(6) Correctly install rear quarter window rubber sealers as outlined in Chapter 3K and sun roof seals as outlined in Chapter 3L.

(7) Make sure that flange is free from buckles or protrusions.

(8) Repeat spray test to ensure that an effective repair has been made.

Ultrasonic Diagnosis and Repair

(1) Make sure suspect areas are thoroughly dry. If an opening or hole is full of water, ultrasonic sound will be blocked.

(2) Close all windows, doors and air vents.

(3) Using Listener Tool J-23455-01, perform ultrasonic test as follows:

(a) Place transmitter in vehicle adjacent to rear quarter window or sun roof and turn switch on.

(b) Slowly pass listener around window opening.

(c) Mark any area where a meter reading of approximately 5 is obtained as an indication of a possible leak.

(d) Repeat test on other side of vehicle.

(4) Clean suspect area as described above under Bonding Surface Preparation.

(5) In instances of leakage from stationary quarter window, apply 3M Windshield Sealer, or equivalent, between glass and sealer or sealer and body flange.

(6) Open rear quarter windows or sun roof and examine rubber sealers for damage, distortion or incorrect location. Damaged or distorted rubber sealers should be replaced.

(7) Correctly install rear quarter window rubber sealers as outlined in Chapter 3K and sun roof seals as outlined in Chapter 3L.

(8) Also, make sure that flange is free from buckles or protrusions.

(9) Repeat ultrasonic test to ensure that an effective repair has been made.

WATER OFF HEADLINER

Luggage Racks and Sun Roofs

Spray Diagnosis and Repair

(1) Lower headliner in suspect area, if equipped.

(2) Perform the following spray test using guidelines described under Spray Test above.

(a) Spray water along luggage rack, skid strip mouldings or sun roof.

(b) If necessary, repeat spray test on other side of vehicle.

(3) If leaks are noted, dry out suspect area as described above under Bonding Surface Preparation.

(4) Remove luggage rack support posts, in suspect area, and seal wellnuts or screw holes to body using 3M Drip-Chek Sealer, or equivalent. Install support posts.

(5) Remove luggage rack skid strips in suspect area, and ensure that all moulding clips are correctly installed. Remove sun roof as outlined in Chapter 3L.

(a) Replace improperly installed or defective moulding clips, if equipped.

(b) If necessary, add sealer to ensure a water tight seal.

(c) Install previously removed skid strips.

(6) Repeat spray test to ensure that an effective repair has been made.

(7) Install headliner.

Ultrasonic Diagnosis and Repair

(1) Make sure suspect areas are thoroughly dry. If an opening or hole is full of water, ultrasonic sound will be blocked.

(2) Remove headliner, if equipped.
(3) Close all windows, doors and air vents.
(4) Using Listener Tool J-23455-01, perform ultrasonic test as follows:
(a) Place transmitter in vehicle adjacent to suspect area and turn switch on.
(b) Slowly pass listener over each luggage rack support post, skid strip or sun roof.
(c) Mark any area reading approximately 5 on the meter as an indication of a possible leak.
(5) Clean suspect area as described above under Bonding Surface Preparation.
(6) Remove luggage rack support posts, in suspect area, seal wellnuts or screw holes to body using 3M Drip-Chek Sealer, or equivalent. Install support posts.
(7) Remove luggage rack skid strips, in suspect area, and ensure that all moulding clips are correctly installed, if equipped. Remove sun roof as outlined in Chapter 3L.
(a) Replace improperly installed or defective moulding clips.
(b) If necessary, add sealer to ensure a water tight seal.
(c) Install previously removed skid strips or sun roof.
(8) Repeat ultrasonic test to ensure that an effective repair has been made.
(9) Install headliner.

Drip Rail

Spray Diagnosis and Repair

(1) Drop headliner in suspect area, if equipped.
(2) Perform the following spray test using guidelines described under Spray Test above.
(a) Spray water along drip rail, starting at front of roof.
(b) If necessary, repeat spray test on other side of vehicle.
(3) If leaks are noted, dry out suspect area as described above under Bonding Surface Preparation.
(a) Examine suspect area for small pin holes in drip rail sealer.
(b) Apply 3M Drip-Chek Sealer, or equivalent, to drip rail and touch up with matching body color when sealant is dry.
(4) Repeat spray test to ensure that an effective repair has been made.
(5) Install headliner, if equipped.

Ultrasonic Diagnosis and Repair

(1) Make sure suspect areas are thoroughly dry. If an opening or hole is full of water, ultrasonic sound will be blocked.
(2) Remove headliner, if equipped.
(3) Close all windows, doors and air vents.
(4) Using Listener Tool J-23455-01, perform ultrasonic test as follows:
(a) Place transmitter in vehicle adjacent to suspect area and turn switch on.
(b) Slowly pass listener over suspect area.
(c) Mark any area reading approximately 5 on the meter as a indication of a possible leak.
(5) Clean suspect area as described above under Bonding Surface Preparation.
(a) Examine drip rail for small pin holes in drip rail sealer.
(b) Apply 3M Drip-Chek Sealer, or equivalent, to drip rail and touch up with matching body color when sealant is dry.
(6) Repeat ultrasonic test to ensure that an effective repair has been made.
(7) Install headliner, if equipped.

WATER IN REAR PASSENGER COMPARTMENT

Rear Floorpan, Side Sills and Rear Wheelhouse Panels

Water can enter at front floorpan-to-rear floorpan seams due to gaps, distorted panels and/or lack of sealer. Water from these leaks appears on the floorpan or under the rear carpet, if equipped.

Leaks can occur between the side sills or leading edge of rear wheelhouse panels due to excessive gaps and /or lack of sealer at the joints. Water leaks from these joints appears on the floorpan or as wet rear carpet or sound insulation material, if equipped.

Also, leaking rear floorpan plugs will allow water to enter under the carpet and sound insulation material, if equipped.

Spray Diagnosis and Repair

(1) Remove rear seat, if equipped.
(2) Remove rear carpet and sound insulation material, if equipped.
(3) Perform the following spray test using guidelines described under Spray Test above.
(a) Spray water from under vehicle at joint of rear floorpan-to-side sill.
(b) Next spray across front floorpan-to-rear floorpan seam and towards rear of vehicle at floorpan plugs.
(c) Move spray slowly along rear floorpan-to-rear wheelhouse panel seams.
(d) Repeat spray test on other side of vehicle.
(4) If leaks are noted, dry out suspect area as described above under Bonding Surface Preparation.
(5) Straighten out distorted panels.
(6) Seal suspect joints or seams using 3M All-Around Autobody Sealant, or equivalent.
(7) Examine suspect area for loose or missing body plugs.

(a) Check that hardened sealer or road dirt is not preventing the plug from seating.

(b) Check the hole to be sure that it is not distorted.

(c) If necessary, reshape floorpan at plug hole and add a bead of 3M All-Around Autobody Sealant, or equivalent, around hole to ensure a satisfactory water tight seal.

(8) Repeat spray test to ensure that an effective repair has been made.

(9) Install sound insulation material and rear carpet, if equipped.

(10) Install rear seat, if equipped.

Ultrasonic Diagnosis and Repair

(1) Make sure suspect areas are thoroughly dry. If an opening or hole is full of water, ultrasonic sound will be blocked.

(2) Remove rear seat, if equipped.

(3) Remove rear carpet and sound insulation material, if equipped.

(4) Close all windows, doors and air vents.

(5) Using Listener Tool, J-23455-01, perform ultrasonic test as follows:

(a) Place transmitter in vehicle adjacent to suspect area and turn switch on.

(b) Slowly pass listener over each joint, plug and seam.

(c) Mark any area reading approximately 5 on the meter as an indication of a possible leak.

(6) Clean suspect area as described above under Bonding Surface Preparation.

(7) Straighten any distorted panels.

(8) Seal suspect joints or seams using 3M All-Around Autobody Sealant, or equivalent.

(9) Examine suspect area for loose or missing body plugs.

(a) Check for hardened sealer or road dirt preventing plug from seating.

(b) Check hole to be sure that it is not distorted.

(c) If necessary, reshape rear floorpan at plug hole and add a bead of 3M All-Around Autobody Sealant, or equivalent, around hole to ensure a satisfactory water tight seal.

(10) Repeat ultrasonic test to ensure that an effective repair has been made.

(11) Install sound insulation material and rear carpet, if equipped.

(12) Install rear seat, if equipped.

Rear Doors and Glass

An improperly adjusted door or defective sealing system will allow water to leak onto the rear carpet or floorpan.

NOTE: *Before starting door leak diagnosis, ensure that the door is correctly set within the body opening paying particular attention to the door flushness relative to surrounding surfaces. The mating surfaces of body opening and door rubber sealer must be wiped clean and dry. Also, ensure that the door glass is properly adjusted.*

Spray Diagnosis and Repair

Repeat Front Doors and Glass Spray Diagnosis and Repair procedures for the rear doors.

Ultrasonic Diagnosis and Repair

Repeat Front Doors and Glass Ultrasonic Diagnosis and Repair procedures for the rear doors.

Rear Quarter Windows

The stationary and opening rear quarter window seals can leak water that may appear on the rear carpet or floorpan.

NOTE: *Before starting rear quarter window leak diagnosis, ensure that the rear quarter windows are properly adjusted.*

Spray Diagnosis and Repair

Repeat Rear Quarter Windows Spray Diagnosis and Repair procedures as described under Water on Front or Rear Seats.

Ultrasonic Diagnosis and Repair

Repeat Rear Quarter Windows Ultrasonic Diagnosis and Repair procedures as described under Water on Front or Rear Seats.

WATER IN CARGO AREA

Liftgate and Tailgate

Improperly adjusted liftgate, tailgate or defective sealing system will allow water to leak into the cargo area.

NOTE: *Before starting liftgate or tailgate leak diagnosis, ensure that the liftgate or tailgate are correctly set within the body opening. The mating surfaces of body opening and rubber sealer must be wiped clean and dry.*

Spray Diagnosis and Repair

(1) Perform the following spray test using guidelines described under Spray Test above.

(a) Start a lower corner of liftgate or tailgate, spray water between lower edge and body panel.

(b) Move slowly up to top of liftgate, or tailgate.

(c) Move to opposite lower corner and spray between edge and adjacent body panel.

(d) Move slowly up to top of liftgate, or tailgate.

(e) Finally, test top edge to adjacent body panel.

(2) If leaks are noted, dry out suspect area as described above under Bonding Surface Preparation.

(3) Examine rubber sealers for damage, distortion or incorrect installation. Damaged or distorted rubber sealers should be replaced as outlined in Chapter 3H.

(4) Correct improperly installed rubber sealers as outlined in Chapter 3H.

(5) In instances of leakage from spot weld burn holes, apply 3M All-Around Autobody Sealant, or equivalent, and touch up with matching body color when dry.

(6) Repeat spray test to ensure that an effective repair has been made.

Ultrasonic Diagnosis and Repair

(1) Make sure suspect areas are thoroughly dry. If an opening or hole is full of water, ultrasonic sound will be blocked.

(2) Close all windows, doors, and air vents.

(3) Using Listener Tool J-23455-01, perform ultrasonic test as follows:

(a) Place transmitter in vehicle cargo compartment, turn switch on.

(b) Slowly pass listener around all edges and sealers.

(c) Mark any area reading approximately 5 on the meter as a indication of a possible leak.

(4) Clean suspect area as described above under Bonding Surface Preparation.

(5) Examine rubber sealers for damage, distortion or incorrect installation. Damaged or distorted rubber sealers should be replaced as outlined in Chapter 3H.

(6) Correct improperly installed rubber sealers as outlined in Chapter 3H.

(7) In instances of leakage from spot weld burn holes, apply 3M All-Around Autobody Sealant, or equivalent, and touch up with matching body color when dry.

(8) Repeat ultrasonic test to ensure that an effective repair has been made.

Rear Floorpan, Wheelhouse Panels, Cross Sills, Quarter Panels, Center Panels, and Extensions

Water can enter at the rear floorpan, wheelhouse panels and quarter panel seams due to gaps, distorted panels and/or lack of sealer. Leaks can occur between the rear cross sill, center panel, rear floorpan or extension panels due to excessive gaps and/or lack of sealer.

Water can enter around rear taillamp housings or side marker lamps due to defective sealer/gasket or damaged housings. Also, leaking floorpan plugs will allow water to enter.

The light test, described above, may also be used for finding water leaks in the cargo area.

Spray Diagnosis and Repair

(1) Remove spare tire.

(2) Remove cargo mat and/or carpet and sound insulation material, if equipped.

(3) Remove rear trim panels in suspect area.

(4) Perform the following spray test using guidelines described under Spray Test above.

(a) Spray water from under vehicle at rear floorpan, wheelhouse panels and quarter panel seams.

(b) Next spray water across rear floorpan, cross sill, center panel and extension panel seams.

(c) Also, spray water across rear floorpan and extension panel plugs.

(d) Move spray slowly upwards until water is directed at each wheelhouse panel seam.

(e) Direct spray on lamp housings and coach seams.

(f) Repeat spray test on other side of vehicle.

(5) If leaks are noted, dry out suspect area as described above under Bonding Surface Preparation.

(6) Straighten any distorted panels.

(7) Seal small suspect joints or seams using 3M All-Around Autobody Sealant, or equivalent.

(8) Seal large suspect joints or seams using 3M Underseal Rubberized Undercoating, or equivalent.

(9) Examine suspect area for loose or missing body plugs.

(a) Check for hardened sealer or road dirt preventing plug from seating.

(b) Check plug hole to be sure that it is not distorted.

(c) If necessary, reshape floorpan or extension panels locally and add a bead of 3M All-Around Autobody Sealant, or equivalent, around hole to ensure a satisfactory water tight seal.

(10) Replace damaged or distorted lamp housing gaskets and/or seals. Also, tighten lamp housing attaching hardware.

(11) Seal coach seams with 3M All-Around Autobody Sealant, or equivalent, and touch up with matching body color after sealant has dried.

(12) Tighten fuel tank filler neck screws and seal any holes or breaks in gasket and/or sealer with above sealant.

(13) Repeat spray test to ensure that an effective repair has been made.

(14) Install previously removed rear trim panels.

(15) Install sound insulation material, if removed, and cargo mat and/or carpet.

(16) Install spare tire.

Ultrasonic Diagnosis and Repair

(1) Make sure suspect areas are thoroughly dry. If an opening or hole is full of water, ultrasonic sound will be blocked.

(2) Remove spare tire.

(3) Remove cargo mat and/or carpet and sound insulation material, if equipped.

(4) Remove rear trim panels in suspect area.

(5) Close all windows, doors and air vents.

(6) Using Listener Tool J-23455-01, perform ultrasonic test as follows:

(a) Place transmitter in cargo compartment, near suspect area, and turn switch on.

(b) Slowly pass listener around all suspect joints/seams.

(c) Mark any area reading approximately 5 on the meter as a indication of a possible leak.

(7) Clean suspect area as described above under Bonding Surface Preparation.

(8) Straighten any distorted panels.

(9) Seal small suspect joints or seams using 3M All-Around Autobody Sealant, or equivalent.

(10) Seal large suspect joints or seams using 3M Underseal Rubberized Undercoating, or equivalent.

(11) Examine suspect area for loose or missing body plugs.

(a) Check for hardened sealer or road dirt preventing plug from seating.

(b) Check plug hole to be sure that it is not distorted.

(c) If necessary, reshape floorpan or extension panels and add a bead of 3M All-Around Autobody Sealant, or equivalent, around hole to ensure a satisfactory water tight seal.

(12) Replace damaged or distorted lamp housing gaskets and/or seals. Also, tighten lamp housing attaching hardware.

(13) Seal coach seams with 3M All-Around Autobody Sealant, or equivalent, and touch up with matching body color after sealant has dried.

(14) Tighten fuel tank filler neck screws and seal any holes or breaks in gasket and/or sealer with 3M All-Around Autobody Sealant, or equivalent.

(15) Repeat ultrasonic test to ensure that an effective repair has been made.

(16) Install previously removed rear trim panels.

(17) Install sound insulation material, if removed, and cargo mat and/or carpet.

(18) Install spare tire.

INTERIOR WIND NOISES

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GENERAL

A systematic diagnosis is necessary to isolate interior wind noises. The spot where the noise is heard may not be where the trouble really originates. Before proceeding with a noise diagnosis, consider the forces that act on the vehicle to generate wind noise.

Air impacts the windshield and is forced around the A-pillar and along the sides of the vehicle. This air motion causes a low pressure area that moves along with the vehicle near the A-pillar and along the sides of the body.

At the same time, air rammed into the vehicle interior by forward motion enters through the heating and ventilating to build a positive pressure inside the vehicle which tends to force the window glass outward.

To maintain a weather-tight, noise-free seal against these two forces, the doors and glass must be properly maintained and adjusted.

STATIC TEST

Before beginning a static test, visually inspect the fit of the doors, liftgates, tailgates and glass. Proper door, liftgate, tailgate and glass adjustments will cure most interior wind noise problems. Also, thoroughly inspect all weatherstrips to make sure they are not damaged or incorrectly installed. Correct improperly installed, misrouted or faulty weatherstrips.

Close all the doors, windows, and vents and turn the blower motor on high. Use a stethoscope to listen for air leakage in the suspected area. If the air leakage appears to be excessive compared with the other side of the vehicle, perform the necessary repairs to correct the air leakage and recheck the repaired area.

Another way to static test the vehicle is to use the Listener Tool J-23455-01. This tool makes use of the fact that ultrasonic energy (high frequency sound) has certain properties that are similar to those of fluids (liquids and gases). Ultrasonic energy does not penetrate solids, such as glass or metal. It is, however, transmitted through cracks and openings, such as those that cause water or air leaks.

An operating ultrasonic generator placed inside vehicle body will fill the vehicle with sound energy. This energy will leak at the same location that permits water

and air leaks. However, if an opening or hole is full of water the ultrasonic sound will be blocked. The water path or opening must be dry.

An ultrasonic generator and detector gun form an ideal combination for determining the location and magnitude of water and air leaks. The ultrasonic leak detector can be used effectively as a diagnostic tool realizing it is not an exact tool and has certain limitations.

To use the Listener, place the tone generator inside the vehicle, close the doors, windows and air vents and listen for the signal in the problem area with the listener. A meter in the listener measures the strength of the signal being received and gives a direct read-out on a dial. This gives an accurate reference point for checking the repair. If the first static test shows a high reading and the after-repairs test shows a low reading, the problem has been repaired.

ROAD TEST

If the wind noise was not located and corrected during the static test, it will be necessary to road test the vehicle. Also, the vehicle should be road tested after repairs are completed to verify that the problem has been corrected. Be prepared to make minor adjustments or repairs on the road test.

Take the following tools and materials on the road test:

- Stethoscope
- Body tape
- Weatherstrip adhesive
- Caulking cord
- Silicone Spray
- Screwdrivers
- Knife
- Small socket wrench set

With the above tools and materials, have an assistant drive the vehicle to the test area. Make sure the test road is dry and smooth as possible. It is difficult to hear wind noise on wet, bumpy roads.

While the assistant drives the vehicle, move the stethoscope slowly along the suspected problem area, and listen for the point where the most noise is coming from. Make sure to test the vehicle with the fresh air vents open, because ram air pressure has an effect on the wind noise level. Also, drive the vehicle in both directions on the test road, as prevailing wind conditions could change the noise level.

After determining where the most noise is coming from, stop the road test and carefully inspect the problem area. If the cause is minor, repair it with the tools and material taken along and retest the vehicle to find out if the repair has worked.

If in doubt that the problem area has been found, cover the suspected area with body tape and continue the road test. If the noise has been eliminated with the body tape, the problem area has been located. However, if the noise continues, apply additional strips of body tape to other areas that may be causing the problem. Continue road testing and applying or removing strips of tape until the wind noise has been isolated.

Many wind noise problems can be satisfactorily repaired while on the road test. However, repair of some of the problems, like aligning a window frame or adjusting a door or window, may require returning to the shop for completion.

DOOR ADJUSTMENTS

Refer to Chapter 3J for detailed procedures on door adjustments.

LIFTGATE-TAILGATE ADJUSTMENTS

Refer to Chapter 3H for detailed procedures on liftgate-tailgate adjustments.

WINDOW ADJUSTMENTS

Refer to Chapter 3J and 3K for detailed procedures on window adjustments.

EXTERIOR WIND WHISTLES

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GENERAL

Noises generated by loose or unseated mouldings, trim, vibrating grille components, etc., can be difficult to diagnose. The most common noise is generally called a "tea kettle" whistle and is usually due to air flowing under instead of around or over a moulding.

ROAD TEST

There is no way to simulate the air flow that makes exterior wind whistles, so a road test is usually necessary. Take along a roll of body tape to help isolate the problem areas when they are located on the road test. It is usually helpful to have an assistant drive the vehicle

or locate the noise. Road test the vehicle with the front windows up and then down, to be sure the noise is coming from outside the vehicle. Also, drive the vehicle in both directions, as the prevailing wind could influence the noise level. Try to determine from which area of the vehicle the wind whistle is coming:

- Grille area
- Hood bezel
- Fender mouldings
- Windshield reveal mouldings
- Luggage rack

When the source of the wind whistle has been found, isolate that component by applying body tape to the suspected area. Retest the temporary repair. If the body tape stops the whistle, align and tighten the moulding/bezel or apply 3M Clear Auto Sealer or equivalent to fill the gap that is causing the whistle.

GRILLE AREA

A process of elimination is the only system to use in locating a wind whistle in the grille area. Make a wind deflector from a piece of cardboard, large enough to cover one-half of the grille area. Tape this deflector to the right front area of the vehicle and road test the vehicle. If the wind whistle is still there, move the deflector to the left front and road test the vehicle. After determining which half of the grille area is causing the wind whistle, apply body tape to all the mouldings and components around the grille opening. Continue road testing the vehicle, progressively remove tape segments until you have isolated the wind whistle. Align and tighten the mouldings or fill the gap with a clear sealer.

FENDER MOULDINGS

Fender mouldings that are not properly aligned or tightly seated to the fender can cause a wind whistle. If this is the case, apply body tape to the suspected moulding and road test the vehicle. If the wind whistle has been eliminated with the body tape, align and tighten the moulding or fill the gap with a clear sealer.

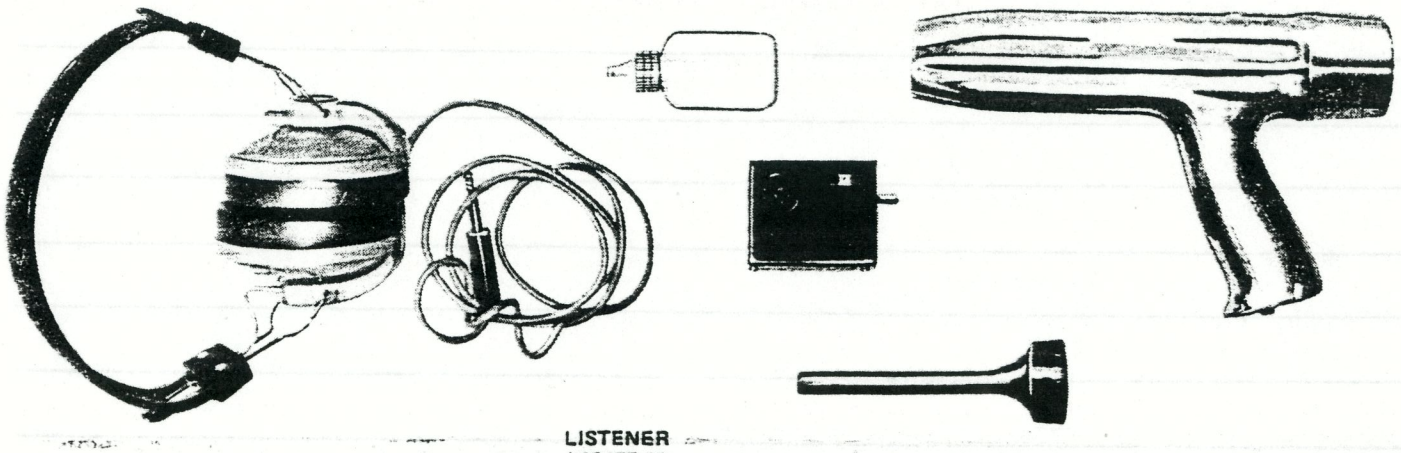
BODY MOULDINGS

Body or windshield reveal mouldings that are not properly aligned or tightly seated can allow air to flow under rather than over them, generating a wind whistle. Apply body tape to the suspected area and road test the vehicle. If the wind whistle is still there, apply additional strips of body tape to the area, until the wind whistle source is located. If a large area has been covered with body tape, continue the road test and progressively remove body tape segments until the wind whistle has been isolated. Align and tighten the moulding or fill the gap with a clear sealer.

LUGGAGE RACKS

Luggage racks present a problem area similar to the grille area covered above. Make a deflector from cardboard, large enough to cover one-half the frontal area of the luggage rack. Tape the deflector to the luggage rack and road test the vehicle. If the wind whistle is still there, move the deflector to the other side and repeat the road test. After determining which side of the luggage rack is causing the wind whistle, apply body tape to all mouldings, supports and rails. Continue the road test and progressively remove tape segments until the wind whistle has been isolated. Align and tighten the mouldings, supports and rails or fill the gap(s) with clear sealer.

Tools



LISTENER
J-23455-01

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NOTES

METAL REPAIR AND PAINTING 3B

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METAL REPAIR

The information contained herein provides instructions for bulge, crease and dent repair. The terms are defined as follows:

- Bulge—An impression in the metal from inside to outside.
- Crease—A depression in the metal up to 1/2-inch to 2 inches long or longer.
- Dent—A depression in the metal larger than 1/4-inch by 1/4-inch.

(1) Wash damaged area with mild detergent and water to remove dirt.

(2) Clean repair area using wax and silicone remover, such as DuPont Prep-Sol, Ditzler Acryli-Clean, or equivalent.

(3) Use a grinder to remove paint and to outline damaged area.

(a) Use a grade 24 disc for initial grinding.

(b) Follow up with a grade 50 disc to prevent coarse scratches from showing up in final finish.

(4) A bulge may require application of heat to shrink metal.

(a) Heat metal bulge with an oxygen-acetylene torch and immediately upset bulge area with a hammer and dolly.

(b) Do not attempt to hammer bulge below original contour completely while metal is hot or metal will be overshrunk.

(5) To restore contour of a bulge, crease or dent after straightening and grinding, apply plastic body filler, such as DuPont Polyester Autobody Filler, Ditzler "999" Body Filler, 3M Plastic Filler, or equivalent. For best results, mix plastic body filler and hardener according to manufacturer's instructions.

(6) Apply plastic filler with a plastic spreader. Use firm pressure to aid in removing air bubbles which will show up as pinholes.

(7) Use an air file or hand file board for shaping of plastic filler.

(a) For initial shaping of plastic filler, use a grade 36 paper.

(b) For final shaping and sanding contours in plastic filler, use a grade 40 paper.

(8) Featheredge paint into bare metal area as described in following steps.

(a) For rough featheredging, use a grade 80 disc on a random disc sander.

(b) For final featheredging, use grade 180 disc on random disc sander or 220 grade paper on a hand sanding block.

PAINT REPAIR WITH ACRYLIC ENAMEL

Recent advancements in acrylic enamels have produced a repair procedure which can be used to effectively spot repair a panel or an area where panels join. This procedure should be used only on secondary surfaces of the vehicle (all surfaces below the level of the top of the wheel openings). If repair of a panel requires more than one-half the total panel area, the entire panel should be refinished.

(1) Using a mild detergent and water, wash complete panel and rinse thoroughly.

(2) Clean repair area with a wax and silicone remover, such as DuPont Prep-Sol, Ditzler Acryli-Clean, or equivalent.

(3) Remove loose paint and rust with body grinder. Featheredge area with sandpaper.

(4) Apply metal conditioner, following manufacturer's instructions.

(5) Wash area to be painted.

(6) Mask area to be painted.

(7) If bare metal is showing through paint in repair area, use following steps to prime area.

(a) Apply metal conditioner to bare metal according to manufacturer's instructions.

(b) Mix primer following manufacturer's instructions.

(c) Apply primer and allow to air dry.

(d) Remove masking and wet sand repair area.

(e) If scratches or pin holes appear in surface, apply glazing putty according to manufacturer's instructions.

(f) After glazing putty dries, wet sand and clean area. Apply final coat of primer and allow to air dry.

(g) Wet sand and clean area with an after-sanding cleaner.

(8) Mask area to be painted.

(9) Mix acrylic enamel color using a paint shaker and following manufacturer's mixing instructions.

(10) Adjust air pressure at air regulator to obtain 40 psi at spray gun and spray test panel. Adjust gun to obtain desired pattern.

(11) Apply one medium color coat to primed area and allow paint to set up for 25 minutes.

(12) Apply two or more medium color coats. Overlap edges of each coat to produce a tapered edge. Allow each coat to flash completely.

(13) Adjust air pressure at air regulator to obtain 70 psi at spray gun and spray test panel. Adjust gun as necessary to obtain desired pattern and color match.

(14) Spray one full wet color coat over entire repair area. Overlap edges of previous coat.

(15) Empty gun and fill cup with enamel reducer. Reduce air pressure at air regulator to obtain 20 psi at spray gun.

(16) Spray blend-coat over edges of old and new paint.

(17) Spray one or two medium coats over entire area.

(18) Remove all masking when paint has tacked up.

NOTE: *If a haze appears over repair area after it has dried, rub area lightly with liquid polishing compound.*

FINISHING METAL REPLACEMENT PARTS

Metal body service replacement panels or assemblies are painted with a black factory primer. For proper adhesion of acrylic enamel color coats in service, the following refinish steps are necessary.

(1) Wash part with paint finish cleaning solvent, such as DuPont Prep-Sol, Ditzler Acryli-Clean, or equivalent.

(2) Scuff sand part with 360 grade dry sandpaper. Avoid cutting through and rewash part.

(3) Mix primer/sealer following manufacturer's instructions.

(4) Apply primer/sealer and allow to air dry.

(5) Wet sand smooth and clean with after sanding cleaner.

Painting Tips

- Use only one brand of refinish materials on each repair.
- Follow manufacturing instruction for use of refinisn materials.
- Use recommended reducer according to shop temperature and humidity conditions.
- Mix paint thoroughly.
- Spray a test panel and adjust gun to obtain desired color before attempting to spray vehicle.
- When matching colors:
  - A given color can be darkened by:
    1. decreasing air pressure
    2. increasing fluid setting on gun
    3. moving gun closer to surface
  - A given color can be lightened by:
    1. increasing air pressure
    2. decreasing fluid setting on gun
    3. moving gun farther from surface

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Metallic Color Guide

To Lighten a Metallic Color:

- Use a Fast-Drying Thinner
- Add More Reducer
- Raise Air-Pressure
- Apply Dryer Coats
- Wait Longer Between Coats
- Mist Coat
- Adjust Fluid Valve on Gun (Close)
- Adjust Air Valve on Gun (Open)
- Hold Gun Further From the Surface

To Darken a Metallic Color:

- Use a Slow-Drying Thinner
- Use Less Reducer than Normal
- Lower Air-Pressure
- Apply Wetter Coats
- Allow Less Waiting Time Between Coats
- Use Retarder in Paint
- Open Fluid Adjustment on Gun
- Close Air Adjustment on Gun
- Hold Gun Closer to the Surface

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(6) Apply acrylic enamel color coats as required.

(7) If part is a replacement fender, perform additional following steps:

(a) Clean inside of replacement fender and allow to dry.

(b) Apply 1/8-inch thick film of spray undercoating, using 3M Body Schutz Rubberized Coating (or equivalent) and 3M Applicator Gun (or equivalent), or a double coat of air-dry acrylic enamel to entire inside surface of fender.

FINISHING PLASTIC TRIM PARTS

General

Paintable plastic interior trim parts can be divided into three general types:

- Polypropylene plastic (Rigid)
- ABS plastic (Rigid)
- Vinyl plastic (Flexible)

It is important to be able to identify each plastic in order to paint it satisfactorily.

The purpose of the following test is to determine the identity of a given plastic so that proper paint procedures and materials can be used.

Test for Polypropylene and ABS Plastic

To determine if a service part to be painted is Polypropylene or ABS plastic, perform the following burn test:

(1) From hidden backside of part, remove a sliver of plastic with a sharp knife.

(2) Hold sliver of plastic with needlenose pliers and ignite plastic.

(3) Observe burning plastic closely.

(a) Polypropylene burns with a clear blue flame which has a yellow tip and no readily visible smoke. When extinguished, it gives off a white smoke with a odor of paraffin.

(b) ABS plastic burns with an orange flame and readily visible black, sooty smoke which hangs temporarily in air.

Test for Vinyl Plastic

To determine if a part to be painted is vinyl plastic, a copper wire test may be performed as follows:

(1) Heat a copper wire in a suitable flame such as a propane torch until wire glows (red).

(2) Touch heated wire to backside or hidden surface of part being tested in a manner so as to retain some of plastic material on wire.

(3) Return wire and retained plastic to flame and observe for a green turquoise blue flame. A flame in this color range indicates that plastic being tested is vinyl.

Procedure for Painting Rigid Polypropylene Plastic Parts

The system for painting polypropylene parts involves the use of a special primer. Since polypropylene plastic is rigid, it can be color coated after prime with appropriate Jeep color interior spray paint (plastic and vinyl) or equivalent.

CAUTION: *It is essential that the service part be primed first with a coating of Jeep 8993626 polypropylene primer (or equivalent) according to the instructions. Failure to use the required primer as directed will result in the color coat lifting or peeling.*

(1) Wash part thoroughly with paint finish cleaning solvent, such as DuPont Prep-Sol, Ditzler Acryli-Clean, or equivalent.

(2) Apply a thin, wet coat of polypropylene primer according to instructions on label. Wetness of primer is determined best by observing gloss reflection of spray application in adequate lighting. Be sure primer application includes all edges.

(3) Allow primer to flash completely.

(4) Apply appropriate color coat of interior spray paint and allow to air dry before installing part.

Procedure for Painting Rigid ABS Plastic Parts

Rigid ABS plastic requires no primer. Jeep color interior spray paint (plastic and vinyl) or equivalent will adhere satisfactorily to rigid ABS plastics.

(1) Wash part thoroughly with a paint finish cleaning solvent, such as DuPont Prep-Sol, Ditzler Acryli-Clean, or equivalent.

(2) Color coat part using appropriate Jeep color interior spray paint (plastic and vinyl) or equivalent.

(3) Allow to dry and then install part.

NOTE: *Apply only sufficient color for proper hiding to avoid washout of grain effect.*

Procedure for Painting Flexible Vinyl Plastic Parts

The paint system for flexible vinyl plastic involves the use of Jeep interior spray paint (plastic and vinyl) or equivalent.

NOTE: *No special primer is required when painting flexible vinyl plastic parts.*

(1) Wash part thoroughly with a vinyl cleaner. Wipe off cleaner while still wet with a clean, lint-free cloth.

(2) Immediately after wiping surface dry, apply appropriate Jeep color interior spray paint (plastic and vinyl) or equivalent in wet coats allowing sufficient flash time between coats.

(3) Allow to dry completely before installing part.

NOTE: *Apply only sufficient color for proper hiding to avoid washout of grain effect.*

NOTES

INSTRUMENT PANELS AND COMPONENTS 3C

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CJ INSTRUMENT PANEL

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GENERAL

CJ instrument panels are of formed sheet metal construction and are reinforced with braces and fastened to adjacent body panels with screws.

A crash pad is available for CJ models and is attached to the instrument panel (fig. 3C-1).

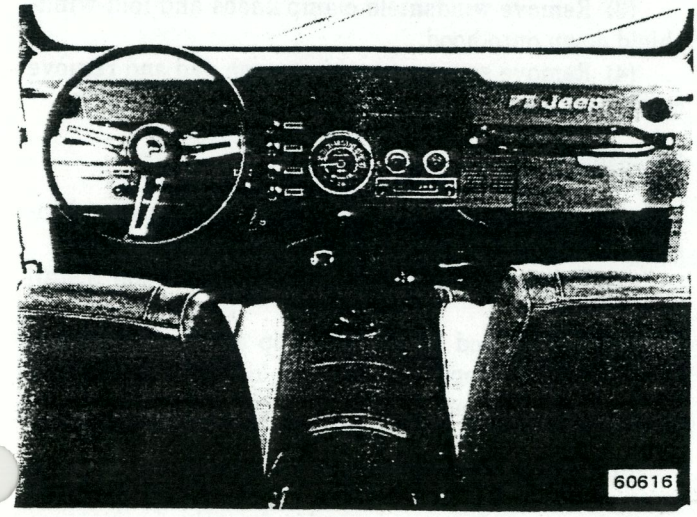

Fig. 3C-1 Instrument Panel

INSTRUMENT CLUSTER

Removal

NOTE: *If equipped with air conditioning, remove screws attaching evaporator assembly to instrument panel and lower evaporator assembly.*

(1) Disconnect battery negative cable.
(2) Disconnect speedometer cable.
(3) Remove cluster attaching screws and remove cluster.
(4) Mark bulb and wire connectors, and disconnect cluster electrical connectors and lamps.

Installation

(1) Connect cluster lamps and electrical connectors.
(2) Position cluster on instrument panel and install attaching screws.
(3) Connect speedometer cable.
(4) Connect battery negative cable.

INSTRUMENT PANEL

Removal

NOTE: *If equipped with air conditioning, remove screws attaching evaporator assembly to instrument panel and lower evaporator assembly.*

(1) Disconnect battery negative cable.

(2) Remove screws attaching steering column bezel to instrument panel. Remove bezel.

(3) Disconnect emergency brake bracket from instrument panel.

(4) Disconnect speedometer cable.

(5) Disconnect heater control cables from damper door levers.

(6) Remove windshield clamp knobs and brackets.

(7) Remove crash pad, if equipped.

(a) If equipped with a soft top, unsnap top snaps at windshield corners, unfasten straps at center and sides of front top support, lay top support back to rear, and release top from header retainer.

(b) If equipped with a hardtop enclosure, remove hardware attaching enclosure to windshield and rear quarter panels and support enclosure with wood blocking (fig. 3C-2).

(c) Fold windshield down onto hood.

(d) Remove screws attaching crash pad, if equipped, and remove crash pad.

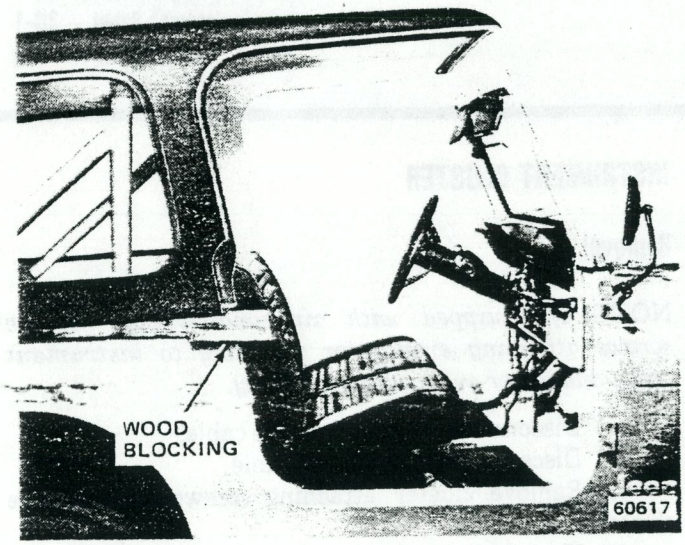

Fig. 3C-2 Hardtop Enclosure Suppported with Wood Blocking

(8) Disconnect all electrical connections.

(9) Remove steering wheel.

(10) Remove automatic transmission shift lever, if equipped.

(a) Place automatic transmission shift lever in Park.

(b) Drive out roll pin attaching shift lever to shift bowl and remove shift lever.

(11) Remove instrument panel-to-dash panel attaching screws and remove instrument panel.

Installation

(1) Position instrument panel in vehicle and install attaching screws.

(2) Install automatic transmission shift lever, if equipped. Insert shift lever in shift bowl and install roll pin.

(3) Install steering wheel.

(4) Connect all electrical connections.

(5) Install crash pad, if equipped.

(a) Position crash pad on instrument panel and install attaching screws.

(b) Raise windshield to upright position.

(c) If equipped with a hardtop enclosure, remove wood blocking supporting top and lower top onto body and windshield. Install hardware attaching top to windshield and rear quarter panels.

(d) If equipped with a soft top, engage top with header retainer, position top support in upright position and fasten center and side straps, and fasten top snaps at windshield corners.

(6) Install windshield brackets and clamp knobs.

(7) Connect heater control cables to damper door levers.

(8) Connect speedometer cable.

(9) Install emergency brake bracket to instrument panel.

(10) Position steering column bezel on instrument panel and install attaching screws.

(11) Connect battery negative cable.

CRASH PAD

Removal

(1) If equipped with a soft top, unfasten top snaps at windshield corners, unfasten straps at center and sides of front top support, lay top support back to rear and release top from header retainer.

(2) If equipped with a hardtop enclosure, remove hardware attaching top to windshield and rear quarter panels and support top with wood (fig. 3C-2).

(3) Remove windshield clamp knobs and fold windshield down onto hood.

(4) Remove screws attaching crash pad and remove crash pad.

Installation

(1) Position crash pad on instrument panel and install attaching screws.

(2) Raise windshield to upright position and install clamp knobs.

(3) If equipped with a hardtop enclosure, remove wood blocking supporting top and lower top onto body and windshield. Install hardware attaching top to windshield and rear quarter panels.

(4) If equipped with a soft top, engage top with header retainer, position top support in upright position and fasten center and side straps, and fasten top snaps at windshield corner.

GLOVE BOX ASSEMBLY

Removal

(1) Remove glove box-to-instrument panel attaching screws.

(2) Remove striker.

(3) Compress glove box at the crease lines and remove box through opening.

Installation

(1) Compress glove box at the crease lines and insert box in opening.

(2) Install glove box-to-instrument panel attaching screws.

(3) Install and adjust striker.

Glove Box Door and Hinge

Removal

The glove box door hinge mounting holes are elongated to provide adjustment. The hinge screws may be loosened and the door moved in the desired direction to fit the door opening.

(1) Remove hinge-to-instrument panel attaching screws.

(2) Remove door and hinge assembly.

Installation

(1) Position door and hinge assembly on instrument panel.

(2) Install hinge-to-instrument panel attaching screws.

(3) Adjust door.

Striker Adjustment

The glove box door lock striker is attached to the instrument panel opening with sheet metal screws. The striker can be moved in or out for door closing adjustment.

INSTRUMENT ILLUMINATION

Instrument panel illumination is provided by three bulbs in the instrument cluster, six molded lamps in the instrument panel, and one bulb each in the voltmeter and oil gauge. Protection for the panel bulbs and lamps is provided by the 3-amp fuse located in the fuse panel. The 3-amp fuse is fed from the headlamp switch through a rheostat.

Do not pull on the bulb wires to remove the bulb socket. Grasp the socket and pull straight out.

To remove the molded lamps, remove the wire connectors. Squeeze the lamp together at the top and bottom to release the small retaining tabs. Push the lamp through the panel (toward the steering wheel). To install the molded lamps, push into the panel until the retaining tabs snap into place.

SPEEDOMETER

A magnetic type speedometer is used on all CJ models.

All speedometers are equipped with a ratchet device to prevent turning the odometer backward.

The following data is supplied for testing and calibrating the speedometer heads.

Speedometer Calibration

Shaft Speed (rpm)	Indication (mph)
333.3	20 ± 1.5
666.7	4.0 ± 1.5
916.7	55 ± 1.5

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Speedometer Head Replacement

Speedometer head replacement includes resetting the replacement odometer to the same mileage as the one removed, unless such setting conflicts with local ordinances.

(1) Remove cluster.

(2) Carefully uncrimp lip of outer bezel. Remove outer bezel, glass and glass retaining bezel.

(3) Remove attaching screws from speedometer housing. Remove speedometer and face plate assembly.

(4) On replacement speedometer, unhook odometer retaining clip. Twist and push down to disengage clip.

(5) Remove odometer and set to proper mileage. Refer to Odometer Setting Procedures.

(6) Install odometer.

NOTE: *Check anti-backup spring for proper positioning.*

(7) Install retaining spring clip using needlenose pliers. Do not force clip against dial face.

(8) Check all light guards for proper positioning. Install speedometer and face plate assembly. Install speedometer attaching screws and washers.

(9) Remove all fingerprints and debris from inside surface of glass.

(10) Install glass, glass retaining bezel and outer bezel. Carefully crimp outer bezel lip four places.

(11) Install cluster.

Odometer Setting Procedure

The following procedure applies with the odometer removed from the speedometer head. Refer to figure 3C-3.

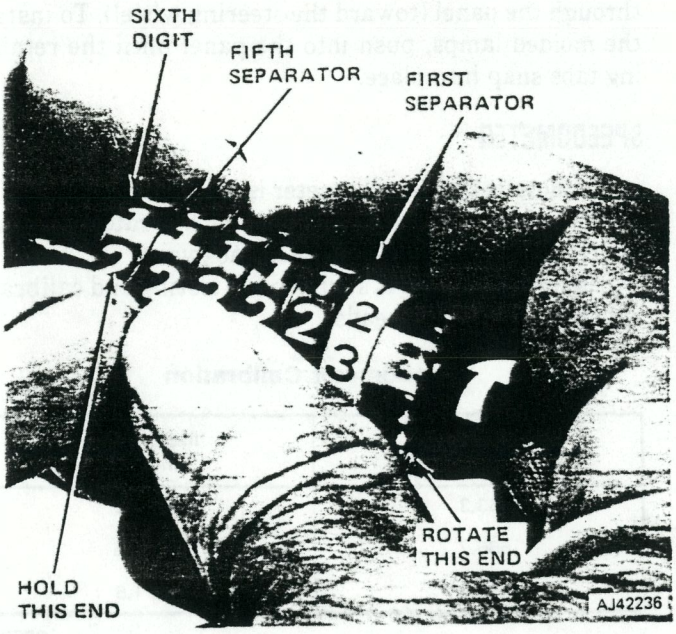

Fig. 3C-3 Advancing Odometer Reading (for Replacement Only)

Hold the fifth separator and rotate the last five numerals in their normal direction until the desired sixth digit is obtained. When the desired sixth digit is obtained, align the fourth separator in line with the fifth separator. Rotate the last four numerals, repeating the process until the desired total mileage is obtained. When installing the odometer, the separators must straddle a cross bar to maintain proper number alignment.

Speedometer Cable Inspection

Visually inspect cable for breaks, kinks, cracks, burns or other physical damage. Remove core from cable assembly and place on a flat surface in the form of an inverted U and then cross the open ends. Hold one end in the left hand, the other in the right hand. Twist one end, applying light finger pressure to the other end. If the core is satisfactory, the turning action will be smooth. A damaged core will react by jumping about on a flat surface.

The speedometer cable requires graphite grease for lubrication.

CLOCK

The clock is attached to the instrument panel by a retaining bracket secured with two screws. To reset the clock, pull out the adjustment knob and rotate. Hands of *fast running* clocks should be turned *backward*, and *slow running* clocks *forward*. Clock speed will then be corrected automatically after one or two adjustments.

CIGAR LIGHTER

The cigar lighter is attaching to the bottom of the instrument panel on all CJ models.

The lighter can be removed by removing the battery feed wire and ground wire and unscrewing the sheil that surrounds the lighter.

The lighter circuit is protected with a 10-amp fuse located at the fuse panel.

CHEROKEE - WAGONEER - TRUCK INSTRUMENT PANEL

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GENERAL

All Cherokee-Wagoneer-Truck instrument panels are of formed sheet metal construction and are reinforced with braces and fastened to adjacent body panels with bolts.

A vinyl-covered polyurethane crash pad is attached to the instrument panel on all models (fig. 3C-4).

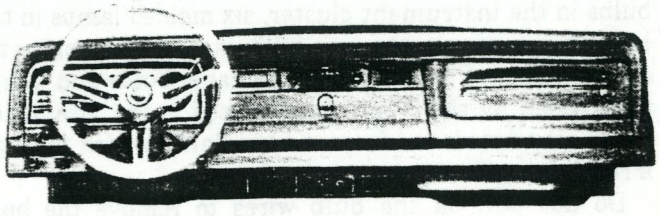

Fig. 3C-4 Instrument Panel

INSTRUMENT CLUSTER

Removal

(1) Disconnect battery negative cable.
(2) Disconnect speedometer cable.
(3) Cover steering column to prevent damaging paint.
(4) Remove cluster attaching screws and tilt top of cluster toward interior of vehicle.
(5) Mark electrical connectors and hoses, and disconnect electrical connectors and heater vacuum hoses.
(6) Disconnect blend air door control cable.
(7) Remove cluster.

Installation

(1) Position cluster on instrument panel.
(2) Connect blend air door control cable.
(3) Connect electrical connectors and heater vacuum hoses.
(4) Install cluster attaching screws.
(5) Connect speedometer cable.
(6) Connect battery negative cable.
(7) Remove covering on steering column.
(8) Check heater and gauge operation.

INSTRUMENT PANEL

Removal

(1) Disconnect battery negative cable.
(2) Remove instrument panel crash pad, as outlined in this chapter.
(3) Remove evaporator assembly and ducts, if equipped with air conditioning.
(4) Remove instrument cluster.
(5) Remove radio and amplifier fader switch, if equipped.
(6) Remove parking brake lever assembly.
(7) Remove air vent cables.
(8) Disconnect electrical connectors and remove courtesy lights.
(9) Disconnect defroster hoses.
(10) Remove steering column trim panel.
(11) Remove bolt from center of brace and lower steering column.
(12) Remove instrument panel attaching screws and remove panel.

Installation

(1) Position instrument panel and install attaching screws.
(2) Raise steering column and install bolt in center of brace.
(3) Install steering column trim panel.
(4) Connect defroster hoses.
(5) Connect electrical connectors and courtesy lights.
(6) Install air vent cables.
(7) Install parking brake lever assembly.
(8) Install instrument cluster.
(9) Install radio and amplifier fader switch, if removed.
(10) Install evaporator assembly and ducts, if removed.
(11) Install instrument panel crash pad.
(12) Connect battery negative cable.

CRASH PAD

Removal

(1) Remove windshield and windshield weatherstrip to expose crash pad retaining screws at base of windshield (refer to Windshield Removal—Chapter 3N).
(2) Remove instrument cluster.
(3) Remove glove box.
(4) Remove ashtray and retainer.
(5) Remove radio, if equipped.
(6) Remove crash pad-to-instrument panel attaching screws and nuts.

NOTE: *The nuts are accessible through the cluster, ashtray, and glove box openings.*

Installation

(1) Position crash pad on instrument panel.
(2) Install attaching screws and nuts.
(3) Install radio, if equipped.
(4) Install ashtray and retainer.
(5) Install glove box.
(6) Install instrument cluster.
(7) Install windshield weatherstrip and windshield (refer to Windshield Installation—Chapter 3N).

GLOVE BOX ASSEMBLY

Removal

(1) Remove glove box-to-instrument-panel attaching screws.
(2) Remove striker.
(3) Remove lockout control switch, if equipped.
(4) Move glove box down and out from rear of instrument panel.

NOTE: *On vehicles equipped with air conditioning, compress the glove box at the crease lines and remove box through opening.*

Installation

(1) Position glove box in glove box opening.
(2) Install glove box-to-instrument panel attaching screws.
(3) Install lockout control switch, if removed.
(4) Install and adjust striker.

Glove Box Door and Hinge

Removal

The glove box door hinge mounting holes are elongated to provide adjustment. The hinge screws may be loosened and the door moved in the desired direction to fit the door opening.

(1) Remove hinge-to-instrument panel attaching screws.

NOTE: *On vehicles equipped with air conditioning, the evaporator housing must be lowered to obtain access to the hinge-to-instrument panel attaching screws.*

(2) Remove door-to-hinge attaching screws.
(3) Remove hinges and glove box door.

Installation

(1) Position hinges on instrument panel and install attaching screws.
(2) Install door-to-hinge attaching screws.
(3) Adjust door.

Striker Adjustment

The glove box door lock striker is attached to the instrument panel opening with sheet metal screws. The striker can be moved in or out for door closing adjustment.

Lock Cylinder Replacement

The glove box lock assembly is inserted through the glove box door from the outside. The assembly is held in place by a screw through the lock clamp cup and into the lock case.

(1) Insert key in lock and rotate cylinder counterclockwise to expose the tumblers.
(2) Remove key and press retainer tumbler down.
(3) Insert key and remove lock cylinder.
(4) If replacement lock cylinder is being installed, insert original key into replacement cylinder and file tumblers flush with cylinder. Stake tumblers into cylinder.
(5) Press retainer tumbler down on lock cylinder and insert key in cylinder.
(6) Insert cylinder into lock case.
(7) Hold cylinder in place and remove key.

INSTRUMENT ILLUMINATION

Four bulbs provide lighting for the instrument cluster (fig. 3C-5) and two bulbs illuminate the heater control panel. Panel lights are fed from the fuse panel through the headlamp switch rheostat. To replace instrument cluster bulbs, reach up behind the cluster, twist the bulb socket counterclockwise (viewed from the rear) and pull out. To replace the heater control panel bulb, pry the bulb socket down to free the spring clip which attaches the socket to the panel.

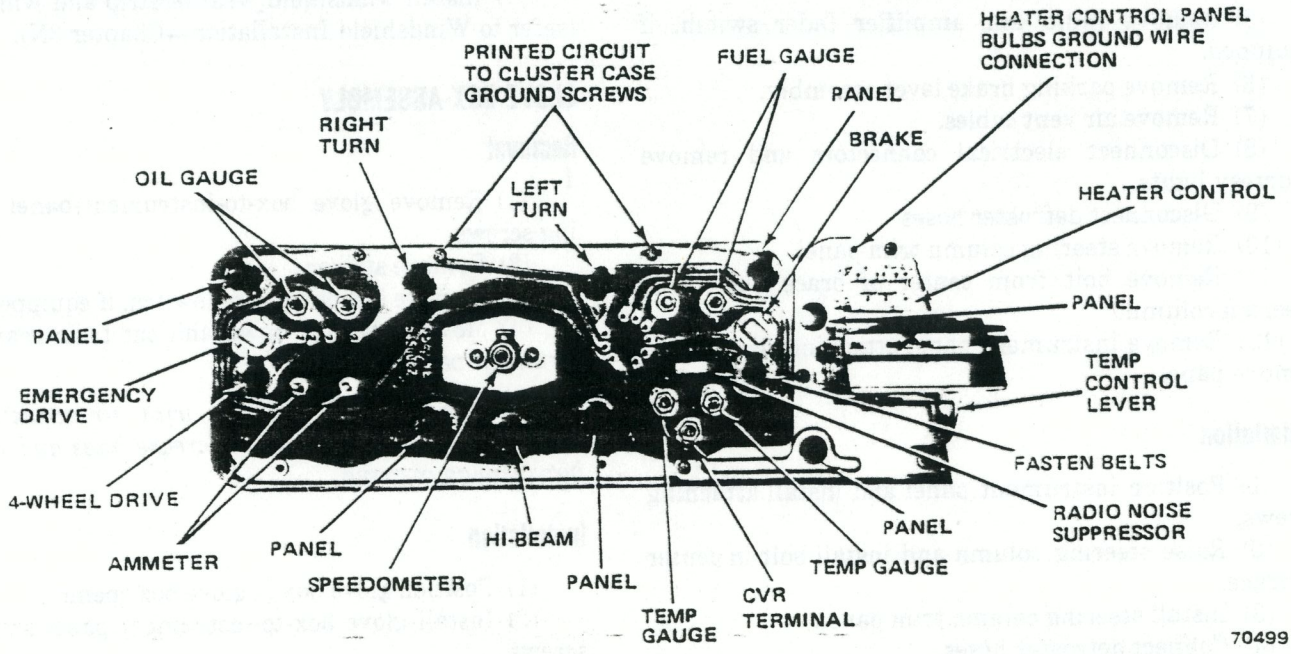

Fig. 3C-5. Instrument Cluster—Rear View

SPEEDOMETER

A magnetic type speedometer is used on all models.

All speedometers are equipped with a ratchet device to prevent turning the odometer backward.

The following data is supplied for testing and calibrating the speedometer heads.

Speedometer Calibration

Shaft Speed (rpm)	Indication (mph)
333.3	20 ± 1.5
666.7	4.0 ± 1.5
916.7	55 ± 1.5

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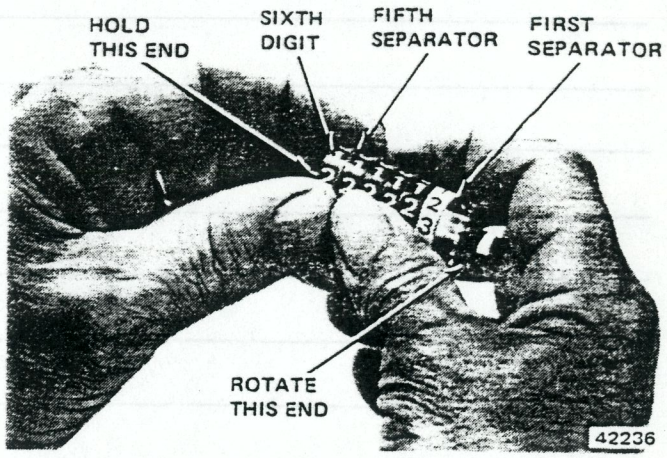

Fig. 3C-6 Advancing Odometer Reading (for Replacement Only)

Speedometer Head Replacement

Speedometer head replacement includes resetting the replacement odometer to the same mileage as the one removed, unless such setting conflicts with local ordinances.

(1) Remove cluster.

(2) Remove printed circuit board attaching screws and separate cluster case from bezel.

(3) Remove two speedometer attaching screws and speedometer.

(4) Remove odometer retaining clip.

(5) Remove odometer.

(6) Install odometer assembly.

NOTE: *Check anti-backup spring for proper positioning.*

(7) Install retaining spring clip.

(8) Install speedometer head.

(9) Install printed circuit board.

(10) Install cluster.

Odometer Setting Procedure

This procedure applies with the odometer removed from the speedometer head. Refer to figure 3C-6.

Hold the fifth separator and rotate the last five numerals in their normal direction until the desired sixth digit is obtained. When the desired sixth digit is obtained, align the fourth separator in line with the fifth separator. Rotate the last four numerals, repeating the process until the desired total mileage is obtained. When installing the odometer, the separators must straddle a cross bar to maintain proper number alignment.

Speedometer Cable Inspection

Visually inspect cable for breaks, kinks, cracks, burns, or other physical damage. Remove core from cable assembly and place on a flat surface in the form of an inverted U and then cross the open ends. Hold one end in the left hand, the other in the right hand. Twist one end, applying light finger pressure to the other end. If the core is satisfactory, the turning action will be smooth. A damaged core will react by jumping about on a flat surface.

The speedometer cable requires graphite grease for lubrication.

CLOCK

The clock is attached to the instrument panel with two nuts.

If the vehicle is not equipped with air conditioning, the clock may be removed by reaching behind the instrument panel and removing the nuts.

If the vehicle is equipped with air conditioning, access to the clock can be obtained by removing the glove box liner attaching screws and pulling down the top portion.

To reset the quartz clock, press left side of rocker bar to set hours. Press right side of rocker bar to set minutes.

CIGAR LIGHTER

The cigar lighter is mounted to the instrument panel on all models.

The lighter can be removed by disconnecting the battery feed wire and unscrewing the shell that surrounds the lighter.

The lighter circuit is protected with a 10-amp fuse located at the fuse panel.

NOTES

HEATER 3D

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CJ HEATER

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GENERAL

The blend-air type heater and defroster system is used on all CJ vehicles. The blend-air method of heating uses a constant flow system with engine coolant continuously flowing through the heater core. The temperature of the heated air entering the passenger compartment is controlled by regulating the quantity of air which flows through the heater core air passages, then blending it with a controlled amount of cool, fresh air which bypasses the heater core. System controls and operation are described in this section.

When servicing a malfunctioning heater system, refer to the Service Diagnosis for a list of the possible causes and recommended service procedures.

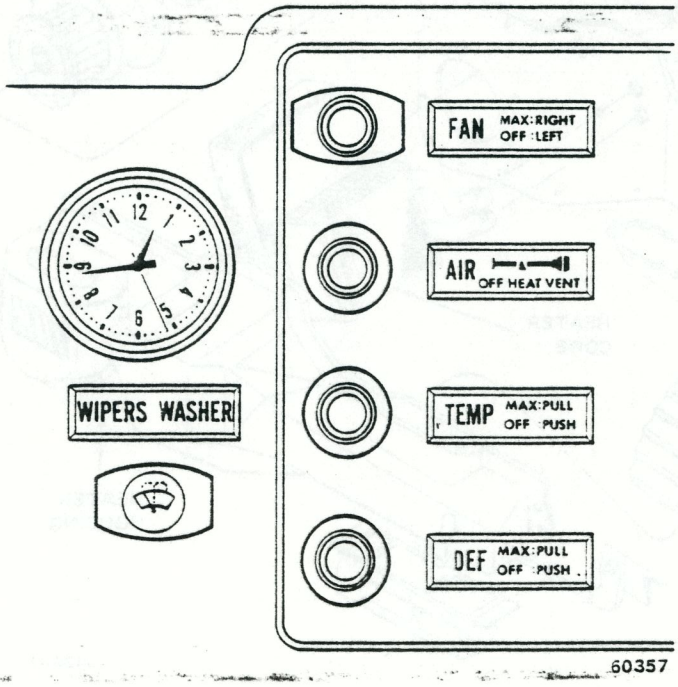

Fig. 3D-1 Heater and Defroster Controls

SYSTEM CONTROLS

The heater and defroster controls consist of a fan control switch and three push-pull knobs and cable assemblies which are located on the instrument panel (fig. 3D-1).

The air control is a dual function control. When the control is pulled to the first position (Heat), it opens a door in the fresh air inlet to allow air to enter the heater. When the control is pulled completely out (Vent), it opens two additional doors (one in the left end of the fresh air inlet and one on the right side of the heater) to allow fresh air to enter the passenger compartment. A new fresh air duct has been added to direct fresh air to the driver's side.

The defrost control knob operates a door in the heater housing which regulates heater and defroster operation by directing the flow of air through the defroster hose or floor outlet.

The temperature control knob adjusts the amount of airflow around the heater core and through the heater core air passages. This regulates the degree of heat entering the passenger compartment.

The fan control is a four-position control switch (Off, Low, Med and High), which regulates the blower motor and airflow for heat and defrost.

HEATER AND DEFROSTER OPERATION

The heater is part of the engine cooling system and depends on normal engine operating temperature and airflow through the cowl fresh air intake to heat the interior of the vehicle. During heater operation, close the fresh air vent.

The air control knob operates a door in the fresh air intake duct which allows air to enter the heater housing. When the knob is pushed in, no air will enter the heater. As the knob is pulled out to the first position (Heat), the door opens, allowing airflow to the heater. The air control knob must be pulled to the Heat position to operate the heater.

The temperature control knob operates the blend air door in the heater housing (fig. 3D-2). At the full out position, all air is directed through the heater core, providing maximum heat flow. At the full in position, all air is directed around the heater core, providing unheated fresh air. Any in-between position of the control allows a blend of cool, fresh outside air and heated air. The defrost control knob must be pushed in for the blended air to enter through the floor heat duct. When the defrost control knob is pulled out completely, all airflow will be directed through the defroster hose and onto the windshield. Any in-between position of the defrost control divides the airflow between the defroster hose and the floor heat duct.

If additional airflow is required, the blower motor should be operated at one of the three available speeds.

FRESH AIR VENTILATION

The fresh air ventilating system directs outside air through the air inlet to a door in the left end of the air inlet to provide air to the driver's side and also through a door on the right side of the heater to provide air to the passenger side. These doors are cable and linkage controlled. When the air control knob is pulled all the way out to the vent position, the driver's vent door is opened by linkage on the air inlet and the passenger vent door is opened by a cable that is attached to the linkage on the air inlet. When the air control is pushed in, no air will enter the vehicle.

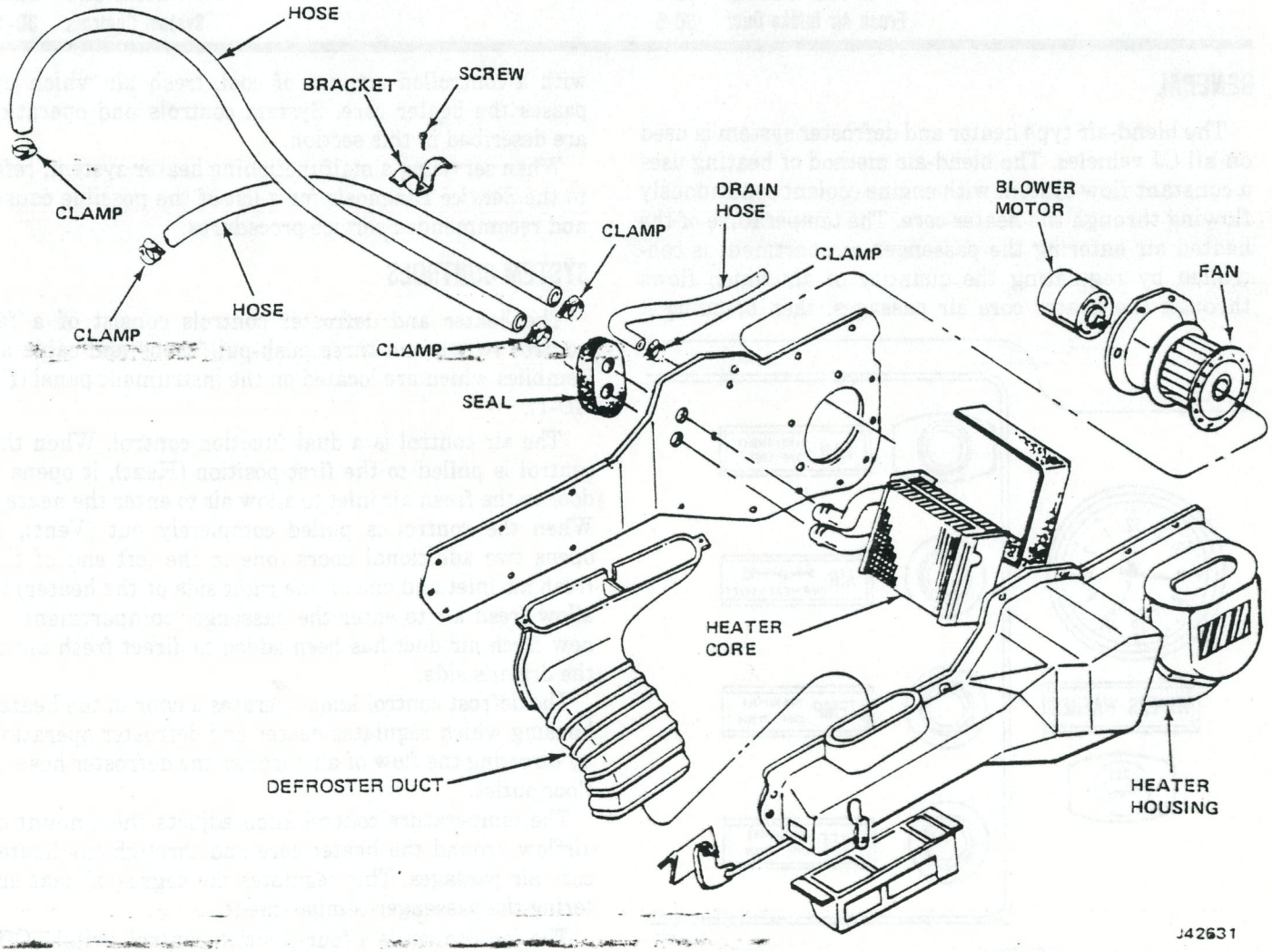

Fig. 3D-2 Heater and Defroster Components

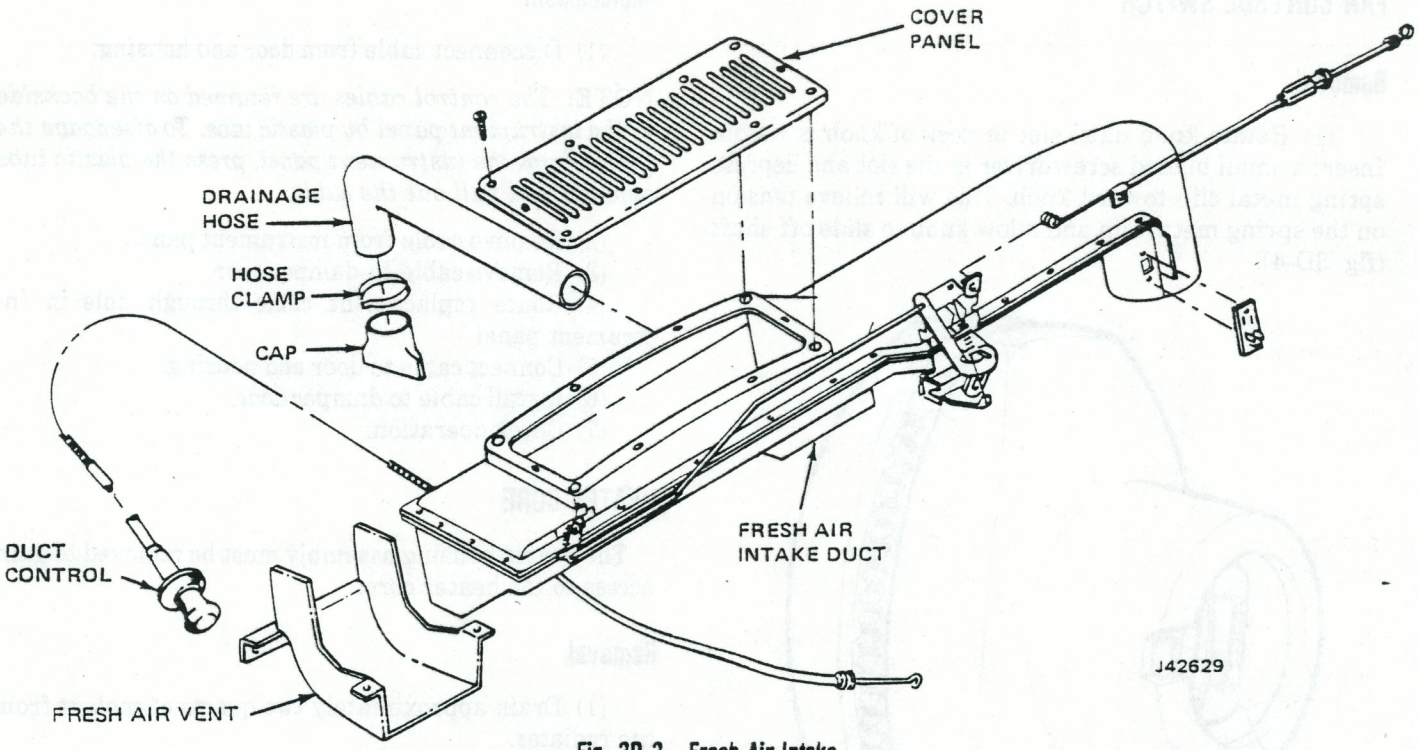

Fig. 3D-3 Fresh Air Intake

Service Diagnosis

Condition	Possible Cause	Correction
FAN MOTOR WILL NOT RUN AT ANY SPEED	(1) Blown fuse	(1) Replace fuse
	(2) Loose connection	(2) Inspect and tighten
	(3) Poor ground	(3) Clean and tighten
	(4) Faulty switch	(4) Replace switch
	(5) Faulty motor	(5) Replace motor
	(6) Faulty resistor	(6) Replace resistor
FAN MOTOR RUNS AT ONE SPEED ONLY	(1) Faulty switch	(1) Replace switch
	(2) Faulty resistor	(2) Replace resistor
FAN RUNS BUT DOES NOT CIRCULATE AIR	(1) Intake blocked	(1) Clean intake
	(2) Fan not secured to motor shaft	(2) Tighten securely
HEATER WILL NOT HEAT	(1) Coolant does not reach proper temperature	(1) Check and replace thermostat if necessary
	(2) Heater core blocked internally	(2) Flush or replace core if necessary
	(3) Heater core air-bound	(3) Purge air from core
	(4) Blend-air door not in proper position	(4) Adjust cable
WILL NOT DEFROST	(1) Control cable adjustment incorrect	(1) Adjust control cable
	(2) Defroster hose damaged	(2) Replace defroster hose

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FAN CONTROL SWITCH

Removal

(1) Rotate knob until slot in neck of knob is visible. Insert a small bladed screwdriver in the slot and depress spring metal clip toward knob. This will relieve tension on the spring metal clip and allow knob to slide off shaft (fig. 3D-4).

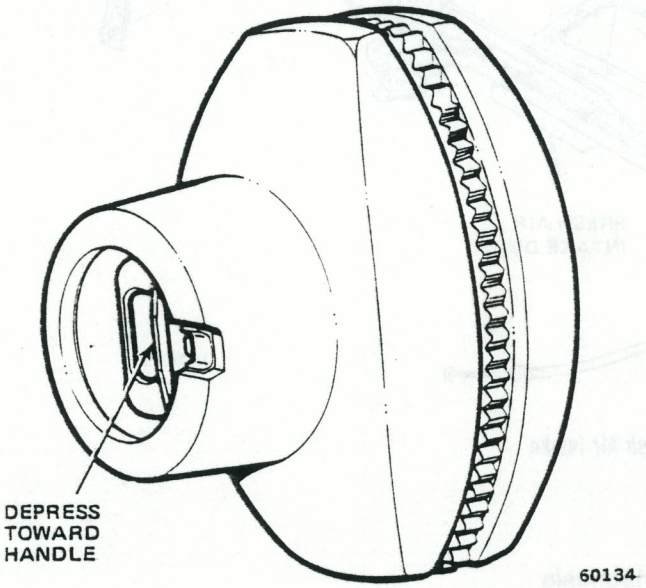

Fig. 3D-4 Fan Control Knob Locking Feature

(2) Remove retaining nut and trim ring.
(3) Remove switch from instrument panel and disconnect wires.

Installation

(1) Connect wires and position switch in instrumentpanel.
(2) Install trim ring and retaining nut.
(3) Install control knob.

CONTROL CABLES

Adjustment

The only cable that is adjustable is the cable from the air inlet linkage to the passenger vent door at the right side of the heater. This cable has a turnbuckle adjustment located approximately six inches above the cable attachment to the right side of the heater. Adjust this cable until the passenger vent door is closed when the air control knob is pushed in.

NOTE: *If the cable is adjusted beyond the closed door position it will cause a bind in the linkage and may prevent the driver's vent door from closing.*

Replacement

(1) Disconnect cable from door and housing.

NOTE: *The control cables are retained on the backside of the instrument panel by plastic tabs. To disengage the cables from the instrument panel, press the plastic tabs together and pull out the cable.*

(2) Remove cable from instrument panel.
(3) Remove cable-to-damper door.
(4) Route replacement cable through hole in instrument panel
(5) Connect cable to door and housing.
(6) Install cable to damper door.
(7) Check operation.

HEATER CORE

The heater housing assembly must be removed to gain access to the heater core.

Removal

(1) Drain approximately two quarts of coolant from the radiator.
(2) Disconnect heater hoses.
(3) Disconnect damper door control cables.
(4) Disconnect blower motor wire.
(5) Disconnect water drain hose and defroster hose.
(6) Remove nuts from heater housing studs in engine compartment.
(7) Remove heater housing assembly by tilting down to disengage from air inlet duct and pulling to the rear of the vehicle.
(8) Remove heater core from heater housing.

Installation

(1) Install heater core in housing.
(2) Position heater core housing and install attaching nuts.

NOTE: *Make sure that the seals around the core pipes and blower motor are in position before installing the heater to the dash panel. Do not over-torque the heater to dash panel nuts as this can cause distortion of the heater assembly. Tighten until two threads are visible beyond the nut.*

(3) Connect water drain hose and defroster hose.
(4) Connect blower motor wire.
(5) Connect and adjust damper door control cables.
(6) Connect heater hoses.
(7) Replace coolant.
(8) Check heater operation.

BLOWER MOTOR

The heater housing assembly must be removed to replace the blower motor.

Removal

(1) Remove heater assembly as outlined above.
(2) Remove blower motor assembly-to-heater housing attaching screws and remove blower motor assembly.

Installation

(1) Position blower motor assembly to heater housing and install attaching screws.
(2) Reinstall heater assembly as outlined above.
(3) Check blower motor and heater control operation.

DEFROSTER DUCT

Removal

(1) Disconnect negative battery cable.
(2) Drain two quarts of antifreeze from radiator.
(3) Remove heater hoses.
(4) Remove drain tube from heater housing.
(5) Remove screws attaching evaporator housing to instrument panel and lower housing.
(6) Disconnect wiring from A/C switch.
(7) Remove screw attaching heater motor housing to bracket.
(8) Remove nuts attaching heater housing-to-dash panel from engine compartment.
(9) Disconnnect speedometer cable.
(10) Remove glove box.
(11) Tilt heater housing assembly back and pull to rear and lower housing.
(12) Disconnect heater control cables.
(13) Remove fresh air cover panel from cowl.
(14) Remove fresh air intake duct assembly.
(15) Lower windshield.
(16) Remove screws from defroster duct and remove defroster duct and tube.

Installation

(1) Position defroster duct and install attaching screws and tube.
(2) Raise windshield and secure.
(3) Install fresh air intake duct assembly.
(4) Install fresh air cover panel on cowl.
(5) Install heater control cables.
(6) Position heater housing assembly on dash panel.
(7) Install nuts attaching heater housing to dash panel.
(8) Install glove box.
(9) Install speedometer cable.
(10) Install screw attaching heater housing to bracket.
(11) Connect wiring to A/C switch.
(12) Install evaporator housing to instrument panel.
(13) Connect drain tube to heater housing.
(14) Connect heater hoses.
(15) Refill radiator.
(16) Connect negative battery cable.

FRESH AIR INTAKE DUCT

Removal

(1) Disconnect negative battery cable.
(2) Drain two quarts of antifreeze from radiator.
(3) Remove heater hoses.
(4) Remove drain tube from heater housing.
(5) Remove screws attaching evaporator housing to instrument panel and lower housing.
(6) Disconnect wiring from A/C switch.
(7) Remove screw attaching heater motor housing to bracket.
(8) Remove nuts attaching heater housing to dash panel from engine compartment.
(9) Disconnnect speedometer cable.
(10) Remove glove box.
(11) Tilt heater housing assembly back and pull to the rear a lower housing.
(12) Disconnect heater control cables.
(13) Remove fresh air cover panel from cowl.
(14) Remove fresh air intake duct assembly.

Installation

(1) Position defroster duct and install attaching screws and tube.
(2) Raise windshield and secure.
(3) Install fresh air intake duct assembly.
(4) Install fresh air cover panel on cowl.
(5) Install heater control cables.
(6) Position heater housing assembly on dash panel.
(7) Install nuts attaching heater housing to dash panel.
(8) Install glove box.
(9) Install speedometer cable.
(10) Install screw attaching heater housing to bracket.
(11) Connect wiring to A/C switch.
(12) Install evaporator housing to instrument panel.
(13) Connect drain tube to heater housing.
(14) Connect heater hoses.
(15) Refill radiator.
(16) Connect negative battery cable.

CHEROKEE - WAGONEER - TRUCK HEATER

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GENERAL

The blend-air type heater and defroster system is used on all Cherokee, Wagoneer and Truck models. The blend-air method of heating uses a constant flow system with engine coolant continuously flowing through the heater core. The temperature of the heated air entering the passenger compartment is controlled by regulating the quantity of air which flows through the heater core air passages, then blending it with a controlled amount of cool, fresh air which bypasses the heater core. System controls and operation are described in this section.

When servicing a malfunctioning heater system, refer to the Service Diagnosis for a list of the possible causes and recommended service procedures.

SYSTEM CONTROLS

The heater and defroster controls consists of a fan control switch, a vacuum control switch operated by three pushbuttons, and a slide temperature control lever (fig. 3D-5).

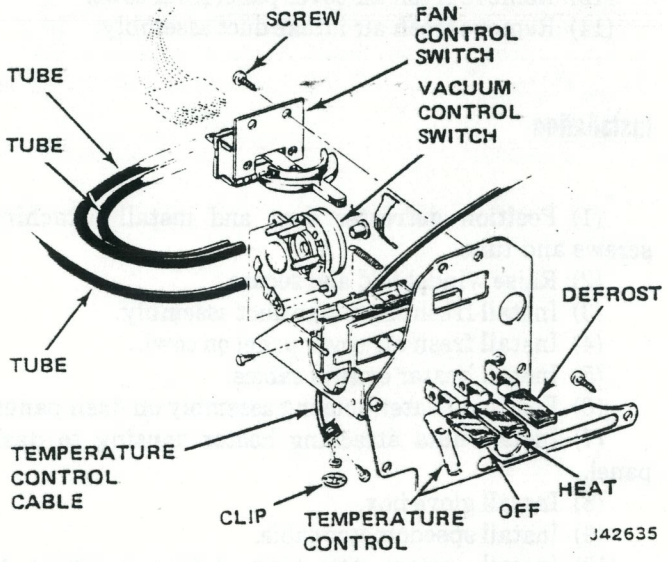

Fig. 3D-5 Heater and Defroster Controls

The three pushbuttons manually operate the vacuum control switch which directs vacuum to two vacuum motors, controlling airflow and point of air distribution.

The temperature control lever adjusts the amount of airflow around the heater core and through the heater core air passages. This regulates the degree of heat entering the passenger compartment.

The fan control is a four-position control switch (Off, Low, Medium, and High), which regulates the blower motor and airflow for heat, defrost, and fresh air ventilation.

There has been a vacuum storage tank added to prevent the heater doors from closing on acceleration and is located in the engine compartment in the center of dash panel.

HEATER AND DEFROSTER OPERATION

The heater is part of the engine cooling system and depends on normal engine operating temperature and airflow through the cowl fresh air intake to heat the interior of the vehicle. During heater operation, close the fresh air vents.

The Off, Heat and Def buttons (fig. 3D-5) on the heater control panel operate a vacuum control switch which controls two vacuum motors. When the off button is pressed, the vacuum switch shuts off vacuum to the air inlet door vacuum motor. A spring closes this door, preventing any outside air from entering the heater (fig. 3D-6).

When the Heat button is pressed, the air inlet door is opened by the air inlet vacuum motor and air will flow through the heat transition housing and out of the floor heat distributor.

When the Def button is pressed, the vacuum switch directs vacuum to the defrost vacuum motor, which closes the door to the floor heat distributor. Airflow is then directed through the defroster hoses onto the windshield. The air inlet door remains open to allow airflow through the heat transition housing.

The Temperature control lever operates the blend air door in the heater core housing. At the full right position, all air is directed through the heater core providing maximum heat flow. At the full left position, all air is directed around the heater core providing unheated fresh air. The temperature control lever may be placed in any in-between position to provide a blend of cool, fresh, outside air and heater air. However, either the Heat or Def button must be pressed before any air can enter the vehicle.

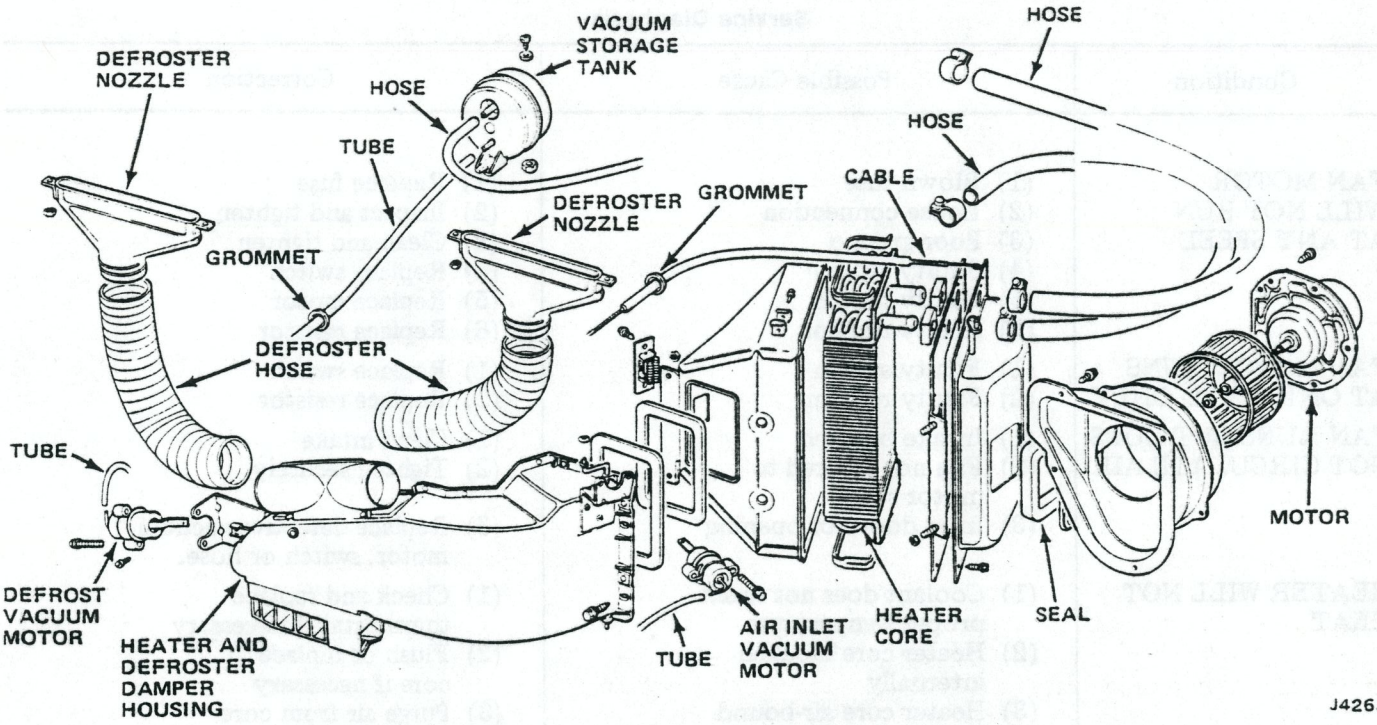

Fig. 3D-6 Heater and Defroster

If additional airflow is required, the blower motor should be operated at one of the three available speeds.

FRESH AIR VENTILATION

The ventilating system has two fresh air vents, one in the right cowl trim panel and one in the left cowl trim panel (fig. 3D-7). Both vents are cable controlled with the control knobs mounted on the instrument panel to the right and left of the steering column.

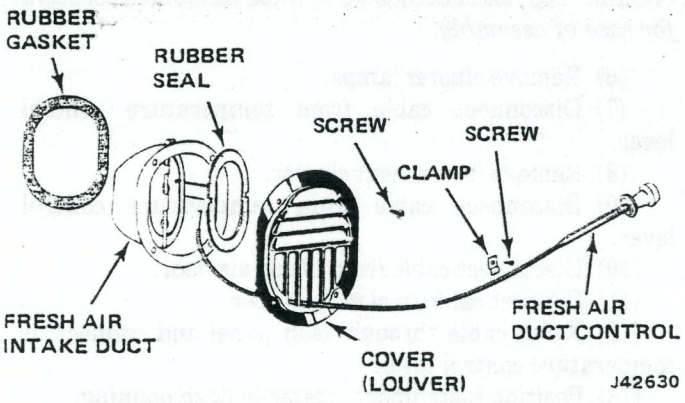

Fig. 3D-7 Fresh Air Intake Duct and Control

HEATER CONTROL PANEL

Removal

(1) Disconnect battery negative cable.
(2) Remove instrument cluster retaining screws.
(3) Disconnect speedometer cable.
(4) Disconnect electrical connectors from cluster.
(5) Disconnect vacuum hoses from vacuum control switch.

NOTE: *Tag hoses according to their numbered location for ease of assembly.*

(6) Remove cluster lamps.
(7) Disconnect cable from temperature control lever.
(8) Remove instrument cluster.
(9) Remove heater and defroster control attaching screws and remove control from cluster.
(10) Remove fan control switch attaching screws and remove switch.

Installation

(1) Install fan control switch.
(2) Install heater and defroster control to cluster.
(3) Position instrument cluster in dash opening.
(4) Install cluster lamps.
(5) Connect cable to temperature control lever.
(6) Connect vacuum hoses.
(a) Number 1 on vacuum control switch goes to defroster vacuum motor.
(b) Number 3 on vacuum control switch goes to vacuum storage tank.
(c) Number 4 on vacuum control switch goes to air inlet door vacuum motor.
(7) Connect cluster electrical connectors.
(8) Connect speedometer cable.
(9) Install cluster retaining screws.
(10) Connect battery negative cable.
(11) Check heater, defroster and fan operation.

Service Diagnosis

Condition	Possible Cause	Correction
FAN MOTOR WILL NOT RUN AT ANY SPEED	(1) Blown fuse	(1) Replace fuse
	(2) Loose connection	(2) Inspect and tighten
	(3) Poor ground	(3) Clean and tighten
	(4) Faulty switch	(4) Replace switch
	(5) Faulty motor	(5) Replace motor
	(6) Faulty resistor	(6) Replace resistor
FAN MOTOR RUNS AT ONE SPEED ONLY	(1) Faulty switch	(1) Replace switch
	(2) Faulty resistor	(2) Replace resistor
FAN RUNS BUT DOES NOT CIRCULATE AIR	(1) Intake blocked	(1) Clean intake
	(2) Fan not secured to motor shaft	(2) Tighten securely
	(3) Inlet door not opening	(3) Replace defective vacuum motor, switch or hose.
HEATER WILL NOT HEAT	(1) Coolant does not reach proper temperature	(1) Check and replace thermostat if necessary
	(2) Heater core blocked internally	(2) Flush or replace core if necessary
	(3) Heater core air-bound	(3) Purge air from core
	(4) Blend-air door not in proper position	(4) Adjust cable
WILL NOT DEFROST	(1) Vacuum motor not operating	(1) Check for engine vacuum at vacuum motor
	(2) Vacuum control switch inoperative	(2) Check for engine vacuum at switch
	(3) Defroster hose damaged	(3) Replace defroster hose

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CONTROL CABLE

Adjustment

The blend-air door control cable is equipped with a turnbuckle to simplify adjustment. The turnbuckle is located in the engine compartment close to the vacuum can.

(1) Rotate turnbuckle counterclockwise to obtain complete closing of the blend-air door when the temperature control lever is in the far left Cool position.

(2) Check blend-air door operation by moving temperature control lever-to-be the Warm position and back to the Cool position. Adjust cabel if necessary.

Replacement

(1) Disconnect battery negative cable.
(2) Remove instrument cluster retaining screws.
(3) Disconnect speedometer cable.
(4) Disconnect electrical connectors from cluster.
(5) Disconnect vacuum hoses from vacuum control switch.

NOTE: *Tag hoses according to their numbered location for ease of assembly.*

(6) Remove cluster lamps.
(7) Disconnect cable from temperature control lever.
(8) Remove instrument cluster.
(9) Disconnect cable from temperature control lever.
(10) Disconnect cable from blend-air door.
(11) Connect cable to blend-air door.
(12) Route cable through dash panel and connect to temperature control lever.
(13) Position instrument cluster in dash opening.
(14) Install cluster lamps.
(15) Connect cable to temperature control lever.
(16) Connect vacuum hoses.
(a) Number 1 on vacuum control switch goes to defroster vacuum motor.
(b) Number 3 on vacuum control switch goes to vacuum storage tank.
(c) Number 4 on vacuum control switch goes to air inlet door vacuum motor.

(17) Connect cluster electrical connectors.
(18) Connect speedometer cable.
(19) Install cluster retaining screws.
(20) Connect battery negative cable.
(21) Check heater, defroster and fan operation.
(22) Adjust cable.
(23) Check cable operation.

HEATER CORE

Removal

(1) Drain approximately two quarts of coolant from radiator.
(2) Disconnect temperature control cable from blend-air door.
(3) Disconnect heater hoses at heater core.
(4) Disconnect blower motor resistor wires.
(5) Remove heater core housing to dash panel attaching nuts.
(6) Remove heater core housing assembly.
(7) Remove attaching screws holding housing halves together and separate housing.
(8) Remove heater core to housing attaching screws and remove core.

Installation

(1) Position heater core in housing and install attaching screws.
(2) Seal and assemble two halves of heater core housing and install attaching screws.
(3) Position heater core housing on dash panel and install attaching nuts.
(4) Connect heater resistor wires.
(5) Connect heater hoses.
(6) Connect temperature control cable to blend air door.
(7) Replace coolant.
(8) Check heater operation.

BLOWER MOTOR

Removal

(1) Disconnect blower motor electrical connector.
(2) Remove blower motor-to-blower motor housing attaching screws and remove blower motor and fan assembly.

Installation

(1) Position blower motor and fan assembly on blower motor housing and install attaching screws.
(2) Connect blower motor electrical connector.
(3) Check blower motor operation.

NOTES

AIR CONDITIONING 3E

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CJ AIR CONDITIONING

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GENERAL

When driving at normal highway speeds the CJ air conditioning system (fig. 3E-1) will provide maximum efficiency. However, when operating under stop-and-go city driving conditions, a slight reduction in cooling efficiency generally will be experienced.

It is recommended that intermediate temperature and high fan setting be used for average city driving and intermediate temperature and medium fan setting for highway driving.

When driving at relatively high speed for an extended period of time, the cooling coil may possibly frost over, resulting in a temporary loss of cooling. Should this occur, simply turn the TEMP knob to OFF and allow the blower to operate for a few minutes to allow the cooling coil to defrost. Then turn the TEMP knob to a setting which is not as cold as the setting at which frosting occurred.

To maintain maximum cooling efficiency, periodically remove bugs and foreign matter from the condenser and radiator fins. DO NOT install a bug screen or other screen material in front of the condenser and radiator.

Water forming under a vehicle, at a point below the cooling case, is condensation water draining from the system and is considered normal.

The engine temperature gauge pointer will indicate a slightly higher than normal temperature when the air conditioning system is operating. However, should excessive overheating occur, check the condition of all water hoses, check the radiator for rust or scaling conditions, and make sure that the condenser is free of bugs or other foreign matter.

The air conditioner also can be used for fast, efficient defogging of windows during cool, damp weather.

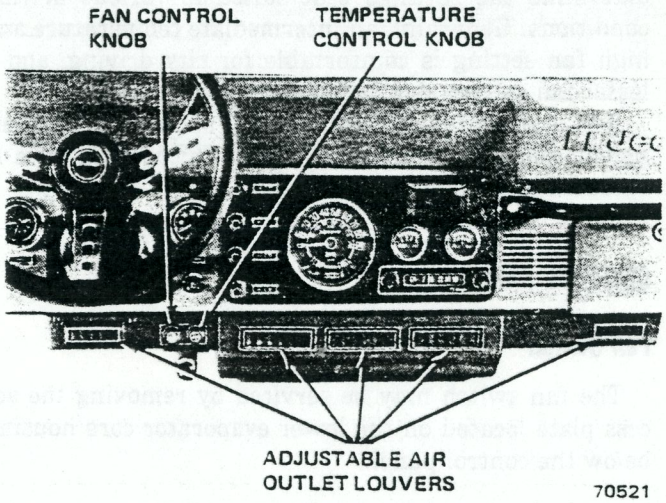

Fig. 3E-1 Air Conditioner—CJ

The condenser is mounted ahead of the radiator and the remaining components are in the engine compartment.

The compressor is a two-cylinder, belt-driven pump. An electromagnetic clutch couples the compressor to the drive pulley. The drive pulley freewheels when the air conditioner is not in use.

The start position on the ignition switch automatically disconnects all accessories, including the air conditioner, to reduce battery load and provide easier starting.

CONTROL OPERATION

For fast, maximum efficiency, purge the vehicle of hot air by driving the equivalent of two or three city blocks with at least one window open. During this time, place the TEMP control in the MAX position and the FAN control in the HI position. This permits the evaporator to precool in hot weather.

Adjust the air outlets to obtain desired airflow distribution by moving the louver levers left, right, up, or down. Airflow can be adjusted for quick delivery to a specific spot or for gentle diffusion of air throughout the vehicle.

When the interior of the vehicle has cooled to the desired temperature, the FAN knob may be set to obtain the desired volume of air from the air outlets. The TEMP knob may be rotated to vary the temperature. It may be necessary to experiment with the TEMP knob to determine the settings best suited to various driving conditions. Generally, an intermediate temperature and high fan setting is comfortable for city driving, and a lesser fan setting comfortable for open road driving.

Run the engine well above idle speed for more efficient cooling under conditions in which the system is operated with the vehicle standing.

CONTROL PANEL

Fan Switch

The fan switch may be serviced by removing the access plate located on the lower evaporator core housing below the control panel.

Temperature Control Thermostat

To service the temperature control thermostat, the evaporator core housing must be disassembled.

When installing a replacement temperature control thermostat, insert the capillary tube into the evaporator coil a minimum of two inches (fig. 3E-2).

CAUTION: *Handle the tube with care to avoid bends or kinks which could cause the thermostat to malfunction.*

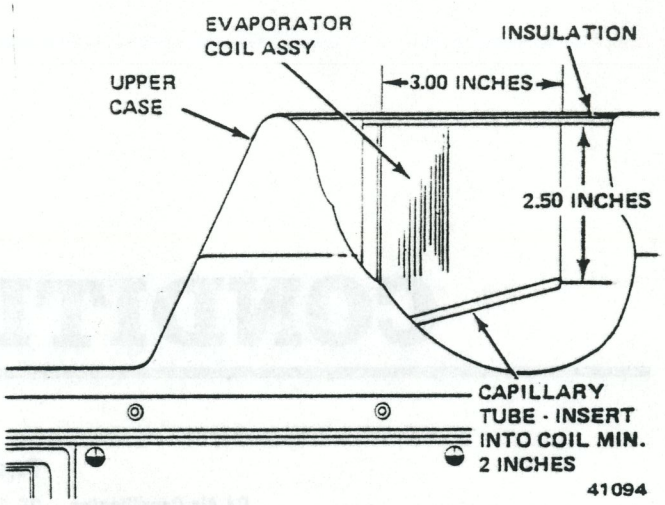

Fig. 3E-2 Capillary Tube Position

CONDENSER AND RECEIVER/DRYER ASSEMBLY

Removal

(1) Discharge refrigerant from system as described in General Information section of this chapter.

NOTE: *Discharge system slowly to prevent loss of compressor oil.*

(2) Drain radiator.
(3) Remove fan shroud and radiator.
(4) Disconnect pressure line at condenser.
(5) Remove condenser attaching screws and tilt bottom of condenser toward engine.

NOTE: *Plug all open connections to prevent entry of dirt and moisture.*

(6) From underside of vehicle, disconnect receiver/dryer-to-evaporator hose at receiver/dryer.
(7) Remove condenser and receiver/dryer assembly.
(8) Remove receiver/dryer from condenser, if necessary.

Installation

(1) If removed, install receiver/dryer to condenser.
(2) Place condenser in position and connect receiver/dryer-to-evaporator hose at receiver/dryer.
(3) Install condenser attaching screws.
(4) Connect pressure line at condenser.
(5) Install radiator and fan shroud.
(6) Fill radiator.
(7) Evacuate, leak test, and charge system as described in General Information section of this chapter.

RECEIVER/DRYER

Removal

(1) Discharge refrigerant from system as described in General Information section of this chapter.

NOTE: *Discharge system slowly to prevent loss of compressor oil.*

(2) Disconnect evaporator and condenser lines from receiver/dryer.

(3) Remove attaching screws from receiver/dryer bracket and remove receiver/dryer.

Installation

(1) Install receiver/dryer to support bracket.

(2) Install evaporator and condenser line to receiver/dryer.

(3) Evacuate, charge system and leak test as described in General Information section of this chapter.

EVAPORATOR HOUSING ASSEMBLY

Removal

(1) Discharge system as described in General Information section of this chapter.

(2) Disconnect inlet (suction) line at compressor.

(3) Disconnect receiver/dryer-to-evaporator hose.

(4) Remove hose clamps and dash grommet retaining screws.

(5) Remove evaporator housing-to-instrument panel attaching screws and the evaporator housing-to-mounting bracket screw (fig. 3E-3).

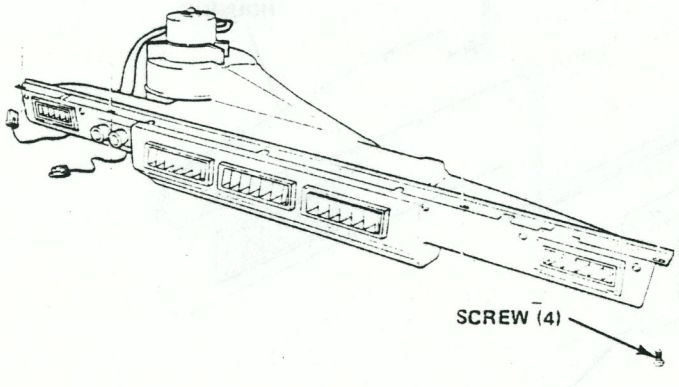

Fig. 3E-3 Evaporator Housing Mounting—CJ

(6) Lower evaporator housing and pull hoses and grommet through opening.

The blower motor, blower motor housing, and evaporator core may be serviced after the evaporator housing is removed (fig. 3E-4).

NOTE: *It is not necessary to discharge the system to service the blower motor. The evaporator housing may be lowered from the instrument panel to gain access to the blower motor attaching screws.*

Installation

(1) Push hoses through grommet opening, and install grommet by pushing toward engine compartment of vehicle and fasten to dash panel with two attaching screws.

(2) Raise evaporator and install evaporator housing-to-instrument-panel attaching screws and the evaporator-to-mounting bracket screw.

(3) Install hose clamps and grommet attaching screws.

(4) Connect receiver/dryer-to-evaporator hose.

(5) Connect inlet (suction) line to compressor.

(6) Evacuate, leak test, and charge system as described in General Information section of this chapter.

EXPANSION VALVE SERVICE

The valve is preset and should not be adjusted. A defective valve requires replacement.

(1) Discharge system as described in General Information section of this chapter.

(2) Remove evaporator housing assembly.

(3) Remove insulation wrapped around suction line and expansion valve. Mark capillary tube location on suction line.

(4) Disconnect inlet and outlet connections, capillary tube clamp, and equalizer tube.

(5) Remove expansion valve.

(6) Clean suction line to provide a positive contact with replacement expansion valve capillary tube.

(7) Connect inlet and outlet hoses. Clamp capillary tube at marked position and connect equalizer tube.

NOTE: *Clamp capillary tube securely so that a firm contact with the suction line is formed.*

(8) Wrap expansion valve and line with insulation.

(9) Install evaporator housing assembly.

(10) Evacuate, leak test, and charge system as described in General Information section of this chapter.

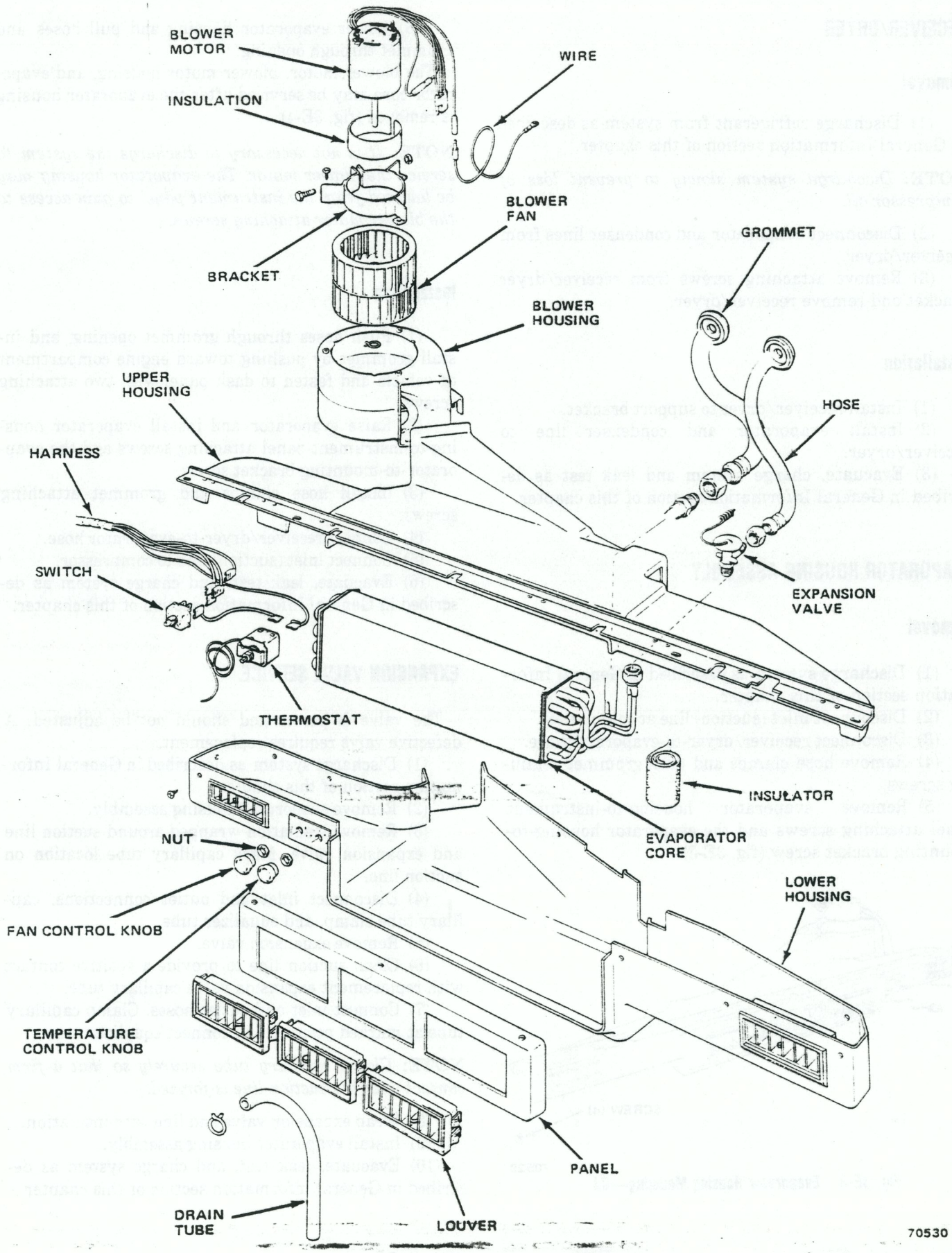

Fig. 3E-4 Evaporator Housing Assembly—CJ

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GENERAL

When driving at normal highway speeds the Jeep air conditioning system will provide maximum efficiency. However, when operating under stop-and-go city driving conditions a slight reduction in cooling efficiency generally will be experienced.

It is recommended that intermediate temperature and high fan setting be used for average city driving and intermediate temperature and medium fan setting for highway driving.

The air conditioning system, as shown for the Wagoneer in figure 3E-5, is applicable to Cherokee and Truck models.

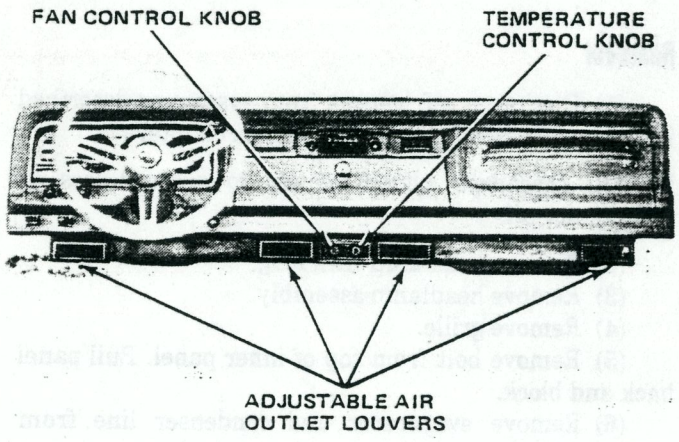

Fig. 3E-5 Air Conditioner—Cherokee-Wagoneer-Truck Models

When driving at relatively high speed for an extended period of time, the cooling coil may possibly frost over, resulting in a temporary loss of cooling. Should this occur, simply turn the TEMP knob to OFF and allow the blower to operate for a few minutes to allow the cooling coil to defrost. Then turn the TEMP knob to a setting which is not as cold as the setting at which frosting occurred.

To maintain maximum cooling efficiency, periodically remove bugs and foreign matter from the condenser and radiator fins. DO NOT install a bug screen or other screen material in front of the condenser and radiator.

Water forming under a vehicle, at a point below the cooling case, is condensation water draining from the system and is considered normal.

The engine temperature gauge pointer will indicate a slightly higher than normal temperature when the air conditioning system is operating. However, should excessive overheating occur, check the condition of all water hoses, check the radiator for rust or scaling conditions, and make sure that the condenser is free of bugs or other foreign matter.

The air conditioner also can be used for fast, efficient defogging of windows during cool, damp weather.

The condenser is mounted ahead of the radiator and the remaining components are in the engine compartment.

The compressor is a two-cylinder, belt-driven pump. An electromagnetic clutch couples the compressor to the drive pulley. The drive pulley freewheels when the air conditioner is not in use.

The start position on the ignition switch automatically disconnects all accessories, including the air conditioner, to reduce battery load and provide easier starting.

CONTROL OPERATION

For fast, maximum efficiency, purge the vehicle of hot air by driving the equivalent of two or three city blocks with at least one window open. During this time, place the TEMP control in the MAX position and the FAN control in the HI or PC position. This permits the evaporator to precool in hot weather.

CAUTION: *Do not leave fan control on PC for longer than 30 seconds. Move the fan control to HI position and raise all windows.*

Adjust the air outlets to obtain desired airflow distribution by moving the louver levers left, right, up, or down. Airflow can be adjusted for quick delivery to a specific spot or for gentle diffusion of air throughout the vehicle.

When the interior of the vehicle has cooled to the desired temperature, the FAN knob may be set to obtain the desired volume of air from the air outlets. The TEMP knob may be rotated to vary the temperature. It may be necessary to experiment with the TEMP knob to determine the settings best suited to various driving

conditions. Generally, an intermediate temperature and high fan setting is comfortable for city driving, and a lesser fan setting comfortable for open road driving.

Run the engine well above idle speed for more efficient cooling under conditions in which the system is operated with the vehicle standing.

CONTROL PANEL

Fan Switch

The fan switch may be serviced by removing the access plate located on the lower evaporator core housing below the control panel.

Temperature Control Thermostat

To service the temperature control thermostat, the evaporator core housing must be disassembled.

When installing a new temperature control thermostat, insert the capillary tube into the evaporator coil a minimum of two inches (fig. 3E-6).

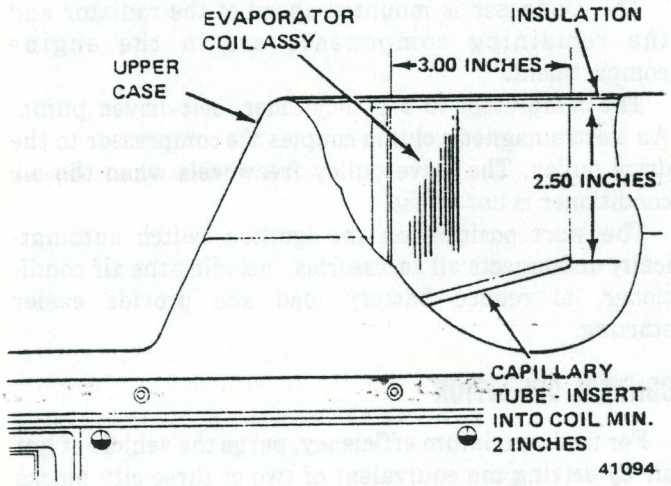

Fig. 3E-6 Capillary Tube Position

CAUTION: *Handle the tube with care to avoid bends or kinks which could cause the thermostat to malfunction.*

CONDENSER AND RECEIVER/DRYER ASSEMBLY

Removal

(1) Discharge refrigerant from system as described in General Information section of this chapter.

NOTE: *Discharge system slowly to prevent loss of compressor oil.*

(2) Drain radiator.

(3) Remove fan shroud and radiator.

(4) Disconnect pressure line at condenser.

(5) Remove condenser attaching screws and tilt bottom of condenser toward engine.

NOTE: *Plug all open connections to prevent entry of dirt and moisture.*

(6) From underside of vehicle, disconnect receiver/dryer-to-evaporator hose at receiver/dryer.

(7) Remove condenser and receiver/dryer assembly.

(8) Remove receiver/dryer from condenser, if necessary.

Installation

(1) If removed, install receiver/dryer to condenser.

(2) Place condenser in position and connect receiver/dryer-to-evaporator hose at receiver/dryer.

(3) Install condenser attaching screws.

(4) Connect pressure line at condenser.

(5) Install radiator and fan shroud.

(6) Fill radiator.

(7) Evacuate, leak test, and charge system as described in General Information section of this chapter.

RECEIVER/DRYER

Removal

(1) Discharge refrigerant from system as described in General Information section of this chapter.

NOTE: *Discharge system slowly to prevent loss of compressor oil.*

(2) Remove headlamp trim ring.

(3) Remove headlamp assembly.

(4) Remove grille.

(5) Remove bolt from top of inner panel. Pull panel back and block.

(6) Remove evaporator and condenser line from receiver/dryer.

(7) Remove screws from receiver/dryer bracket and remove receiver/dryer.

Installation

(1) Install receiver/dryer to radiator support bracket.

(2) Install evaporator and condenser lines to receiver/dryer.

(3) Remove block and install inner panel bolt.

(4) Install grille.

(5) Install headlamp assembly.

(6) Install headlamp trim ring.

(7) Evacuate, charge system and leak test as described in General Information section of this chapter.

EVAPORATOR HOUSING ASSEMBLY

Removal

(1) Discharge system as described in General Information section of this chapter.

(2) Disconnect inlet (suction) line at compressor.

(3) Disconnect receiver/dryer-to-evaporator hose at quick-disconnect coupling (fig. 3E-7).

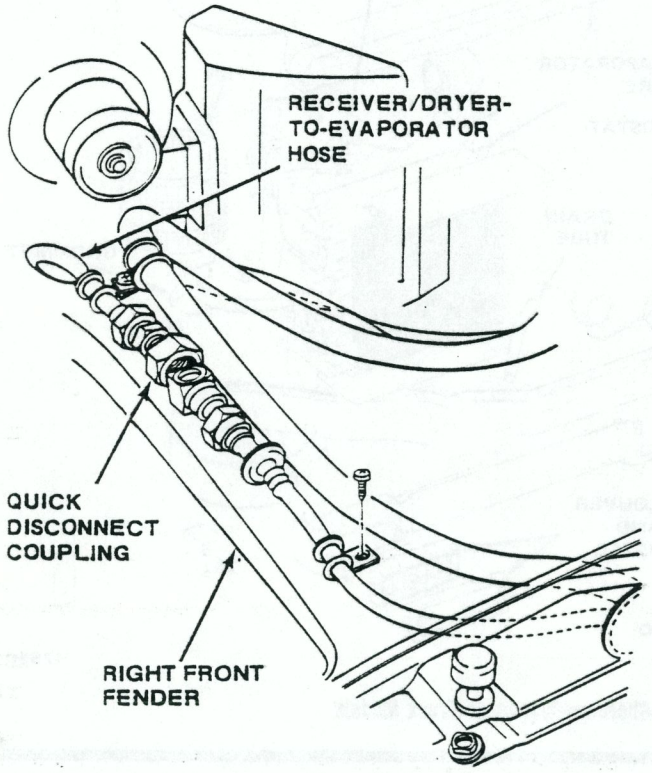

Fig. 3E-7 Quick-Disconnect Coupling

(4) Remove hose clamps and dash grommet retaining screws.

(5) Remove evaporator housing-to-instrument panel attaching screws and evaporator housing-to-mounting bracket screw (fig. 3E-8).

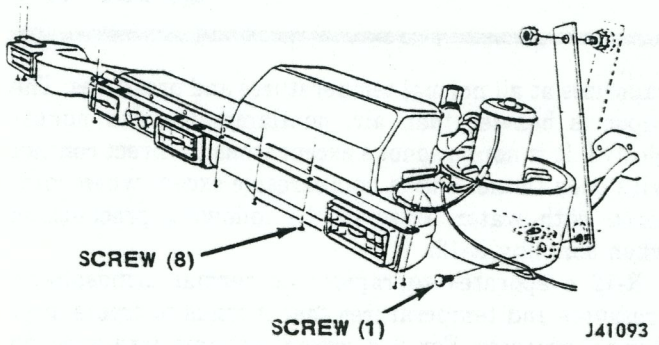

Fig. 3E-8 Evaporator Housing Mounting—Cherokee-Wagoneer-Truck Models

(6) Lower evaporator housing and pull hoses and grommet through opening.

The blower motor, blower motor housing, and evaporator core may be serviced after the evaporator housing is removed (fig. 3E-9).

NOTE: *It is not necessary to discharge the system to service the blower motor. The evaporator housing may be lowered from the instrument panel to gain access to the blower motor attaching screws.*

Installation

(1) Push hoses through grommet opening, and install grommet by pushing toward engine compartment of vehicle and fasten to dash panel with two attaching screws.

(2) Raise evaporator and install evaporator housing-to-instrument-panel attaching screws and evaporator-to-mounting bracket screw.

(3) Install hose clamps and grommet attaching screws.

(4) Connect receiver-to-evaporator hose at quick-disconnect coupling.

(5) Connect inlet (suction) line to compressor.

(6) Evacuate, leak test, and charge system as described in General Information section of this chapter.

EXPANSION VALVE SERVICE

The valve is preset and should not be adjusted. A defective valve requires replacement.

(1) Discharge system as described in General Information section of this chapter.

(2) Remove evaporator housing assembly.

(3) Remove insulation wrapped around suction line and expansion valve. Mark capillary tube location on suction line.

(4) Disconnect inlet and outlet connections, capillary tube clamp, and equalizer tube.

(5) Remove expansion valve.

(6) Clean suction line to provide a positive contact with replacement expansion valve capillary tube.

(7) Connect inlet and outlet hoses. Clamp capillary-tube at marked position and connect equalizer tube.

NOTE: *Clamp capillary tube securely so that a firm contact with suction line is formed.*

(8) Wrap expansion valve and line with insulation.

(9) Install evaporator housing assembly.

(10) Evacuate, leak test, and charge system as described in General Information section of this chapter.

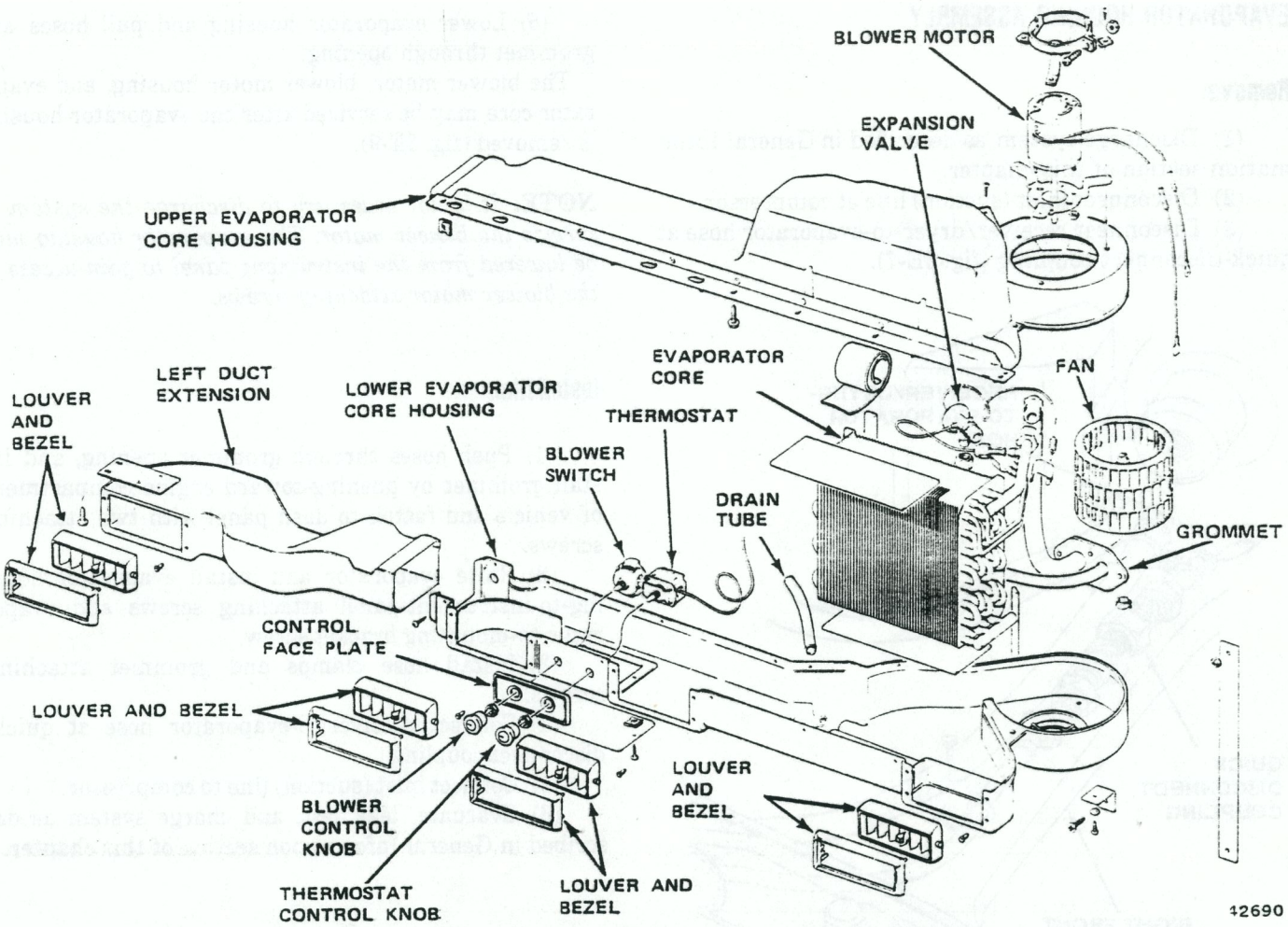

Fig. 3E-9 Evaporator Housing Assembly—Cherokee-Wagoneer-Truck Models

GENERAL INFORMATION

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Charging System	3E-16	Flushing System	3E-15
Checking for Leaks	3E-13	General	3E-8
Checking System Pressures	3E-10	Pressure Gauge and Manifold Assembly	3E-9
Discharging System	3E-12	Refrigerant Safety Precautions	3E-8
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GENERAL

The following service procedures apply to all factory installed air conditioning systems unless otherwise specified.

REFRIGERANT SAFETY PRECAUTIONS

The refrigerant used in automotive air conditioning systems is dichlorodifluoromethane, commonly known as Refrigerant-12 or R-12. It is transparent and colorless in both the liquid and vapor state. Since it has a boiling point of **21.7°F below zero** at atmospheric pressure, it vaporizes at all normal temperatures and pressures. The vapor is heavier than air, nonflammable and nonexplosive. It is nonpoisonous except when in direct contact with open flame, and is noncorrosive except when combined with water. Observe the following precautions when handling R-12.

R-12 evaporates so rapidly at normal atmospheric pressures and temperatures that it tends to freeze anything it contacts. For this reason, extreme care must be taken to prevent any liquid refrigerant from contacting the skin and especially the eyes.

WARNING: *Always wear safety goggles when servicing the refrigeration part of the air conditioning system. Keep a bottle of sterile mineral oil and a weak solution of boric acid handy when working on the refrigeration system. Should any liquid refrigerant get into the eyes, use a few drops of mineral oil to wash them out (R-12 is rapidly absorbed by oil). Next, wash the eyes with the weak solution of boric acid. Call a doctor immediately, even though irritation has ceased after the first aid treatment.*

WARNING: *Do not heat R-12 above 125°F.*

In most instances, moderate heat is required to bring the pressure of the refrigerant in its container above the pressure of the system when charging or adding refrigerant. A bucket or large pan of hot water not over 125°F is all the heat required for this purpose. Do not heat the refrigerant container with a blow torch or any other means that would raise temperature and pressure above this temperature. Do not weld, steam clean or heat the system components or refrigerant lines.

CAUTION: *Keep R-12 containers upright when charging the system, so as to utilize the vapor instead of the liquid.*

When metering R-12 into the refrigeration system, **keep the supply tank or cans in an upright position.** If the refrigerant container is on its side or upside down, liquid refrigerant will enter the system and damage the compressor.

WARNING: *Always work in a well-ventilated area.*

Always maintain good ventilation in the working area. Always discharge the refrigerant into the service bay exhaust system or outside the building. Large quantities of refrigerant vapor in a small, poorly ventilated room can displace the air and cause suffocation.

Although R-12 vapor is normally nonpoisonous, it can be changed into a very poisonous gas if allowed to come in contact with an open flame. Do not discharge large quantities of refrigerant in an area having an open flame. A poisonous gas is produced when using the halide torch leak detector. Avoid inhaling the fumes from the leak detector.

CAUTION: *Do not allow liquid refrigerant to touch bright metal.*

Refrigerant will tarnish bright metal and chrome surfaces. Avoid splashing refrigerant on any surface. Refrigerant in combination with moisture is very corrosive and can cause extensive damage to all metal surfaces.

SERVICE VALVES

The discharge and suction service valves are mounted directly to the compressor head. The valves are used for diagnosis, charging, discharging, evacuating, and component removal.

The service valves are three-position valves (fig. 3E-10). The normal operating position, shown in figure 3E-10, View B, has the valve stem turned **counterclockwise** to the **back-seated** (full-out) position.

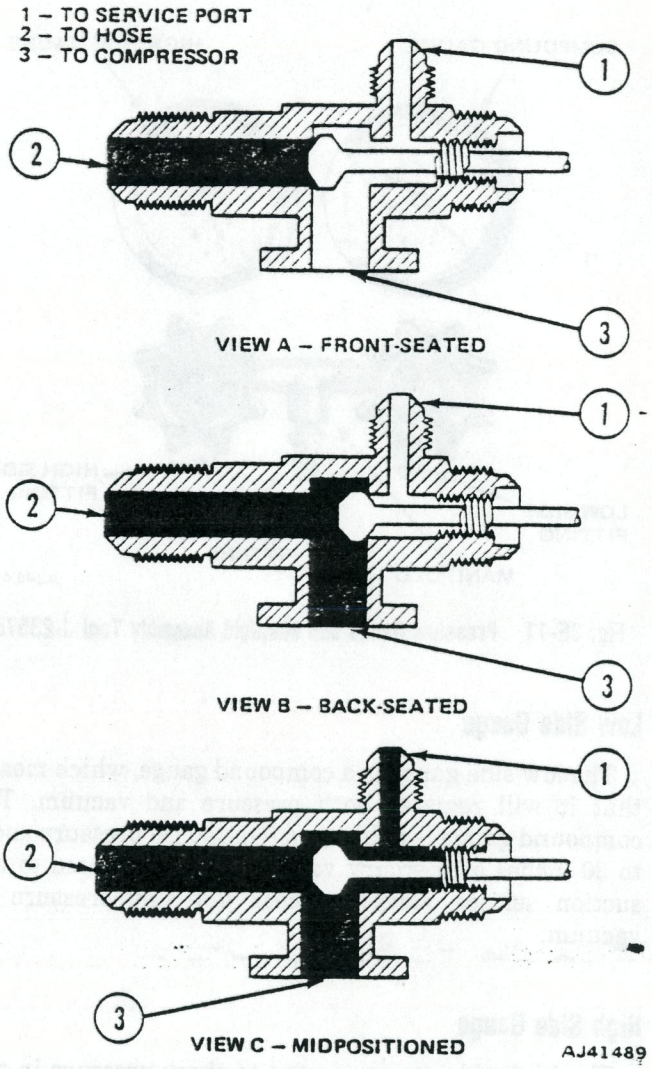


Fig. 3E-10 Service Valve Operating Positions—Typical

When the valve stem is turned **clockwise** to the **front-seated** (full-in) position (fig. 3E-10, View A), the compressor is isolated from the system. This position is used when removing the compressor or when checking compressor oil level.

When the valve is **mid-positioned** (cracked) (fig. 3E-10, View C), the gauge port is **open.** This position is used when charging, discharging, evacuating, and checking system pressure.

PRESSURE GAUGE AND MANIFOLD ASSEMBLY

The pressure gauge and Manifold Assembly Tool J-23575 (fig. 3E-11) is the most important tool used to service the air conditioning system. The gauge assembly is used to determine system high and low side gauge pressures, the correct refrigerant charge, and for system

diagnosis. It is designed to provide simultaneous high and low side pressure indications, because these pressures must be compared to determine correct system operation.

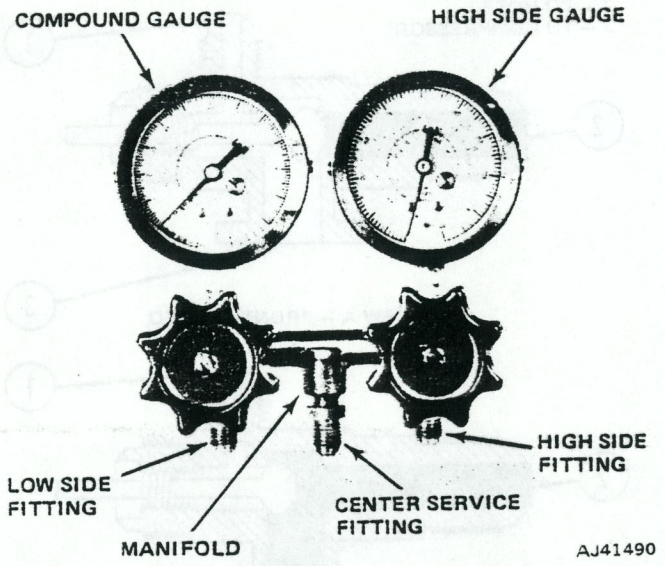


Fig. 3E-11 Pressure Gauge and Manifold Assembly Tool J-23575

Low Side Gauge

The low side gauge is a compound gauge, which means that it will register both pressure and vacuum. The compound gauge is calibrated 0 to 150 psi pressure and 0 to 30 inches of mercury vacuum. It is connected to the suction service valve to check low side pressure or vacuum.

High Side Gauge

The high side gauge is used to check pressure in the discharge side of the air conditioning system.

Manifold

The gauges are connected into the air conditioning system through a manifold (fig. 3E-11). The manifold has three connections. The low side hose and fitting is connected directly below the low side gauge. The high side hose and fitting is connected below the high side gauge.

The center connection of the manifold is used for charging, discharging, evacuating, and any other necessary service. Both the high and low sides of the manifold have hand shutoff valves. The hand shutoff valves open or close the respective gauge connections to the center service connection or to each other. The manifold is constructed so that pressure will be indicated on the gauges regardless of hand valve position.

Connecting the Pressure Gauge and Manifold Assembly

(1) Remove protective caps from service valve gauge ports and valve stems.

(2) Close both hand valves on gauge manifold set.

(3) Connect compound gauge hose to compressor suction service valve gauge port (low-side).

(4) Connect high pressure gauge hose to discharge service valve gauge port (high-side).

NOTE: *If necessary, to facilitate installation of the gauge set, loosen the service valve-to-compressor fitting and* ***rotate the service valve slightly****. Do not allow line to contact engine or body components. Tighten the service valve-to-compressor fitting to 25 foot-pounds (34 N•m) torque or 15 foot-pounds (20 N•m) torque for flange-type service valve screws.*

(5) Set both service valve stems to mid- or cracked-position. The gauges will indicate high and low side pressure respectively.

(6) Purge any air from high side test hose by opening high side hand valve on manifold for three to five seconds (center connection on manifold must be open).

(7) Purge any air from low side test hose by opening low side hand valve on manifold for three to five seconds (center connection on manifold must be open).

(8) Air conditioning system may be operated with gauge manifold assembly connected in this manner. Gauges will indicate respective operative pressures.

CHECKING SYSTEM PRESSURES

The pressure developed on the high side and low side of the compressor indicate whether the system is operating properly.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(1) Attach pressure gauge and manifold assembly.

(2) Close both hand valves on gauge and manifold assembly.

(3) Set both service hand valve stems to mid-position.

(4) Operate air conditioning system with engine running at 1500 rpm and controls set for full cooling but not into the MAX or COLD detent.

(5) Insert thermometer into discharge air outlet and observe air temperature.

(6) Observe high and low side pressures and compare with those shown in the Normal Operating Temperatures and Pressures Chart. If pressures are abnormal, refer to Pressure Diagnosis Chart.

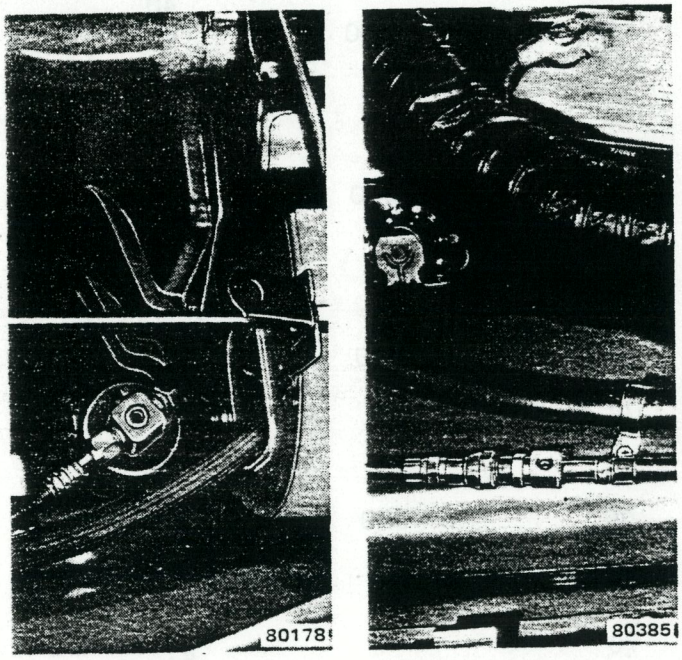
Normal Operating Temperatures and Pressures *

Relative Humidity (percent)	Surrounding Air Temperature (° F)	Engine Speed (RPM)	Maximum Desirable Center Register Discharge Air Temp. (° F)	Suc Pres PS (RE
20	70	1500	40	1
	80		41	1
	90		42	2
	100		43	2
30	70	1500	40	1
	80		41	16
	90		42	22
	100		44	26
40	70	1500	40	13
	80		42	18
	90		43	23
	100		44	26
50	70	1500	40	14
	80		42	19
	90		44	25
	100		46	27
60	70	1500	41	15
	80		43	21
	90		45	25
	100		46	28
70	70	1500	41	16
	80		43	22
	90		45	26
	100		46	29
80	70	1500	42	18
	80		44	23
	90		47	27
	100		—	—
90	70	1500	42	19
	80		47	24
	90		48	28
	100		—	—

*Operate engine with transmission in neutral. Keep vehicle out of direct sunlight.

SIGHT GLASS

A sight glass is incorporated in the receiver-to-evaporator hose at the receiver end (fig. 3E-12). The sight glass provides a visual check of the system refrigerant level. A continuous stream of bubbles will appear in the sight glass of a system which is not properly charged. Properly charged and completely discharged systems will appear similar through the sight glass because of a lack of bubbles. To distinguish between the two situations, cycle the magnetic clutch Off and On with the engine running at 1500 rpm. During the time the clutch is off, bubbles will appear if the refrigerant is in the system and will disappear when the clutch is on. If no bubbles appear when cycling the magnetic clutch, there is no refrigerant in the system since some bubbles would appear in a fully charged system. If the system is discharged, it will be necessary to leak test, repair as required, evacuate, and charge the system.



CJ CHEROKEE-WAGONEER-TRUCK

Fig. 3E-12 Sight Glass

DISCHARGING SYSTEM

Refrigerant should be discharged from the system before replacing any part in the system except the compressor.

(1) Connect pressure gauge and manifold assembly to proper service valves.

(2) Turn both manifold hand valves to maximum counterclockwise (open) position.

(3) Open both service valves a slight amount (from back-seated position) and allow refrigerant to discharge **slowly** from system (fig. 3E-13).

CAUTION: *Do not allow the refrigerant to rush out, as the oil in the compressor or system will be forced out along with it.*

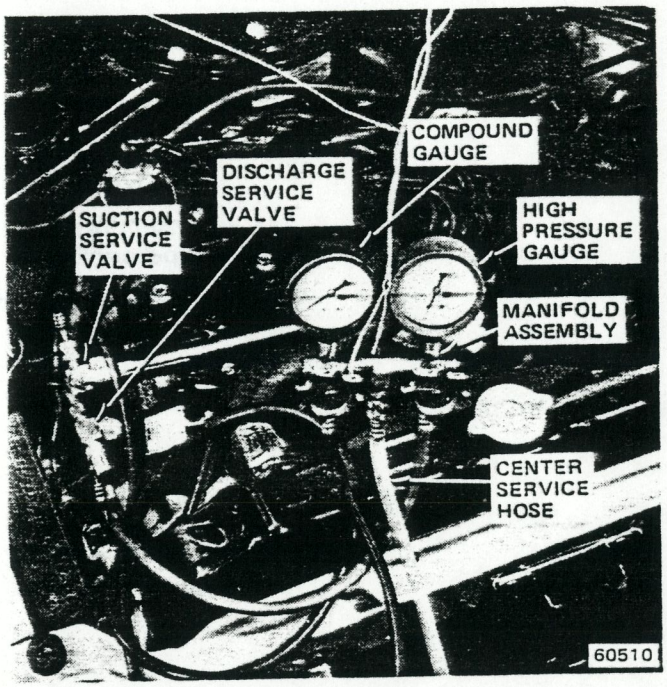


Fig. 3E-13 Typical Pressure Gauge and Manifold Assembly Connections for Discharging System

EVACUATING SYSTEM

A system with the refrigerant removed during repair, or one that is excessively low on refrigerant must be evacuated with a vacuum pump before new refrigerant is installed. The reason for evacuating a system is to remove any air and moisture that may have entered the system.

Moisture in any quantity is extremely harmful to the air conditioning system. Moisture may collect and freeze in the thermostatic expansion valve orifice, blocking refrigerant flow and preventing system cooling. Moisture will also react with R-12 to form hydrochloric acid which will corrode metal parts of the system. Corrosion particles may become detached and block the small passages and orifices in the system.

Unwanted air and moisture are removed from the system by proper evacuation of the system. A vacuum pump is used to lower the pressure sufficiently so that moisture boiling temperature is reduced to a point where the water will vaporize and can be evacuated from the system.

Water boils at 212°F at 14.7 psi (sea level). As the vacuum pump lowers the pressure of the closed air conditioning system, the boiling point of the moisture in the system will also be lowered. In evacuating the system, it is necessary to lower the boiling point of any moisture in the system to a point lower than the ambient (surrounding) temperature to ensure that all moisture is boiled

off. At an ambient temperature of 75°F, when the desired vacuum of 29.5 in. Hg is reached, water will boil at approximately 54°F and a complete boiling off of all moisture in the system is assured when this vacuum reading has been reached.

At altitudes higher than sea level, it will not be possible to obtain a vacuum reading of 29.5 in. Hg on the low side compound gauge. For each 1,000 feet of altitude, the vacuum gauge must be corrected by one in. Hg to compensate for a change in atmospheric pressure. For example, at altitudes of 1,000 feet, a gauge reading of 28.5 in. Hg will be the same as a gauge reading of 29.5 in. Hg at sea level. When this vacuum is reached, a minimum of 30 minutes should be allowed in evacuating the system to ensure complete moisture removal.

Evacuating Procedure with J-26695 Vacuum Pump

The J-26695 Vacuum Pump and motor is a self-contained unit equipped with a carrying handle and stand. The unit must be kept upright at all times to prevent oil from spilling.

(1) Connect pressure gauge and Manifold Assembly Tool J-23575.

(2) Discharge system.

(3) Connect center service hose to inlet fitting of vacuum pump (fig. 3E-14).

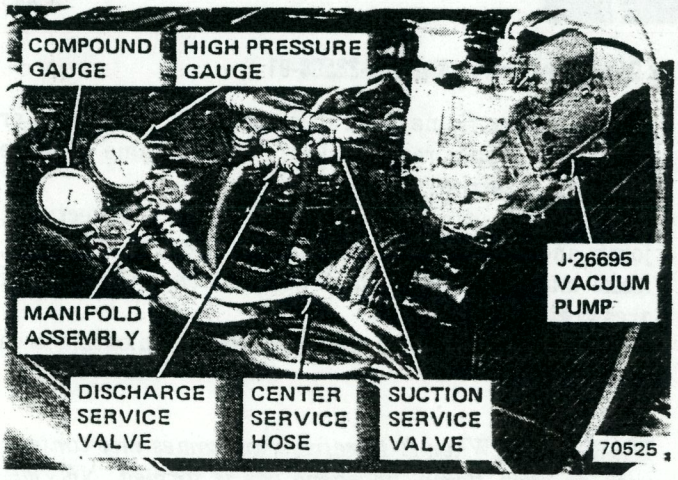


Fig. 3E-14 Typical Connections for Evacuating System with J-26695 Vacuum Pump

(4) Open both manifold hand valves wide open.

(5) Start vacuum pump; note compound gauge reading.

(6) Operate pump a MINIMUM of 30 minutes after reaching lowest vacuum.

(7) Test system for leaks. Close both manifold hand valves, turn off vacuum pump, and note compound gauge reading. Gauge needle should remain stationary at point at which pump was turned off.

(8) If gauge needle returns to zero rapidly, install a partial charge in system and locate leak with leak detector. Repair leak and repeat evacuation procedure.

(9) If gauge needle remains stationary and vacuum is maintained for three to five minutes, resume evacuation for minimum of 30 minutes.

(10) Close both manifold hand valves and stop vacuum pump.

(11) Disconnect center service hose from vacuum pump. System is now ready for charging.

Evacuation Procedure with J-23500-01 Portable Air Conditioning Service Station

The J-23500-01 Portable Air Conditioning Service Station (fig. 3E-15) is a completely portable station equipped with vacuum pump, metering-charging cylinder, refrigerant supply, gauges, hoses and hand control valves.

The control switch for the vacuum pump is mounted on the front of the charging station. It should be in the Off position before inserting plug into the power source.

NOTE: *Be certain system is completely depressurized before evacuating. With the system under pressure, refrigerant may enter vacuum pump and damage the pump.*

(1) Close all hand valves.

(2) Connect red charging hose to discharge service valve port on compressor.

(3) Connect blue charging hose to suction service valve port on compressor.

(4) Discharge system, leaving suction and discharge service valves in the mid- or cracked-position.

(5) Connect vacuum pump hose to vacuum pump inlet.

(6) Open low pressure hand control valve and high pressure hand control valve on charging station.

(7) Start vacuum pump and open vacuum control valve; note compound gauge reading.

(8) Operate pump **minimum of 30 minutes** after reaching lowest vacuum.

(9) Fill charging cylinder, as described below, while system is evacuating.

(10) Close vacuum control valve and stop vacuum pump. Observe blue compound gauge to determine if leak exists. System is now ready for charging.

CHECKING FOR LEAKS

Whenever a system requires more than 1/2 pound of refrigerant after a season's operation, a serious leak is indicated which must be located and repaired.

Most leaks will be located at points of connection and are caused by automobile vibration. Correction of this type of leak may only require retightening of the connection. However, some leaks may occur only at periods

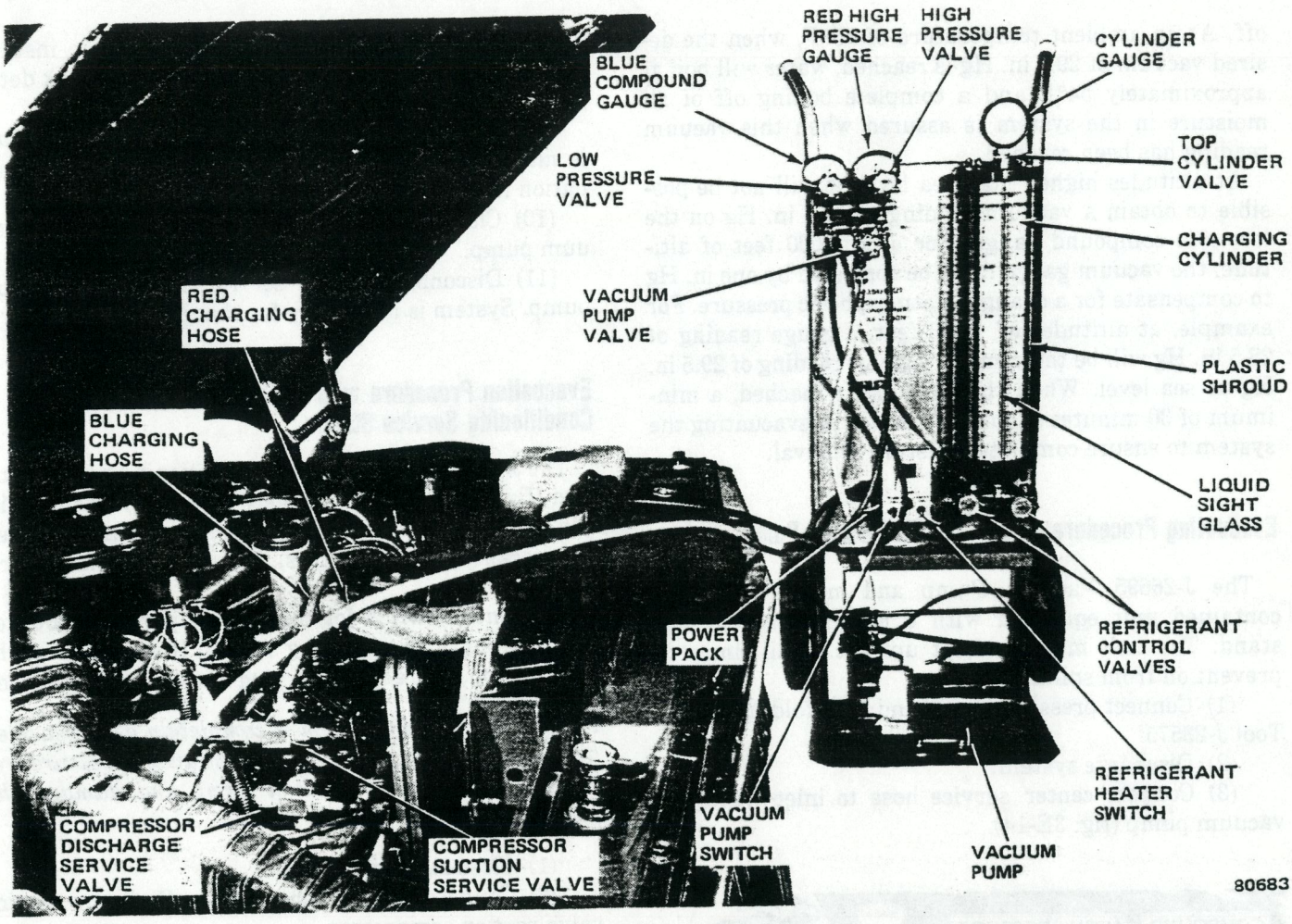


Fig. 3E-15 Typical Connections for Portable Air Conditioning Service Station J-23500-01

of high traffic on a very warm day. This type of leak most often occurs through the compressor shaft seal or service valve gasket.

A system must contain an adequate quantity of refrigerant to be properly leak tested. If a system is completely discharged, evacuate and install 1/2 pound of refrigerant.

Halide Torch Leak Detection

External leaks are detected and located with a Halide Torch Tool J-6084 (fig. 3E-16). The torch burns propane fuel and is equipped with a search hose. When air is drawn into the hose by the torch, it contacts a heated copper reactor ring in the torch. If refrigerant gas is present in the air, the normally light blue flame will change color. A small refrigerant leak will change the flame color to yellow. A large refrigerant leak will change it to green or purplish-blue.

Leak Test Procedure Using Halide Torch

(1) Open torch valve and light torch, adjusting flame just high enough to heat copper reactor ring to a cherry red.

(2) Lower flame until it is about 1/4 inch above or even with copper reactor ring. Smaller flame is more sensitive to refrigerant.

(3) Move search hose slowly **under** all connections, joints and seals. Because refrigerant is heavier than air, leaks may be more readily detected on lower side of areas being checked.

(4) Watch for color change of flame indicating area of leak.

WARNING: *When R-12 refrigerant comes into contact with an open flame, phosgene gas is formed. NEVER INHALE THE VAPORS OR FUMES FROM THE HALIDE TORCH; they are poisonous.*

(5) Repair leaks as required.

(6) Evacuate and leak-test system after all leaks are corrected.

(7) Charge system.

Electronic Leak Detection

External leaks are detected and located with the Electronic Leak Detector Tool J-26933. The leak detector is

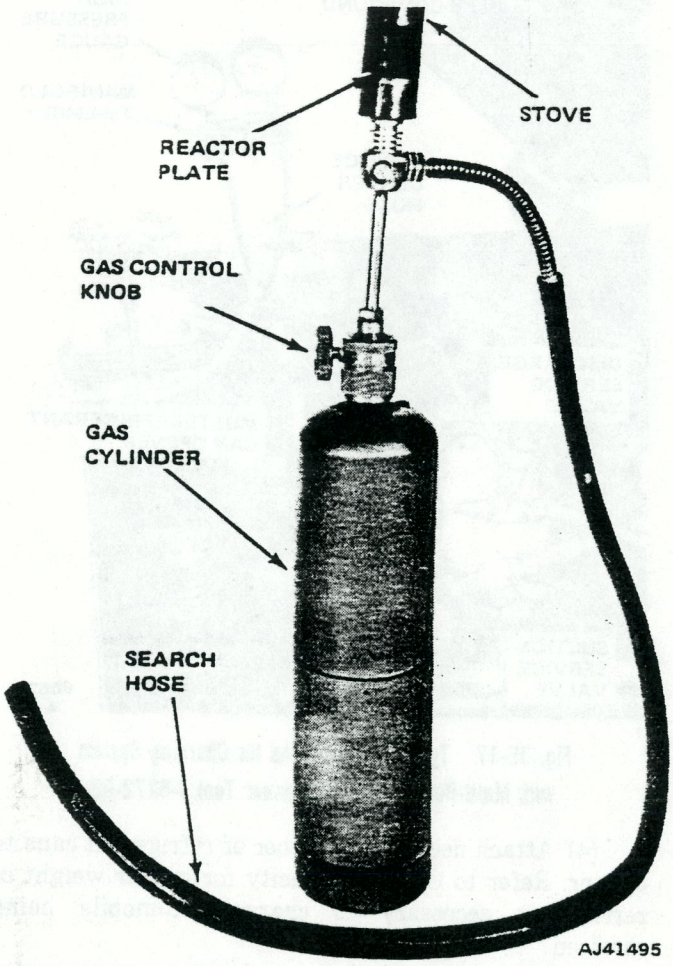


Fig. 3E-16 Halide Torch Tool J-6084

an electronic instrument designed to detect R-12 refrigerant leaks as small as one-half ounce per year. The 18-inch flexible probe gets at inaccessible places. Follow the manufacturer's calibration instructions, included with the unit, to set up the electronic leak detector for proper operation.

NOTE: *Using the Electronic Leak Detector Tool J-26933, will NOT expose the user to phosgene gas vapors or fumes.*

Leak Test Procedure Using Electronic Detector

(1) Unwind flexible probe from case.

(2) Activate Off/On switch, place flexible probe tip near leak port and adjust BAT thumbwheel a few teeth until light goes on and goes out when tip is removed from leak port.

(3) Move flexible probe slowly **under** suspected connections, joints, and seals. R-12 refrigerant is heavier than air, leaks may be detected more readily on lower side of areas being checked.

(4) When a leak is found, its presence will be indicated by white signal light.

NOTE: *If probe tip is held too long on the leak, the white signal light will go out.*

(5) Repair leaks, as required.

(6) Evacuate system after all leaks are corrected.

(7) Charge system.

FLUSHING SYSTEM

Anytime a failure of the compressor causes foreign material to be passed into the system, the condenser must be flushed and the receiver/drier replaced. Filter screens in the compressor at the suction side and in the receiver/drier will confine foreign material to the compressor, condenser, receiver/drier and connecting hoses.

Flushing Procedure

(1) Install replacement compressor and connect service valves and hoses.

NOTE: *System must be in a discharged state.*

(2) Using Portable Air Conditioning Service Station J-23500-01, close all control valves, and connect red high pressure to compressor discharge service valve.

WARNING: *Wear goggles to protect eyes.*

(3) Open refrigerant drum valve. Bleed charging cylinder through valve located on back of control panel directly above cylinder. When two pounds of refrigerant is in charging cylinder, close bleed valve.

(4) Close refrigerant drum valve.

(5) Disconnect receiver/drier from condenser. Place a shop towel on condenser outlet to catch oil that will be forced from system.

(6) Center compressor discharge valve.

(7) Fully open high pressure valve on control panel and allow liquid refrigerant to flow through condenser.

WARNING: *Always maintain good ventilation in the working area. Always discharge the refrigerant into the service bay exhaust system or outside the building. Large quantities of refrigerant vapor in a small, poorly ventilated room can displace the air and cause suffocation.*

(8) When charging cylinder is empty, close high pressure valve on control panel.

(9) Check compressor oil level.

(10) A replacement receiver/drier should be installed, and system evacuated before charging.

FILLING CHARGING CYLINDER

(1) Be certain refrigerant drum is inverted and valve is open.

(2) Open right hand valve at base of charging cylinder and fill with required amount of refrigerant to charge system (refer to Charge Capacity). Liquid refrigerant will be observed rising in charging cylinder sight glass.

(3) Crack open valve at top of cylinder when pressure in charging cylinder equals pressure in supply tank. This relieves head pressure and allows refrigerant to continue filling cylinder.

(4) Observe pressure gauge at top of cylinder and rotate plastic shroud until pressure heading column corresponds with gauge pressure in line with sight glass.

NOTE: *If pressure gauge at top of cylinder reads, for example, 70 psi, find the column with the pressure heading of "70" and rotate shroud so the "70" column aligns with the sight glass.*

(5) When refrigerant reaches desired level in sight glass, close both the right hand valve at base of cylinder and refrigerant drum valve. Be certain top cylinder valve is fully closed.

NOTE: *If bubbling occurs in sight glass, tilt charging station back momentarily.*

(6) Connect heating element cord to heating element receptacle of power pack and turn heater switch On. Allow refrigerant to heat (building up pressure proportionately) for about ten minutes while vacuum pump is running.

CHARGING SYSTEM

Before making a complete charge, check the compressor oil level, leak test if necessary, and evacuate the system.

Charge Capacity

The recommended charge for the respective systems is as follows: CJ—2-1/2 pounds R-12; Cherokee, Wagoneer and Truck—2-1/4 pounds R-12. Capacities are also indicated on a decal attached to compressor.

NOTE: *Replacement of a hose, receiver/dryer, condenser, expansion valve or evaporator requires the addition of one ounce of AMC Oil 8132400, or equivalent.*

Charging Procedure with Multi-Refrigerant Can Opener Tool J-6272-02

The following charging procedure is based on the use of pressure gauge and Manifold Assembly J-23575, and Multi-Refrigerant Can Opener J-6272-02. Refer to figure 3E-17.

WARNING: *Wear goggles to protect eyes.*

(1) Connect pressure gauge and Manifold Assembly J-23575 and evacuate system. Keep both service valves in mid- or cracked-position.

(2) Close both gauge hand valves.

(3) Disconnect service hose from vacuum pump and connect it to center of Multi-Refrigerant Can Opener J-6272-02. Close four petcock valves on dispenser.

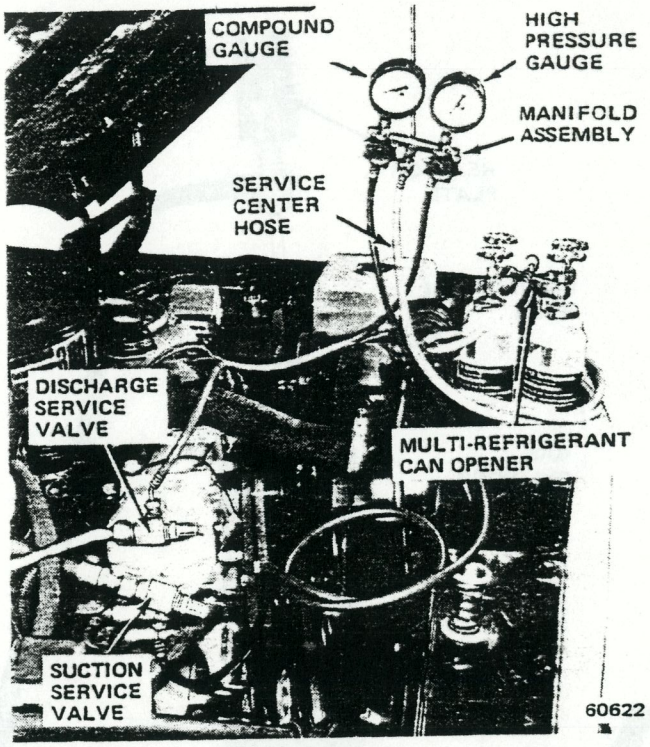


Fig. 3E-17 Typical Connections for Charging System with Multi-Refrigerant Can Opener Tool J-6272-02

(4) Attach necessary number of refrigerant cans to opener. Refer to Charge Capacity for proper weight of refrigerant necessary to charge automobile being serviced.

(5) Open one petcock valve. Loosen center service hose at pressure gauge and manifold assembly allowing refrigerant to purge air from line. Tighten service hose connection and close petcock valve.

(6) Open suction (compound) gauge hand valve and one petcock valve. Do not open discharge (high pressure) gauge hand valve.

WARNING: *Use extreme caution when engine is operating. Do not stand in direct line with fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.*

(7) Start engine and place air conditioning controls in maximum cooling position. The compressor will operate and help pull refrigerant gas into suction side of system.

NOTE: *The refrigerant cans may be placed upright in warm water NO HOTTER THAN 125°F to speed up the charging process.*

(8) When first refrigerant can is empty, open another petcock valve to continue charging system.

(9) Continue charging until specified amount of refrigerant is in system. The frost line on refrigerant can will indicate what portion of refrigerant in can has entered system. This may be used as a guide when a system requires a fraction of a full can.

NOTE: *If an accurate scale is available, weigh the refrigerant cans before and during the charging procedure to assure that the correct amount of refrigerant is being used.*

(10) When system is fully charged, close suction (compound) gauge hand valve and all petcock valves.

(11) Operate system five to ten minutes to allow it to normalize and to determine if system will cycle properly. Refer to Checking System Pressures.

(12) Upon completion of operational check, back-seat suction and discharge service valves to their normal operating position by turning them fully counterclockwise.

(13) Loosen pressure gauge and manifold assembly service hoses to allow refrigerant trapped in hoses to discharge.

(14) Remove pressure gauge and manifold assembly and install dust caps on fittings.

Charging Procedure with Portable Air Conditioner Service Station J-23500-01

NOTE: *Fill charging cylinder as described above.*

WARNING: *Wear goggles to protect eyes.*

(1) Discharge and evacuate system as described above.

(2) Close low pressure valve on charging station, fully open left hand refrigerant control valve at base of cylinder and high pressure valve on charging station, and allow required charge of refrigerant to enter high side of system. When full charge has entered system, close refrigerant control valve and high pressure valve on charging station.

CAUTION: *Do not permit liquid level to drop below zero on cylinder sight glass.*

(3) Close manifold gauges after completion of charging, and check high and low pressures and system operation.

CAUTION: *Read gauges with high and low pressure valves on charging station closed. The low pressure gauge could be damaged if both high and low pressure valves of manifold are opened. The high pressure developed in discharge side (high side) of compressor would peg indicator needle of low pressure gauge and damage the gauge.*

(4) Close all valves on charging station and close refrigerant drum valve when all operations are completed.

(5) Upon completion of operational check, back-seat suction and discharge service valves to their normal operating position by turning them fully counterclockwise.

(6) Disconnect high and low pressure charging hoses from compressor with care. (A small amount of refrigerant remaining in hoses will escape.) Replace charging hoses on hose holder on charging station to keep air and dirt out of hoses.

(7) Open valve at top of cylinder to remove remaining refrigerant.

NOTE: *The charging cylinder is not designed to store refrigerant.*

(8) Replace quick seal caps on compressor service valves when service is completed.

SERVICE PROCEDURES — 49-STATE SIX AND EIGHT-CYLINDER MODELS

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GENERAL

This section consists of a general description of each component and the system operation of all components used with the 49-State six- and eight-cylinder engines. Service information for the compressor and magnetic clutch is also contained within this section. All other service information can be found in the CJ Air Conditioning and Cherokee-Wagoneer-Truck Air Conditioning sections or the General Information section of this chapter.

The 49-State six- and eight-cylinder engine components are as follows.

Compressor—The compressor used on the 49-State six- and eight-cylinder engines is a two-cylinder in-line unit that is driven by a single V-belt. It is used to circulate and increase the pressure of the refrigerant in the system. It is mounted to the engine as shown in figures 3E-18 and 3E-19.

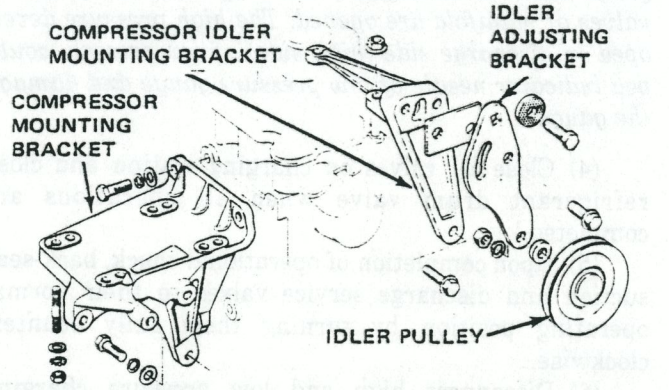


Fig. 3E-18 Compressor Mounting—49-State Six-Cylinder Engine

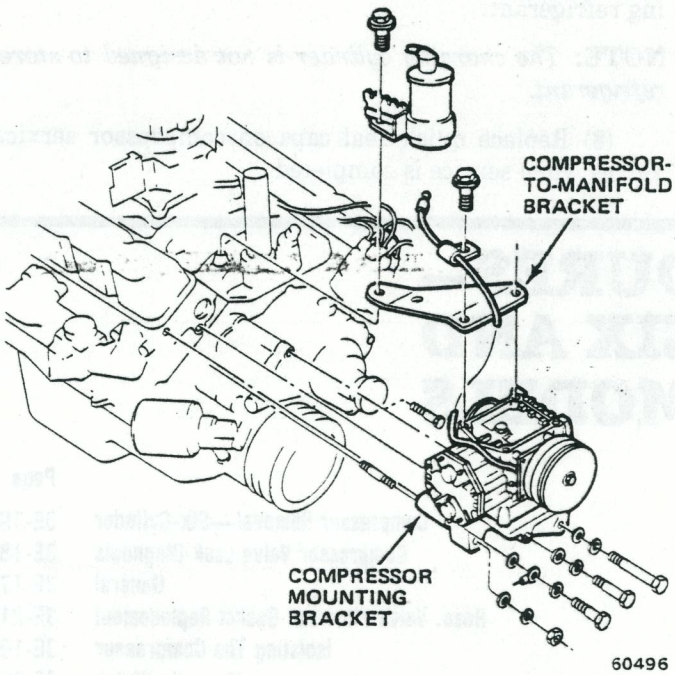


Fig. 3E-19 Compressor Mounting—49-State Eight-Cylinder Engine

Condenser—The condenser is mounted in front of the radiator to allow air to flow over the cooling fins and remove heat from the refrigerant. As the refrigerant passes through the condenser, it liquifies (condenses).

Receiver/Drier—The receiver/drier is a reservoir used to store the precise amount of refrigerant required by the system. The refrigerant level in the receiver/drier must be adequate to provide a steady flow of refrigerant to the expansion valve. The receiver/drier contains a desiccant to remove moisture from the system. The receiver/drier must be replaced anytime the system has been open to atmosphere due to a system component failure. If during servicing the receiver/drier is removed from the system, it must be tightly capped immediately.

Expansion Valve—The thermostatic expansion valve is located at the inlet of the evaporator. It meters the refrigerant to the evaporator, so as to maintain the proper flow for the various evaporator heat load requirements encountered during operation. The metering action of the expansion valve is controlled by the temperature sensing bulb mounted on the outlet (suction) line of the evaporator.

Evaporator—The evaporator is an air cooler and dehumidifier. As the refrigerant enters the evaporator core, it begins to boil. The heat in the air passing over the evaporator transfers or gives up its heat to the boiling refrigerant. As the air cools, the moisture in the air condenses on the evaporator core and is drained off as water.

SYSTEM OPERATION

The compressor increases the pressure and temperature of the system refrigerant. The heated refrigerant vapor is then pumped into the condenser where it cools by giving off heat to air passing over the condenser fins. As the refrigerant cools in the condenser, it condenses into a liquid. Still under high pressure, the liquid refrigerant passes into the receiver. The receiver acts as a reservoir to furnish refrigerant to the expansion valve at all times. From the receiver, the high pressure liquid refrigerant passes to the expansion valve. The expansion valve meters refrigerant into the evaporator where a low pressure is maintained by the suction side of the compressor. As it enters the evaporator, the refrigerant immediately begins to boil by absorbing heat from the air passing over the evaporator core. Having given up its heat to boil the refrigerant, the air is cooled and passes into the passenger compartment of the vehicle. From the evaporator the vaporized refrigerant is drawn back to the compressor to repeat the cycle.

COMPRESSOR VALVE LEAK DIAGNOSIS

The compressor should be at operating temperature to perform an accurate test.

(1) Install pressure gauge and Manifold Assembly J-23575.

(2) Front-seat the suction and discharge service valve by turning them clockwise.

(3) Discharge refrigerant remaining in compressor by opening suction gauge hand valve **slowly**.

(4) Open suction gauge hand valve and close the high pressure gauge hand valve.

(5) Start engine and operate compressor. Pressure will build up rapidly. Stop engine/compressor at 150 to 200 pounds pressure.

NOTE: *Pressure should hold if the discharge valve is operating properly. Loss of pressure indicates leaking compressor discharge valve or head gasket.*

COMPRESSOR BELT TENSION

Belt tensions are important and should be inspected at time of new vehicle predelivery and at subsequent scheduled maintenance intervals.

Belt Tension Gauge, Tool J-23600, will provide accurate belt tension adjustments. Install the gauge on the longest accessible belt span. Belt tension for new vehicle predelivery and all belts with previous service should be 90 to 115 pounds (400 to 512 newtons).

Belt tension is adjusted by moving the idler mounting bracket.

When a replacement belt is installed, it should be adjusted to 125 to 155 pounds (556 to 689 newtons), 155 pounds (689 newtons) preferred, tension to compensate for the initial run-in loss that occurs within the first several minutes of operation.

NOTE: *New belt tension specifications apply only to service replacement belts. Once a belt has been tensioned and run, it is considered a used belt and should be adjusted to used-belt specifications.*

A characteristic of the **Dacron type belt(s)** used to drive the A/C compressor is that **it tends to increase in tension, rather than stretch, when subjected to heat.** The loss in belt tension which can be observed after the initial run-in is the result of wear-in which allows the belt to ride deeper in the V-groove of the pulleys.

If a belt is run with less than the specified tension, slippage can occur and cause the belt contact surfaces to become glazed. A glazed belt looses some of its load carrying capabilities and may slip even when adjusted to specified belt tension.

Belt **vibration**, particularly on six-cylinder engine models, is usually the result of improper belt tension. When excessive belt vibration or flutter is encountered, adjust the belt tension to specifications. Adjusting to higher tensions will not stop vibration but will increase stress on the idler assembly.

ISOLATING THE COMPRESSOR

It is not necessary to discharge the system for compressor removal. The compressor can be isolated from the remainder of the system, eliminating the need for recharging when performing compressor service.

(1) Connect pressure gauge and Manifold Assembly J-23575.

(2) Close both gauge hand valves and mid-position (crack) both service valves.

(3) Start engine and operate air conditioning.

(4) Turn the suction service valve slowly clockwise toward front-seated position. When suction pressure is reduced to zero or less, stop engine and compressor and quickly finish front-seating the suction service valve.

(5) Front-seat discharge service valve.

(6) Loosen oil check plug slowly to release any internal pressure in compressor. The compressor is now isolated from the remainder of the system. Service valves can be removed from compressor.

COMPRESSOR REMOVAL— SIX-CYLINDER

(1) Isolate compressor.

(2) Remove both service valves and cap compressor and valves.

(3) Loosen compressor belt and move aside.

(4) Remove alternator belt and adjusting bolt.

(5) Remove upper alternator mounting bolt.

(6) Loosen lower alternator mounting nut.

(7) Remove back idler.

(8) Remove compressor mounting nuts and remove compressor.

COMPRESSOR INSTALLATION—SIX-CYLINDER

(1) Position compressor and install mounting nuts.

(2) Install back idler.

(3) Install alternator upper mounting bolt.

(4) Tighten lower mounting nut.

(5) Install alternator adjusting bolt.

(6) Install alternator drive belt and adjust to proper tension.

(7) Install compressor drive belt and adjust to proper tension.

(8) Attach compressor service valves and lines.

(9) Purge compressor of air and open service valves.

(10) Connect clutch wire.

COMPRESSOR REMOVAL—EIGHT-CYLINDER

(1) Isolate compressor.

(2) Remove both service valves and place protective caps over compressor head fittings and service valve openings.

(3) Loosen and remove compressor belt(s).

(4) Disconnect clutch wire.

NOTE: *Remove alternator mounting bracket to obtain working clearance for removing compressor mounting bracket attaching bolts and nuts.*

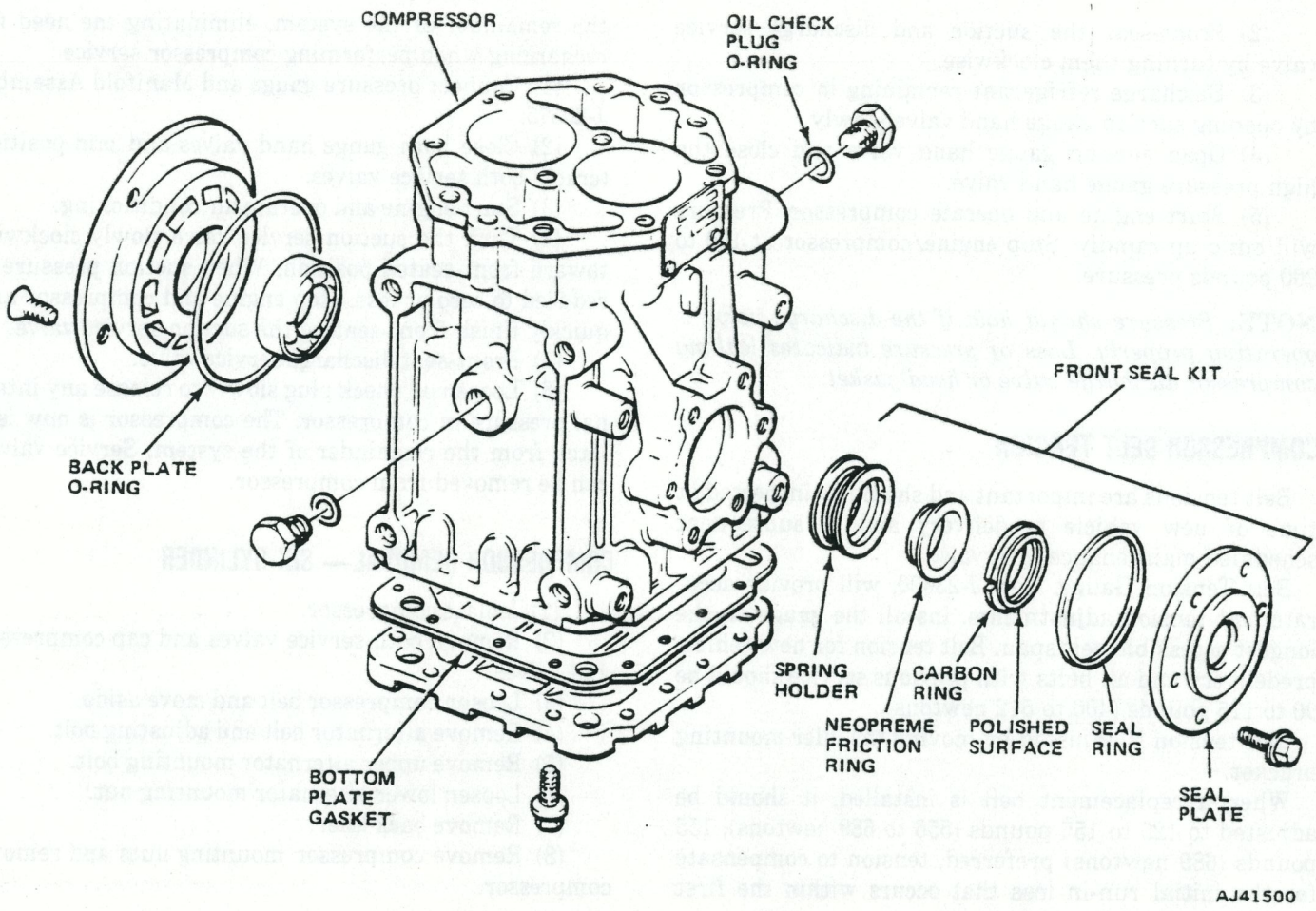


Fig. 3E-20 Compressor Seal Components and Gaskets

(5) Remove compressor and mounting bracket as an assembly and place on work bench.

(6) Remove bracket and bracket attaching nuts and studs.

COMPRESSOR INSTALLATION—EIGHT-CYLINDER

(1) Install mounting bracket to compressor.

(2) Install compressor and bracket assembly to engine.

(3) Install alternator mounting bracket, if removed.

(4) Install compressor drive belt(s) and adjust to proper tension.

(5) Attach compressor service valves and lines.

(6) Purge compressor of air and open service valves.

(7) Connect clutch wire.

COMPRESSOR FRONT SEAL REPLACEMENT

The compressor front seal is serviced in kit form. Kit components are shown in figure 3E-20. All seal parts must be replaced if a leak has been detected at the seal.

NOTE: *A small amount of oil around the shaft seal is normal and does not indicate a seal leak. All seal parts were dipped in oil at the time of assembly and operation may force out surplus oil.*

(1) Isolate compressor.

(2) Remove belt.

(3) Remove clutch and woodruff key from compressor shaft.

(4) Remove seal plate capscrews. Pry seal plate loose and remove.

(5) Carefully pry behind spring holder (that part of the seal assembly farthest back on the shaft) and remove seal assembly.

(6) Lubricate new seal assembly with clean refrigeration oil.

NOTE: *Cleanliness, careful handling, and clean refrigeration oil are important for successful seal replacement.*

(7) Push neoprene friction ring and spring holder over compressor shaft.

(8) Move assembly in and out on compressor shaft to seat neoprene friction ring.

(9) Push assembly in until spring holder contacts bearing race. Position carbon ring in spring holder with polished side facing out.

NOTE: *The carbon ring must seat in the retainer. Engage notches in carbon ring with drive tangs in spring holder.*

(10) Coat mating surfaces of compressor and seal plate with film of refrigeration oil. Position seal ring in groove on compressor.

(11) Install seal plate with polished face toward carbon ring.

(12) Install seal plate capscrews and tighten evenly. Center seal plate on shaft by lightly tapping plate. Tighten the capscrews in a diagonal pattern to 6 foot-pounds (8 N•m) torque.

(13) Turn compressor shaft by hand, using clutch mounting bolt, to seat seal.

(14) Install clutch and woodruff key.

(15) Install belt.

(16) Purge compressor of air.

(17) Leak test system. Evacuate and charge, if necessary.

BACK PLATE O-RING SEAL REPLACEMENT

NOTE: *It is not necessary to remove the compressor for seal replacement on six-cylinder engines.*

(1) Isolate and remove compressor.

(2) Remove four back plate attaching screws using Torx Bit Tool J-25359-C.

(3) Remove back plate by gently prying it loose from crankcase. Pry in such a manner to pull parallel to bearing surface.

(4) Remove O-ring seal from back plate.

(5) Clean back plate and apply light film of refrigeration oil to O-ring sealing area.

(6) Position O-ring seal on back plate and install back plate over rear bearing and into crankcase.

(7) Install four back plate attaching screws and tighten in diagonal pattern to 13 foot-pounds (18 N•m) torque.

(8) Install and purge compressor of air.

(9) Leak test system. Evacuate and charge, if necessary.

HEAD, VALVE PLATE AND GASKET REPLACEMENT

(1) Isolate compressor.

(2) Remove service valves from compressor. The compressor head service valve ports are identified as **D** for discharge and **S** for suction.

(3) Remove compressor head attaching screws.

(4) Tap under valve plate ears (short, half-round projections on the valve plate) to remove head and valve plate.

(5) Tap valve plate ears while holding the compressor head to separate head from valve plate.

(6) Clean all gasket material from head, valve plate, and compressor using care not to scratch or nick sealing surfaces.

(7) Coat all machined sealing surfaces with light film of refrigeration oil.

(8) Install new valve plate cylinder gasket on compressor body, locating gasket on dowel pins.

(9) Install valve plate on compressor, locating it on dowel pins so that discharge valve is at top. Figure 3E-21 shows correct assembly sequence.

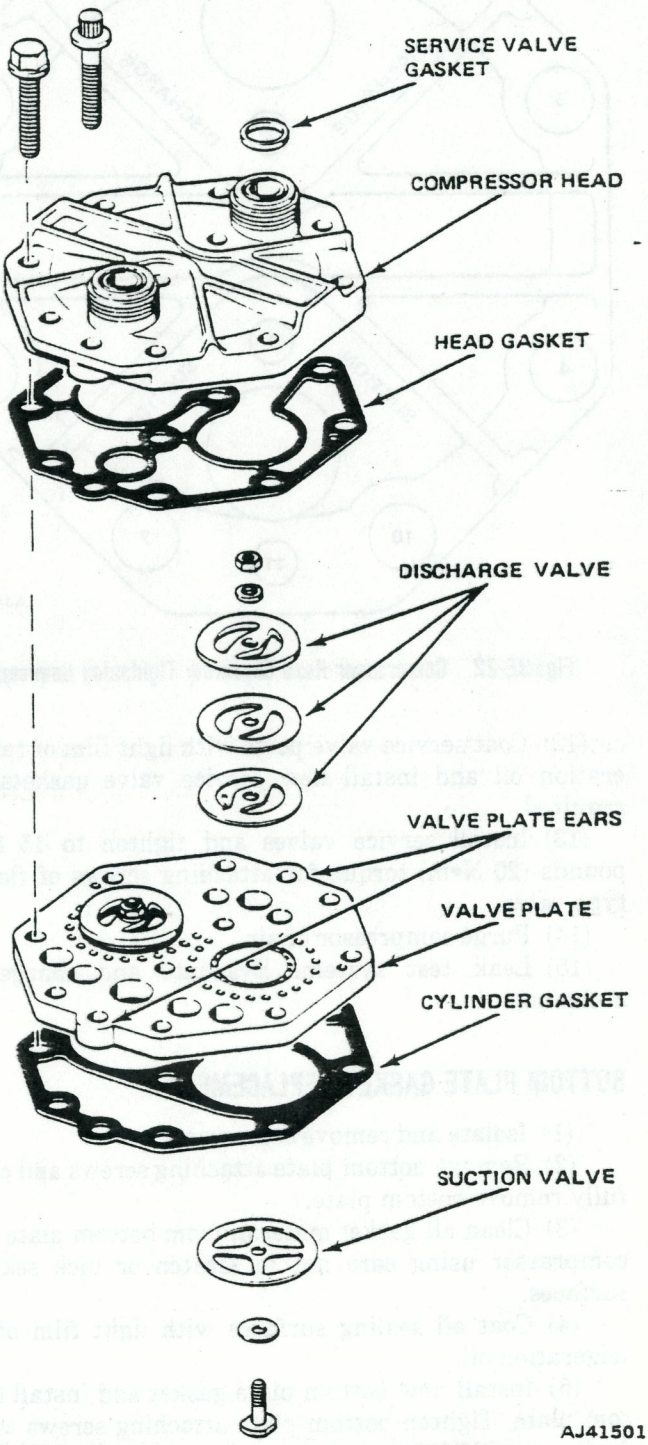


Fig. 3E-21 Head and Valve Plate Assembly Sequence

(10) Install replacement head gasket, locating it on dowel pins.

(11) Install head. Tighten compressor head capscrews to 15 foot-pounds (20 N•m) torque, following sequence outlined in figure 3E-22.

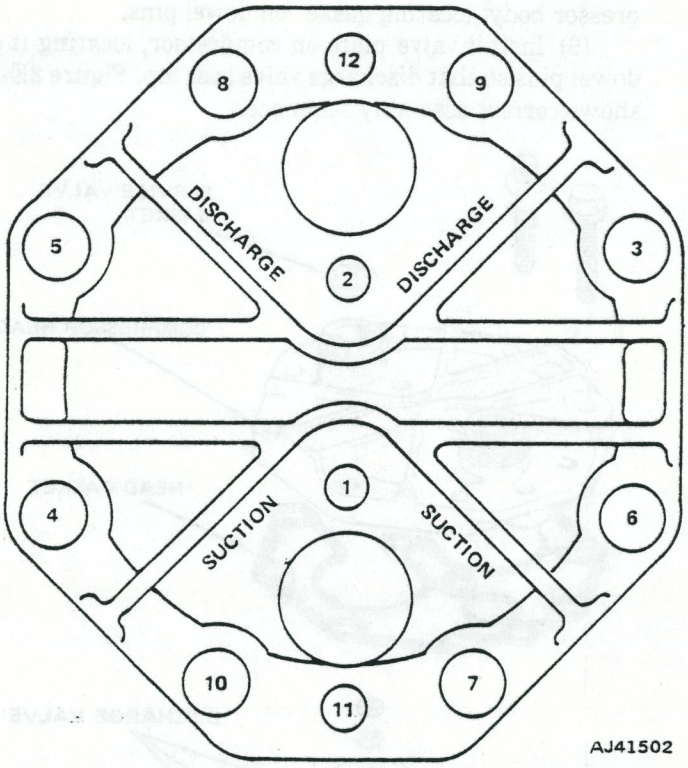


Fig. 3E-22 Compressor Head Capscrew Tightening Sequence

(12) Coat service valve ports with light film of refrigeration oil and install new service valve gaskets, as required.

(13) Install service valves and tighten to 15 foot-pounds (20 N•m) torque for attaching screws of flange type valve.

(14) Purge compressor of air.

(15) Leak test system. Evacuate and charge, if necessary.

BOTTOM PLATE GASKET REPLACEMENT

(1) Isolate and remove compressor.

(2) Remove bottom plate attaching screws and carefully remove bottom plate.

(3) Clean all gasket material from bottom plate and compressor using care not to scratch or nick sealing surfaces.

(4) Coat all sealing surfaces with light film of refrigeration oil.

(5) Install new bottom plate gasket and install bottom plate. Tighten bottom plate attaching screws to 15 foot-pounds (20 N•m) torque.

(6) Install and purge compressor of air.

(7) Leak test system. Evacuate and charge, if necessary.

CHECKING COMPRESSOR OIL LEVEL

Initially, the compressor has 7 ounces of refrigeration oil in the crankcase (Approved oil: Sun Oil Suniso 5, Texaco Capella E, or equivalent). In normal operation, a small amount of oil is always circulating with the refrigerant in the system. Unless the system has developed a leak, the oil level will remain the same in the system.

CAUTION: *The oil level should be checked whenever the system is discharged for a service part replacement, and especially after a rapid loss of refrigerant has occurred.*

NOTE: *Check compressor oil level with compressor in operating position, and only after the vehicle interior air has been cooled to the desired temperature. Operating the system stabilizes the oil entrained in the system, and provides an accurate oil level reading. The oil check plugs are located on either side of the compressor crankcase.*

Before installing a replacement compressor, check the oil level in the compressor to be replaced prior to removing it. The oil level in the replacement compressor must be adjusted to correspond with that of the replaced compressor.

(1) Isolate compressor.

(2) Loosen crankcase oil check plug slowly to release any internal pressure in compressor. Remove check plug when all pressure is relieved.

(3) Fabricate dipstick rod as shown in figure 3E-23.

(4) Hold dipstick as vertical as possible and insert in check plug opening. The oil level should be within specified levels indicated.

(5) Add clean refrigerant oil, if necessary.

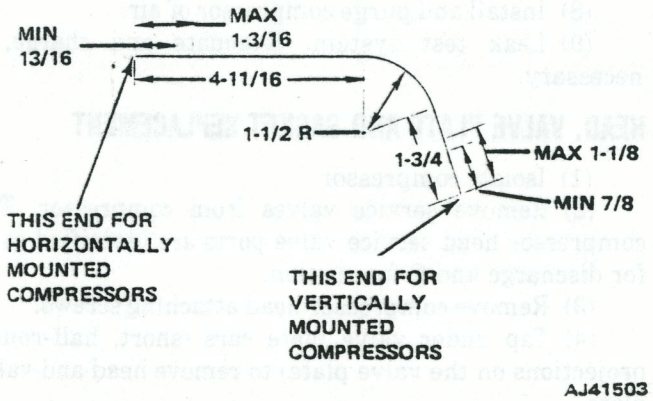


Fig. 3E-23 Oil Dipstick Fabrication Dimensions (Inches)

NOTE: *Refrigeration oil readily absorbs moisture. Keep the container capped until ready to use, and recap immediately after use.*

(6) Install oil check plug O-ring seal. Be sure O-ring is not twisted.

NOTE: *Oil filler plug leaks are usually due to a damaged O-ring or dirt on the seat.*

(7) Install plug and tighten to 4 foot-pounds (5 N•m) torque.

(8) Purge compressor of air.

PURGING COMPRESSOR OF AIR

The compressor must be purged of air whenever it has been isolated for oil level check or other service procedures without discharging the entire system.

(1) Cap service gauge ports on both service valves.

(2) Back-seat the suction service valve to allow system refrigerant to enter compressor.

(3) Place discharge service valve in mid- or cracked-position.

(4) Loosen discharge service valve gauge port cap to permit refrigerant to force any air out of the compressor.

(5) Back-seat the discharge service valve and tighten the gauge port cap.

The compressor is now ready for service.

MAGNETIC CLUTCH

The magnetic clutch consists of a stationary electromagnetic coil and a rotating pulley and plate assembly.

The electromagnetic coil is mounted on four bosses on the compressor. The pulley and plate assembly is mounted on the compressor shaft. When the air conditioner is off, the pulley is free to turn on the clutch hub bearing. When the clutch is energized, the plate is magnetically attracted to the pulley and turns the compressor crankshaft.

Do not attempt to replace the bearing, pulley or clutch plate separately. These components are serviced only as a complete assembly. The coil is serviced as a separate unit.

Electrical Diagnosis

Refer to the Magnetic Clutch Troubleshooting Guide when diagnosing magnetic clutch malfunctions.

Diagnosis for Noisy Clutch

Spin the pulley by hand. There must be no interference between the field and the rotor assembly. The clutch coil must be mounted properly using the special capscrews which position the field coil to the compressor.

A worn pulley bearing can be detected by the roughness felt when spinning the pulley. Do not attempt to replace the bearing. Replace the clutch as an assembly.

A replacement clutch may emit a short squeal when initially engaged. After a few cycles of operation, the noise will disappear.

Clutch Removal

(1) Remove compressor belt(s).

(2) Energize the clutch or use a spanner wrench to hold clutch plate while removing the clutch-to-shaft attaching bolt and washer.

(3) Install a 5/8-inch by 11 standard thread bolt in the threaded center of the clutch plate.

(4) Tighten bolt and pull clutch from shaft.

CAUTION: *Do not pry on clutch to remove.*

(5) Remove four capscrews which retain the magnetic coil and disconnect coil wire. Remove coil.

Clutch Installation

(1) Install magnetic coil with the four special capscrews provided with the replacement unit. These capscrews are used to ensure coil is positioned properly on the compressor.

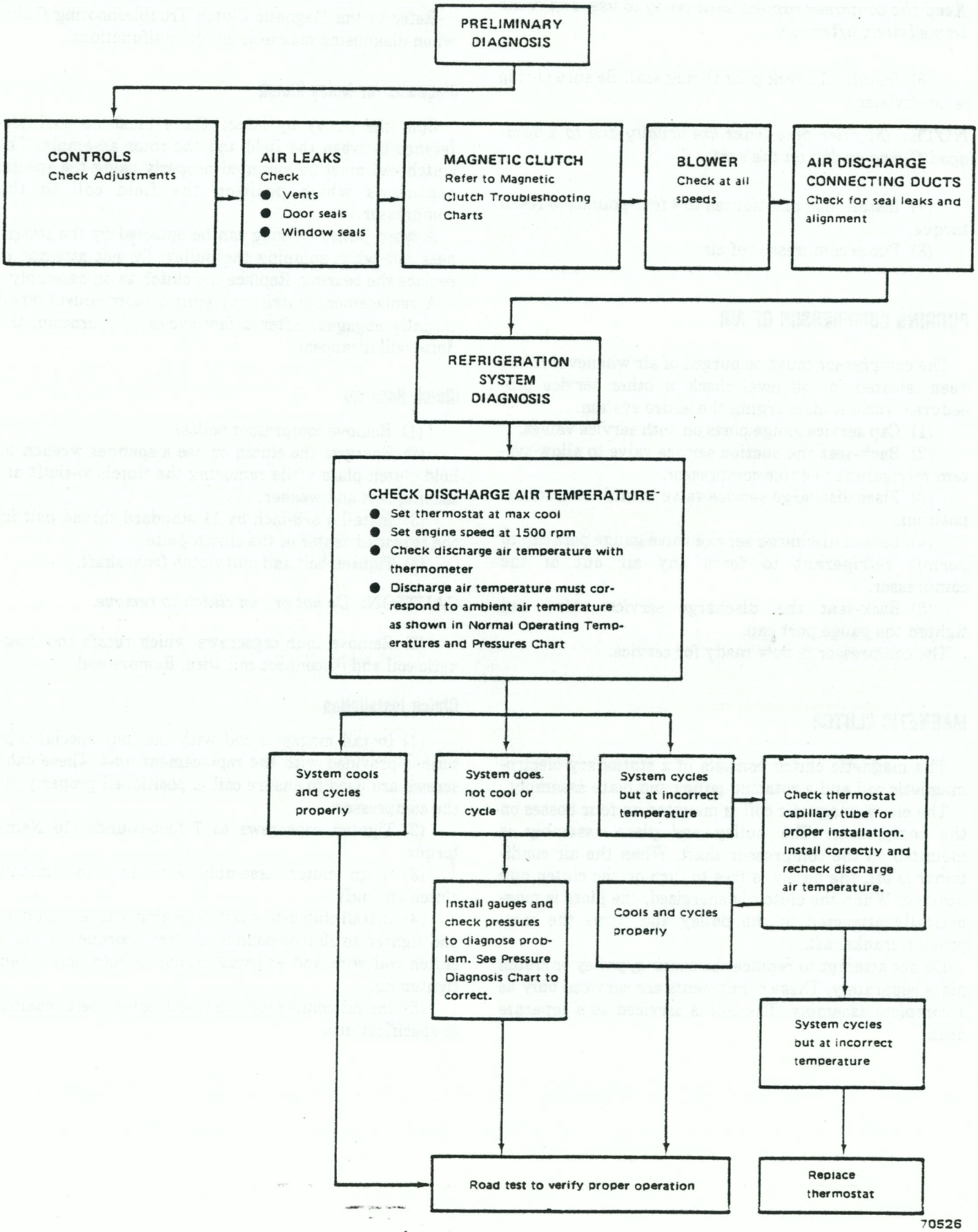
(2) Tighten capscrews to 7 foot-pounds (10 N•m) torque.

(3) Align clutch assembly with key and install clutch on shaft.

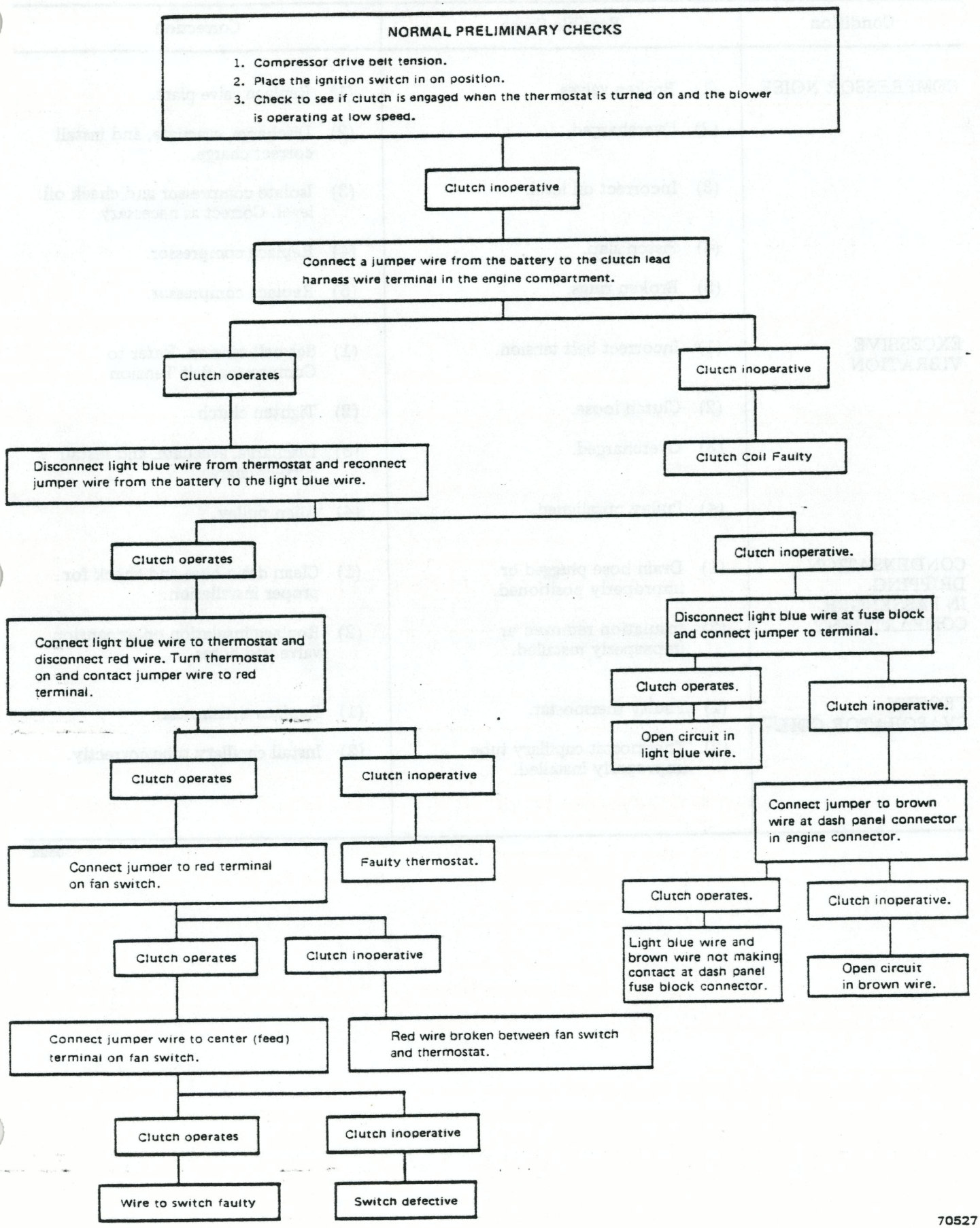
(4) Install clutch-to-shaft attaching washer and bolt and tighten to 20 foot-pounds (27 N•m) torque. Connect clutch coil wire and energize clutch to hold unit when tightening.

(5) Install compressor belt and adjust belt tension to specifications.

System Troubleshooting



Magnetic Clutch Troubleshooting



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Performance Diagnosis—All Models

Condition	Possible Cause	Correction
COMPRESSOR NOISE	(1) Broken valves.	(1) Replace valve plate.
	(2) Overcharged.	(2) Discharge, evacuate, and install correct charge.
	(3) Incorrect oil level.	(3) Isolate compressor and check oil level. Correct as necessary.
	(4) Piston slap.	(4) Replace compressor.
	(5) Broken rings.	(5) Replace compressor.
EXCESSIVE VIBRATION	(1) Incorrect belt tension.	(1) Set belt tension. Refer to Compressor Belt Tension
	(2) Clutch loose.	(2) Tighten clutch.
	(3) Overcharged.	(3) Discharge, evacuate, and install correct charge.
	(4) Pulley misaligned.	(4) Align pulley.
CONDENSATION DRIPPING IN PASSENGER COMPARTMENT	(1) Drain hose plugged or improperly positioned.	(1) Clean drain hose and check for proper installation.
	(2) Insulation removed or improperly installed.	(2) Replace insulation on expansion valve and hoses.
FROZEN EVAPORATOR COIL	(1) Faulty thermostat.	(1) Replace thermostat.
	(2) Thermostat capillary tube improperly installed.	(2) Install capillary tube correctly.

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Pressure Diagnosis—All Models

Condition	Possible Cause	Correction
LOW SIDE LOW—HIGH SIDE LOW	(1) System refrigerant low.	(1) Evacuate, leak test, and charge system.
LOW SIDE HIGH—HIGH SIDE LOW	(1) Internal leak in compressor — worn.	(1) Remove compressor cylinder head and inspect compressor. Replace valve plate assembly if necessary. If compressor pistons, rings, or cylinders are excessively worn or scored, replace compressor.
	(2) Head gasket leaking.	(2) Install new cylinder head gasket.
	(3) Expansion valve.	(3) Replace expansion valve.
	(4) Drive belt slipping.	(4) Set belt tension.
LOW SIDE HIGH—HIGH SIDE HIGH	(1) Clogged condenser fins.	(1) Clean out condenser fins.
	(2) Air in system.	(2) Evacuate, leak test, and charge system.
	(3) Expansion valve.	(3) Replace expansion valve.
	(4) Loose or worn fan belts.	(4) Adjust or replace belts as necessary.
LOW SIDE LOW—HIGH SIDE HIGH	(1) Expansion valve.	(1) Replace expansion valve.
	(2) Restriction in liquid line.	(2) Check line for kinks — replace if necessary.
	(3) Restriction in receiver.	(3) Replace receiver.
	(4) Restriction in condenser.	(4) Replace condenser.
LOW SIDE AND HIGH SIDE NORMAL (INADEQUATE COOLING)	(1) Air in system.	(1) Evacuate, leak test, and charge system.
	(2) Moisture in system.	(2) Evacuate, leak test, and charge system.

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SERVICE PROCEDURES — CALIFORNIA SIX-CYLINDER MODELS

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Compressor Front Seal Replacement	3E-30
Compressor Head, Valve Plate and Gasket Replacement	3E-32
Compressor Valve Leak Diagnosis	3E-29
Compressor Replacement	3E-30
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GENERAL

This section consists of a general description of each component and the system operation of all components used with the California six-cylinder engine. Service information for the rotary compressor and magnetic clutch, which are unique to vehicles equipped with the California six-cylinder engine, is also contained within this section. All other service information can be found in the CJ Air Conditioning and Cherokee-Wagoneer-Truck Air Conditioning sections or the General Information section of this chapter.

The air conditioning system components used with the California six-cylinder engine are as follows.

Compressor—The compressor on the California six-cylinder engine, is a five-cylinder rotary unit driven by a serpentine drive single belt system (fig. 3E-24). The compressor is used to circulate and increase the pressure

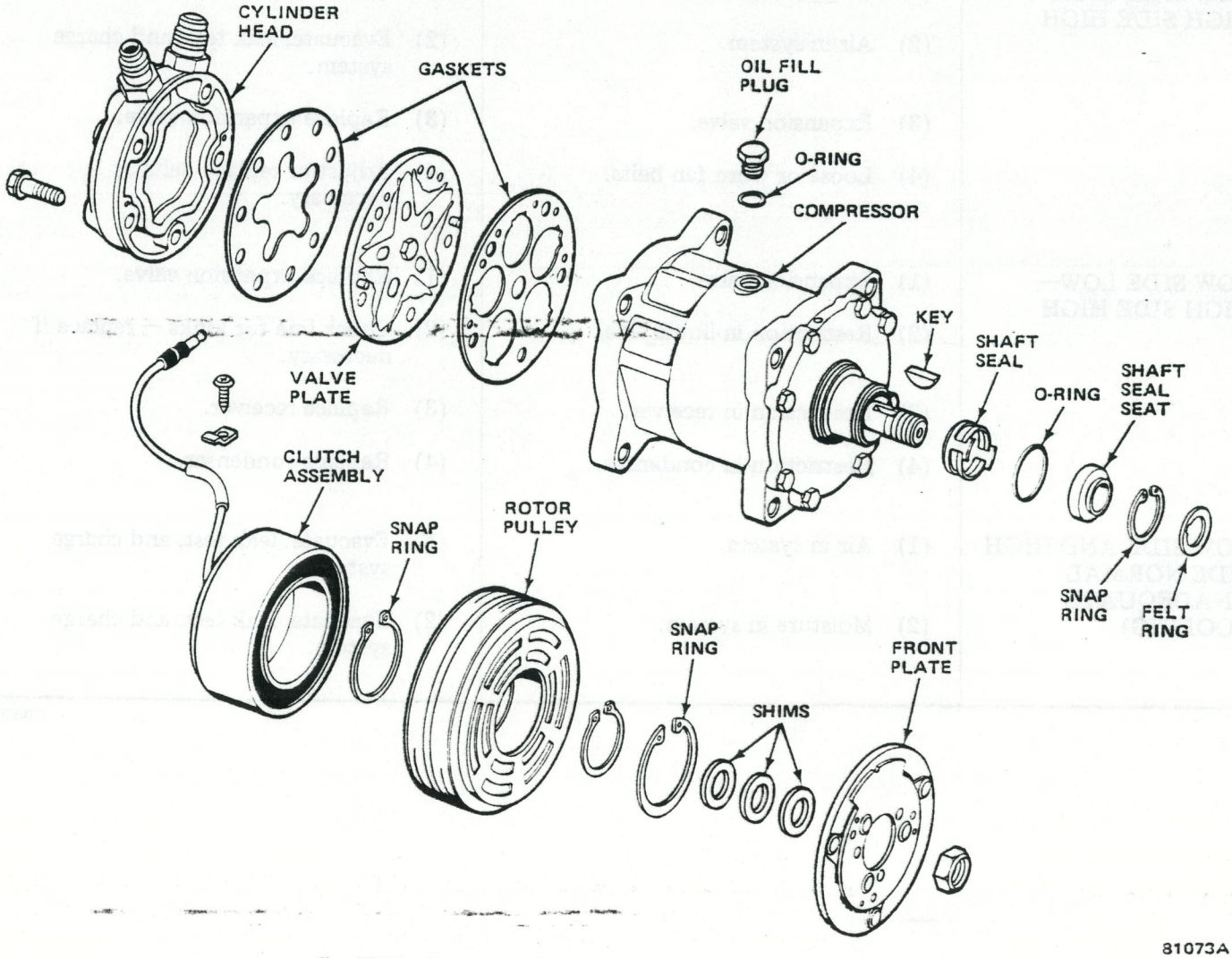

Fig. 3E-24 Compressor Components—California Six-Cylinder Engine

of the refrigerant in the system. Refer to the Trouble-shooting chart at the end of this section for Diagnosis Procedures. The compressor is mounted to the engine as shown in figure 3E-25.

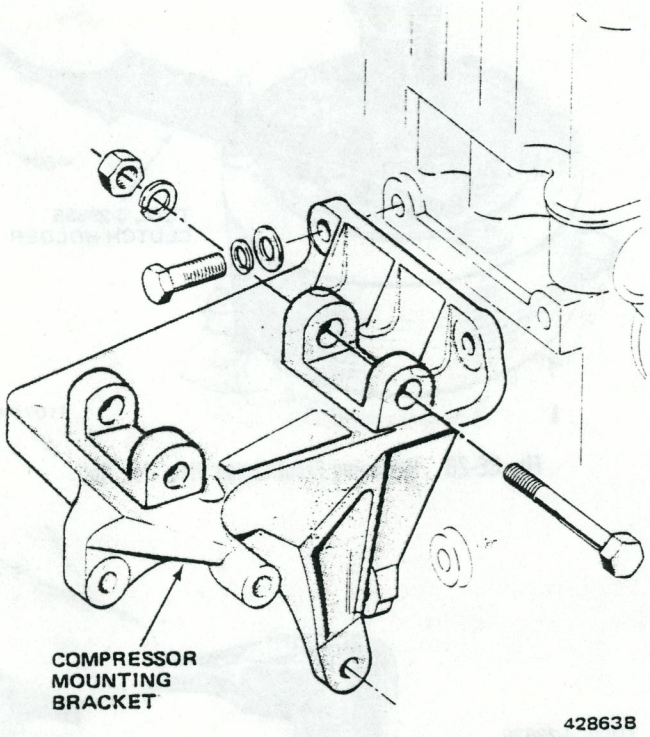

Fig. 3E-25 Compressor Mounting—California Six-Cylinder Engine

Condenser—The condenser is mounted in front of the radiator to allow air to flow over the cooling fins and remove heat from the refrigerant. As the refrigerant passes through the condenser, it liquifies (condenses).

Receiver/Drier—The receiver/drier is a reservoir used to store the precise amount of refrigerant required by the system. The refrigerant level in the receiver/drier must be adequate to provide a steady flow of refrigerant to the expansion valve. The receiver/drier contains a desiccant to remove moisture from the system. The receiver/drier must be replaced anytime the system has been open to atmosphere due to a system component failure. If during servicing the receiver/drier is removed from the system, it must be tightly capped immediately.

Expansion Valve—The thermostatic expansion valve is located at the inlet of the evaporator. It meters the refrigerant to the evaporator, so as to maintain the proper flow for the various evaporator heat load requirements encountered during operation. The metering action of the expansion valve is controlled by the temperature sensing bulb mounted on the outlet (suction) line of the evaporator.

Evaporator—The evaporator is an air cooler and dehumidifier. As the refrigerant enters the evaporator core, it begins to boil. The heat in the air passing over the evaporator transfers or gives up its heat to the boiling refrigerant. As the air cools, the moisture in the air condenses on the evaporator core and is drained off as water.

SYSTEM OPERATION

The compressor increases the pressure and temperature of the system refrigerant. The heated refrigerant vapor is then pumped into the condenser where it cools by giving off heat to air passing over the condenser fins. As the refrigerant cools in the condenser, it condenses into a liquid. Still under high pressure, the liquid refrigerant passes into the receiver. The receiver acts as a reservoir to furnish refrigerant to the expansion valve at all times. From the receiver, the high pressure liquid refrigerant passes to the expansion valve. The expansion valve meters refrigerant into the evaporator where a low pressure is maintained by the suction side of the compressor. As it enters the evaporator, the refrigerant immediately begins to boil by absorbing heat from the air passing over the evaporator core. Having given up its heat to boil the refrigerant, the air is cooled and passes into the passenger compartment of the vehicle. From the evaporator the vaporized refrigerant is drawn back to the compressor to repeat the cycle.

COMPRESSOR VALVE LEAK DIAGNOSIS

The compressor should be at operating temperature to perform an accurate test.

(1) Install pressure gauge and Manifold Assembly J-23575.

(2) Front-seat suction and discharge service valve by turning them clockwise.

(3) Discharge refrigerant remaining in compressor by opening suction service valve **slowly**.

(4) Open suction gauge hand valve and close high pressure gauge hand valve.

(5) Start engine and operate compressor. Pressure will build up rapidly. Stop engine/compressor at 150 to 200 pounds pressure.

NOTE: *Pressure should hold if the discharge valve is operating properly. Loss of pressure indicates leaking compressor discharge valve or head gasket.*

COMPRESSOR BELT TENSION

For the serpentine drive belt tension procedure refer to Section 1C.

ISOLATING THE COMPRESSOR

It is not necessary to discharge the system for compressor removal. The compressor can be isolated from the remainder of the system eliminating the need for recharging when performing compressor service.

(1) Connect pressure gauge and Manifold Assembly J-23575.

(2) Close both gauge hand valves and mid-position (crack) both service valves.

(3) Start engine and operate air conditioning.

(4) Turn suction service valve slowly clockwise toward front-seated position. When suction pressure is reduced to zero or less, stop engine and compressor and quickly finish front-seating suction service valve.

(5) Front-seat discharge service valve.

(6) Loosen oil check plug slowly to release any internal pressure in compressor. The compressor is now isolated from remainder of system. Service valves can be removed from compressor.

COMPRESSOR REPLACEMENT

Removal

(1) Disconnect battery negative cable.

(2) Isolate the compressor (see previous procedure).

(3) Remove discharge and suction hoses from compressor, then cover all openings with tape or plastic plugs.

(4) Remove drive belts by loosening alternator.

(5) Remove alternator from mounting bracket and lay aside.

(6) Remove compressor from engine mounting bracket.

Installation

(1) Install compressor to engine mounting bracket.

(2) Install alternator to alternator mounting bracket.

(3) Install drive belt and tighten as specified in Section 1C.

(4) Remove tape or plastic plugs from all suction and discharge openings and install hoses on compressor.

(5) Evacuate and charge system as described under General Information.

(6) Connect battery negative cable.

COMPRESSOR FRONT SEAL REPLACEMENT

(1) Remove compressor.

(2) Insert two pins of Front Plate Spanner J-29635 into any two bolt holes in clutch front plate (fig. 3E-26). Hold clutch plate stationary and remove nut.

(3) Remove clutch plate using Clutch Plate Puller J-29636, and remove key from shaft (fig. 3E-27).

(4) Using snap ring pliers, insert pliers into two holes in felt ring metal retainer and lift out felt ring.

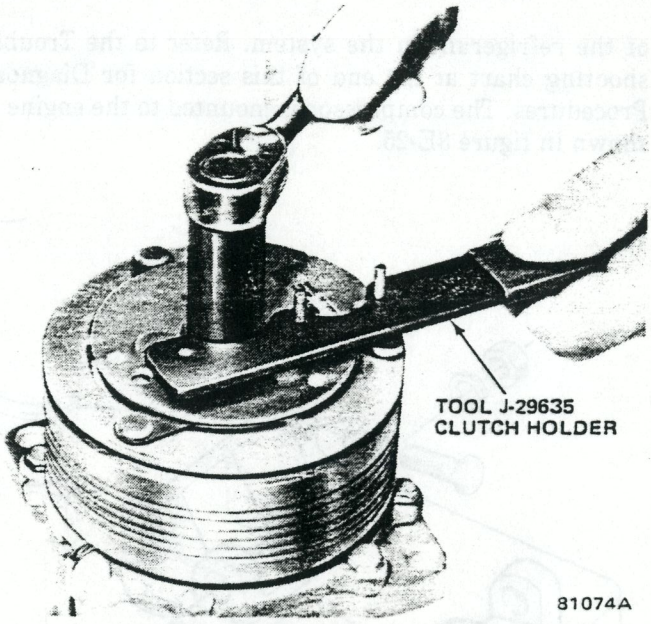

Fig. 3E-26 Removing Front Clutch Plate Hex Nut

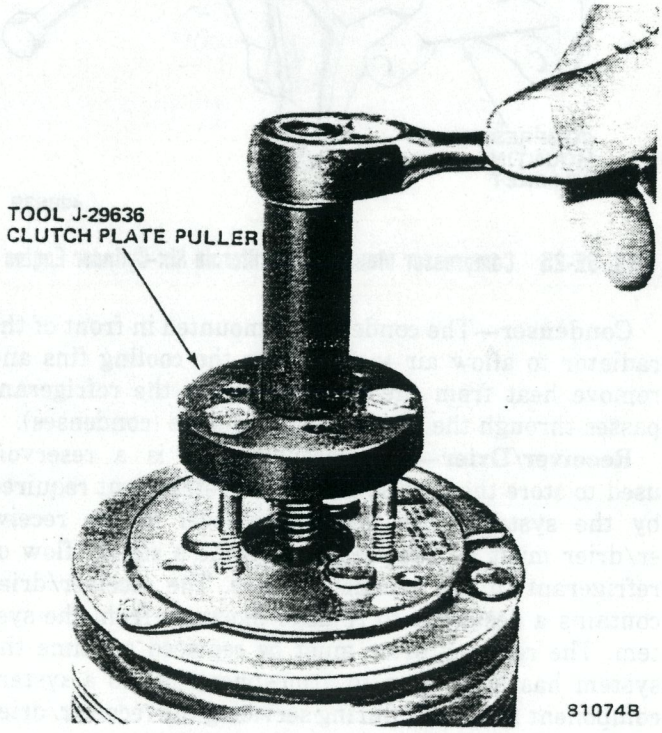

Fig. 3E-27 Removing Front Clutch Plate with Puller

(5) Remove clutch shims. Use O-ring hook and small screwdriver to prevent shim from binding on shaft.

(6) Remove shaft seal seat retaining snap ring with pliers.

(7) Remove shaft seal seat using Seal Retainer Tongs J-9393-2 (fig. 3E-28).

CAUTION: *When removing shaft seal O-ring, do not scratch the O-ring groove with O-ring hook.*

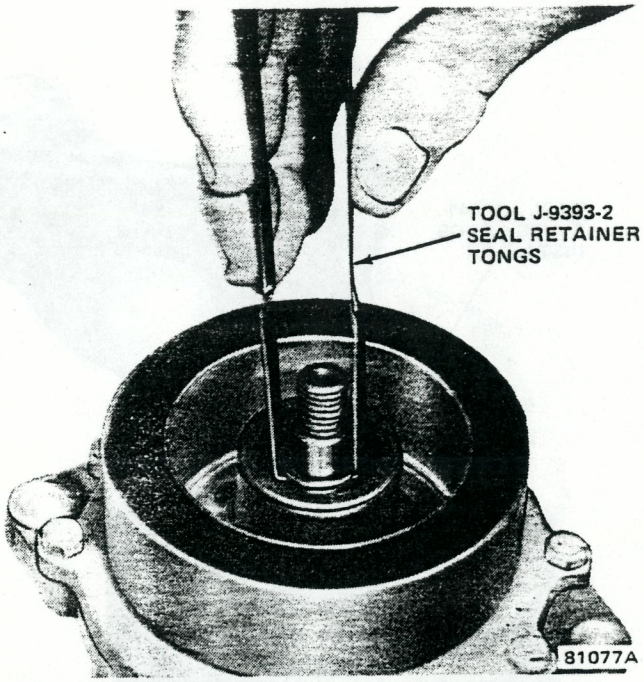

Fig. 3E-28 Removing Shaft Seal Seat Using Tongs

(8) Use O-ring Hook J-9553-01 to remove shaft seal O-ring (fig. 3E-29).

(9) Insert Seal Installer and Remover J-29639 into seal bore, press down against seal spring and twist tool until it engages in slots in seal cage and lift seal out (fig. 3E-30).

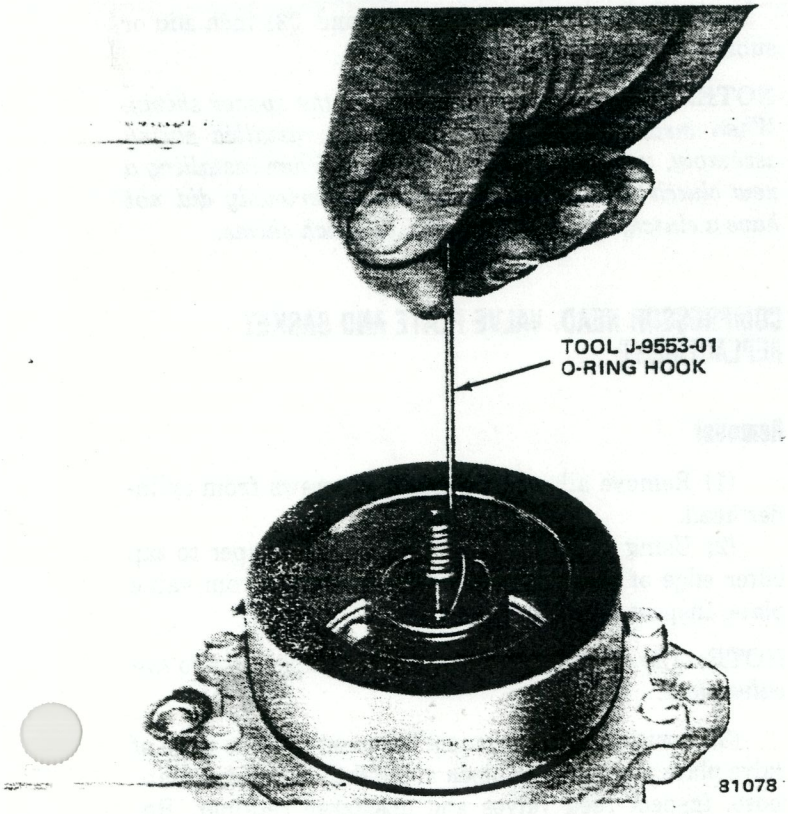

Fig. 3E-29 Removing O-Ring

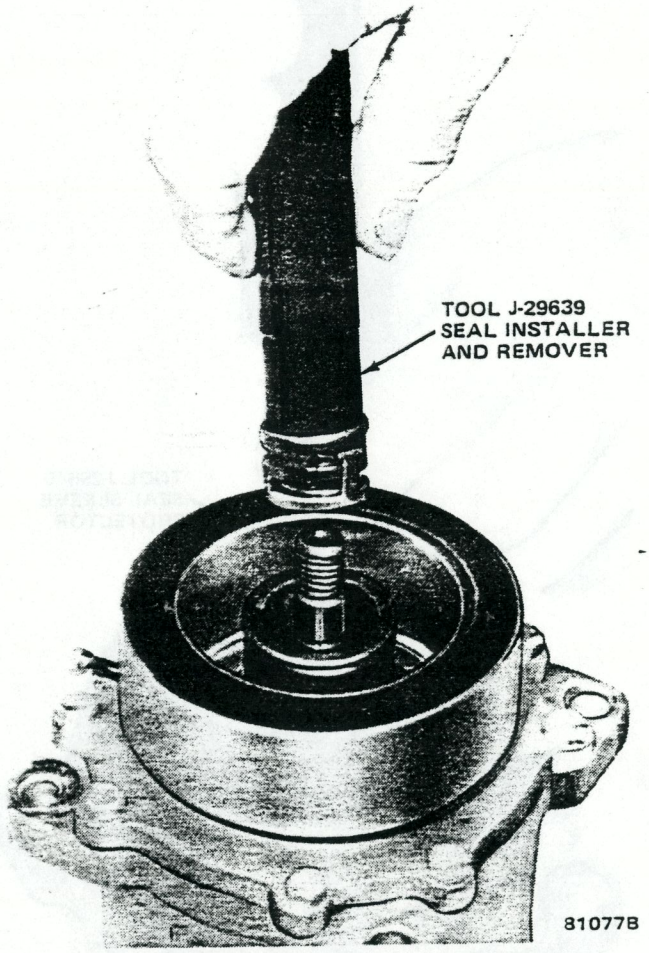

Fig. 3E-30 Removing Shaft Seal

(10) Clean seal cavity thoroughly with "lint-free" or synthetic cloth and clean refrigerant oil and then blow out with clean dry air.

NOTE: *Be sure all foreign materials are removed from the seal bore prior to seal installation.*

(11) Insert Seal Sleeve Protector J-29640 over compressor shaft (fig. 3E-31).

CAUTION: *Do not touch the new seal lapping surfaces.*

(12) Dip mating surfaces of seal lapping surfaces in clean refrigerant oil.

(13) Engage slots of Seal Remover and Installer J-29639 in slots in seal cage and insert seal assembly firmly into place in compressor seal cavity. Twist tool in opposite direction to disengage tool from seal cage (fig. 3E-30).

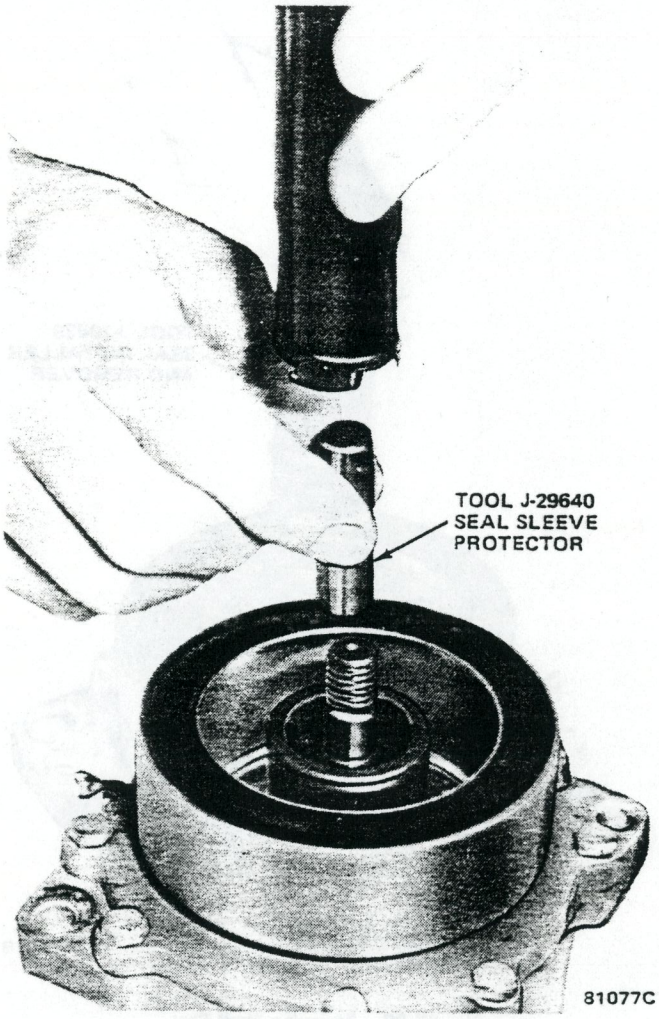

Fig. 3E-31 Shaft Seal Replacement

CAUTION: *When installing shaft seal O-ring, do not scratch the O-ring groove with O-ring hook.*

(14) Coat O-ring with clean refrigerant oil and carefully place in seal groove with O-ring Hook J-9553-01.

(15) Coat seal retainer with clean refrigerant oil and install with Seal Retainer Tongs J-9393-2. Press retainer lightly against seal.

(16) Install snap ring with beveled edge outward (away) from compressor.

NOTE: *It may be necessary to lightly tap the snap ring to seat it in its groove.*

(17) Install clutch spacer shims.

(18) Tap new felt ring into place and install compressor shaft key.

(19) Align front plate keyway to compressor shaft key.

(20) Using Clutch Face Installer J-29641 (fig. 3E-32), tap front plate to shaft until it has bottomed on clutch shims.

NOTE: *When the front plate bottoms on the shims a distinct sound change will take place.*

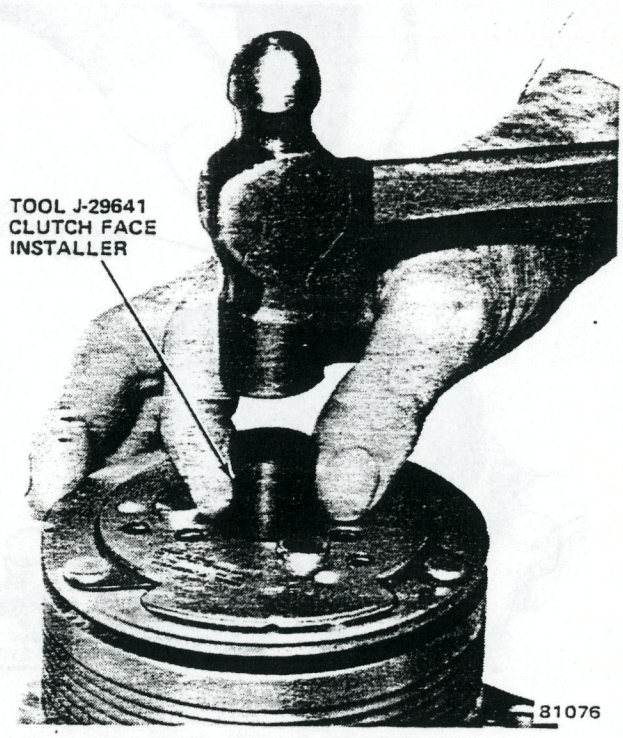

Fig. 3E-32 Front Plate Installation

(21) Install shaft nut and torque to 25 to 30 foot-pounds (34 to 41 N•m).

(22) Check air gap with feeler gauge which must be between .016 and .031 inch. If air gap is not consistent pry up lightly at minimum variations and tap down lightly at points of maximum variation.

If the air gap is not between .016 and .031 inch add or subtract shims as necessary.

NOTE: *The air gap is controlled by the spacer shims. When installing a new or previously installed clutch assembly, try the original shims first. When installing a new clutch onto a compressor that previously did not have a clutch, use .040, .020 and .005-inch shims.*

COMPRESSOR HEAD, VALVE PLATE AND GASKET REPLACEMENT

Removal

(1) Remove all cylinder head capscrews from cylinder head.

(2) Using small hammer and gasket scraper to tap outer edge of cylinder head until separated from valve plate. Inspect for damage.

NOTE: *The cylinder head gasket normally sticks to the valve plate.*

(3) Position gasket scraper between outside edge of valve plate and cylinder block and lightly tap valve plate loose. Inspect reed valves and discharge retainer. Replace any damaged portion.

CAUTION: *When cleaning gasket material from cylinder head or valve plate of cylinder head be careful not to damage machined surfaces.*

(4) If valve plate and/or cylinder head are to be reinstalled, carefully remove gasket materials with gasket scraper.

(5) Inspect cylinder head for fitting or thread damage. Replace cylinder head if damaged.

(6) Inspect service ports on back of cylinder head. Remove valve core with valve core tool to inspect.

(7) Remove service port to inspect O-ring; if damaged replace O-ring.

Installation

(1) Coat valve plate gasket with clean refrigerant oil.

(2) Install valve plate gasket.

NOTE: *Align valve plate gasket to locating pin holes and oil orifice in cylinder block.*

(3) Install cylinder head with fittings pointing up or in line with oil filler plug.

(4) Insert cylinder head capscrews finger-tight. Torque cylinder head bolts to 22 to 25 foot-pounds (30 to 25 N•m) torque following torque sequence (fig. 3E-33).

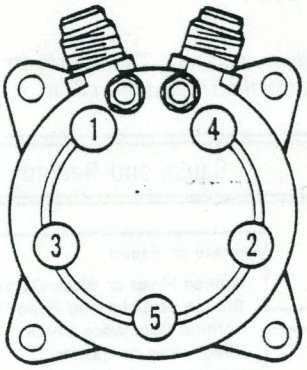

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Fig. 3E-33 Cylinder Head Bolt Tightening Sequence

Checking Compressor Oil Level

When replacing a compressor that contains uncontaminated oil, use the following oil level check.

(1) Drain oil from new compressor.

(2) Drain and measure oil from old compressor.

(3) Measure new oil equal to amount drained from old compressor and add one ounce of additional oil. Fill new compressor with this oil.

NOTE: *This compressor is a high-speed compressor. Satisfactory operation depends on sufficient lubrication, however too much oil decreases cooling efficiency.*

MAGNETIC CLUTCH

The magnetic clutch consists of a stationary electromagnetic coil and a rotating pulley and plate assembly.

The electromagnetic coil is retained on the compressor with a snap ring and is slotted to maintain its position.

The pulley and plate assembly are mounted on the compressor shaft. When the compressor is not pumping, the pulley freewheels on the clutch hub bearing. When the coil is energized the plate is magnetically engaged with the pulley and turns the compressor shaft.

Magnetic Clutch Noise Diagnosis

When a magnetic clutch assembly is suspected of being the source of unusual noises, follow the sequence given on the Troubleshooting Chart.

Magnetic Clutch Removal

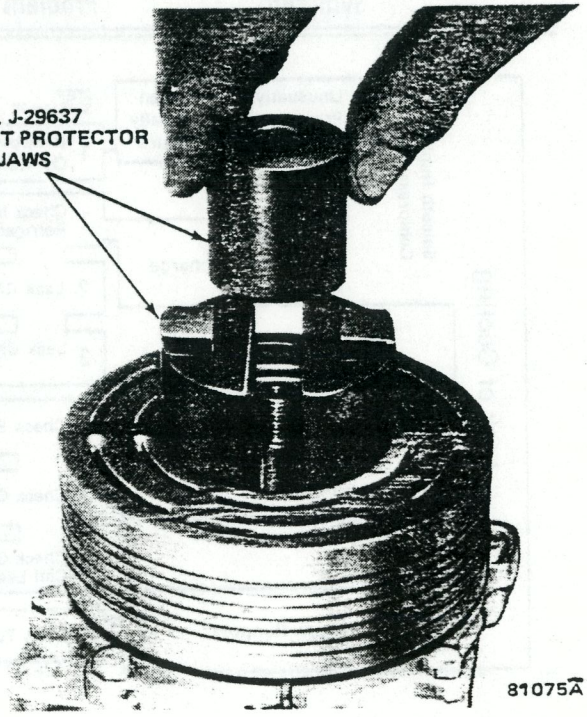
(1) Insert two pins of front plate spanner J-29635 into any two bolt holes in front clutch plate. Hold clutch plate stationary and remove nut as shown in figure 3E-26.

(2) Remove clutch plate using Clutch Plate Puller J-29636 and remove key from shaft as shown in figure 3E-27.

(3) Remove internal bearing snap ring.

(4) Remove external front snap ring.

(5) Remove rotor pulley assembly using Shaft Protector and Jaws J-29637 as shown in figure 3E-34. Insert lip of jaws into internal bearing snap ring groove. Place rotor puller shaft protector over exposed compressor shaft. Align thumb head bolts to puller jaws and finger-tighten. Turn puller center bolt clockwise to remove rotor pulley.



81075A

Fig. 3E-34 Removing Rotor Pulley with Jaws Installed

(6) Remove field coil lead wire from clip on top of compressor front housing.

(7) Using snap ring pliers remove snap ring and then remove field coil.

Magnetic Clutch Installation

(1) Install field coil.

NOTE: *Coil flange protrusion must align with hole in front housing to prevent coil movement and correctly locate lead wire.*

(2) Support compressor by four mounting ears on rear of compressor. Do not clamp compressor in vise with jaws on compressor body.

(3) Align rotor assembly squarely on front housing hub. Use suitable driver to drive rotor assembly onto shaft.

(4) Install internal bearing snap ring and then external bearing snap ring.

NOTE: *All snap rings have a straight edge and a beveled edge on the circumference. Position the snap rings so that the flat edge is toward the compressor and the beveled edge is outward.*

(5) Install front plate assembly using original clutch shims on compressor shaft.

(6) Install compressor shaft key.

(7) Align front plate keyway to compressor shaft key and using Clutch Face Installer J-29641 tap front plate onto shaft until it bottoms on clutch shims as shown in figure 3E-32.

NOTE: *When installing the front plate a distinct change in the sound will be heard when the front plate bottoms.*

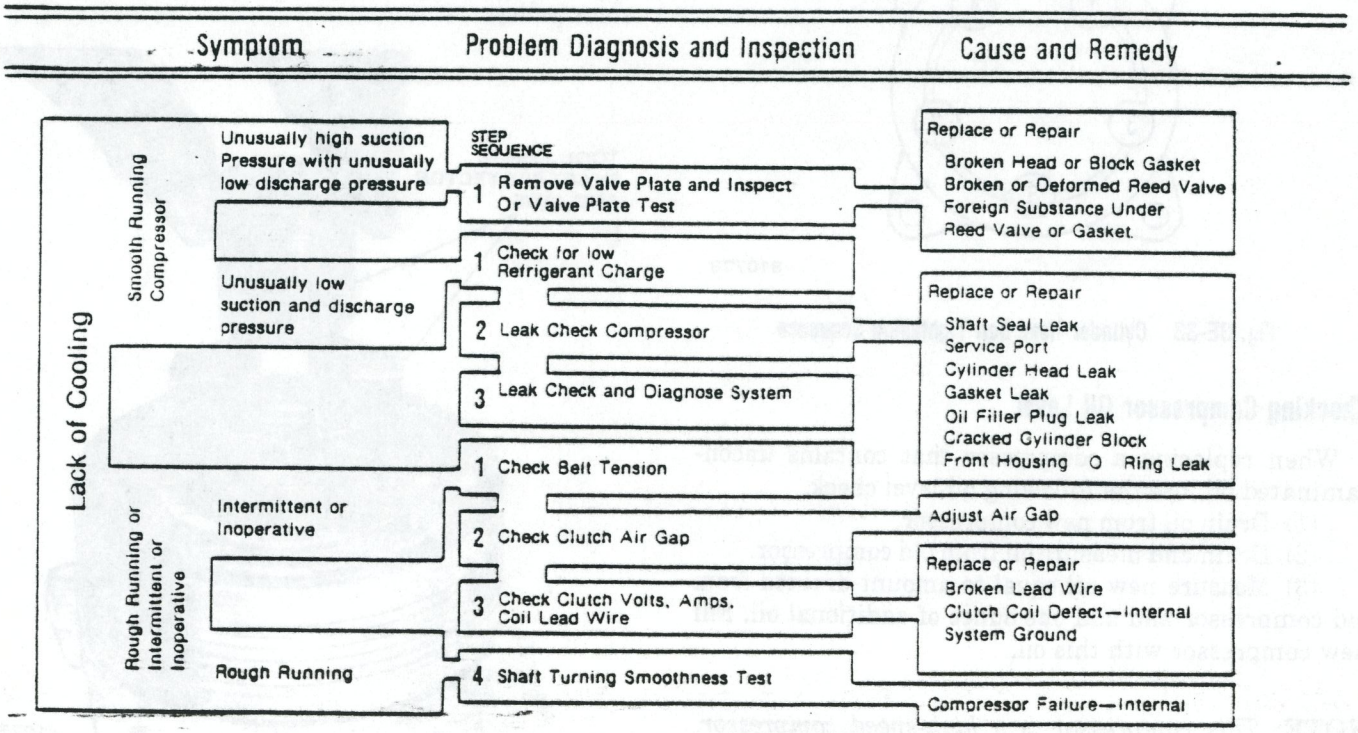
(8) Install hex nut and torque to 25 to 30 foot-pounds (34 to 41 N•m) torque.

(9) Check air gap with feeler gauge. Air gap should consistently be .016-.031 inch around circumference of magnetic clutch. If air gap varies, pry up lightly at minimum variations and tap down at maximum variations. If air gap does not meet specifications remove hex nut and front plate.

NOTE: *The air gap is determined by the spacer shims. When assembling existing or new clutch components try the original shims first. When installing a new clutch onto a compressor that previously had no clutch use a .040-.020 and .005-inch shim.*

TROUBLE SHOOTING CHART

During diagnosis follow the inspection procedures in the sequence shown until a defect is found. Then perform the repair in the Cause and Remedy Section. If this repair does not fully solve the problem, proceed to the next Inspection Step.



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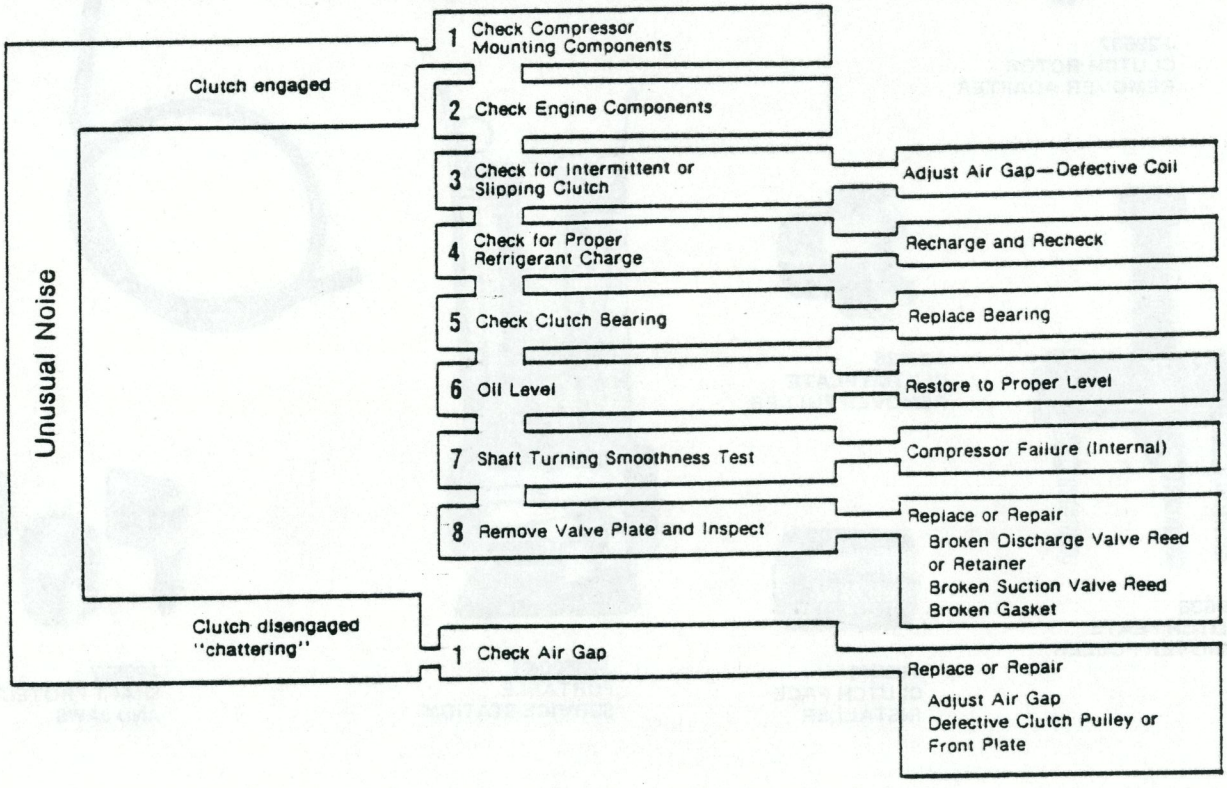
TROUBLE SHOOTING CHART (Continued)

During diagnosis follow the inspection procedures in the sequence shown until a defect is found. Then perform the repair in the Cause and Remedy Section. If this repair does not fully solve the problem, proceed to the next Inspection Step.



81152

SPECIFICATIONS

Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft-lbs)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
A/C Service Valve (Flange Type)	15	13-17	20	17-24
A/C Service Valve (Rototype)	Wet Torque			
Clutch Retaining Nut	27	25-30	37	34-39
Cylinder Head Cap Screws	24	22-25	33	30-34
Discharge Hose Fitting	20	18-22	27	24-30
Oil Filler Plug	24	22-25	33	30-34
Suction Hose Fitting 5/8 inch Flange				

All Torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

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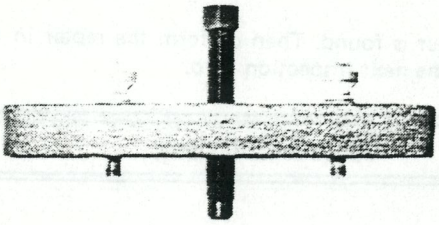
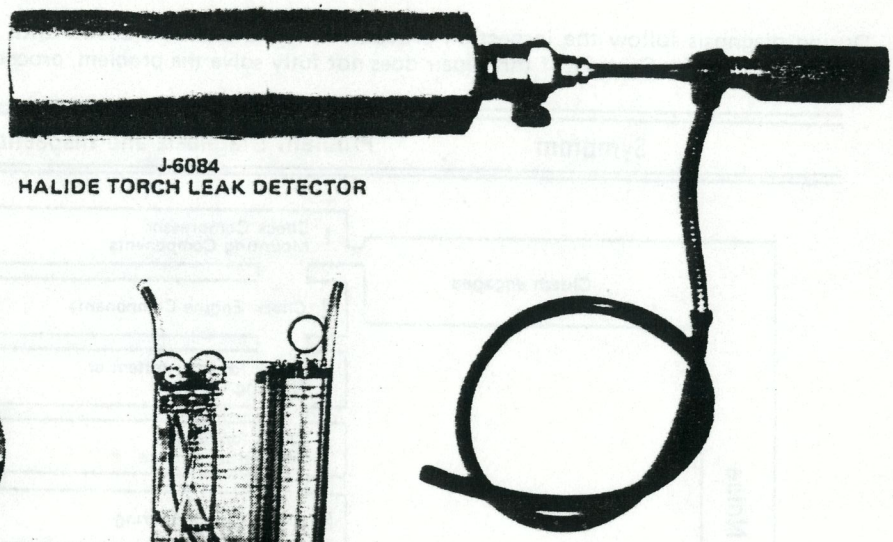
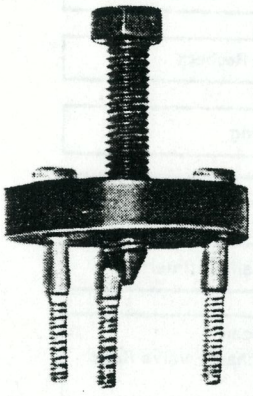
TOOLS



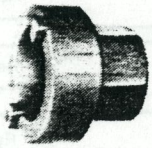
J-29637
CLUTCH ROTOR
REMOVER ADAPTER



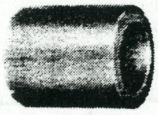
J-6084
HALIDE TORCH LEAK DETECTOR



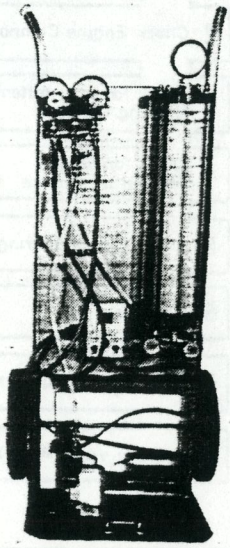
J-29636
CLUTCH PLATE
REMOVER PULLER



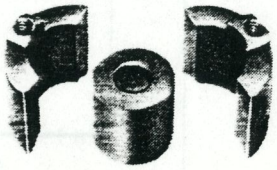
J-29636
CLUTCH PLATE
REMOVER PULLER



J-29641
CLUTCH FACE
INSTALLER

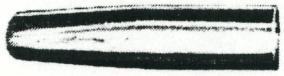


J-23500-01
PORTABLE
SERVICE STATION



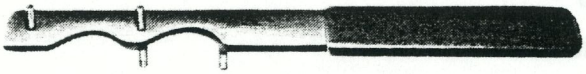
J-29637
SHAFT PROTECTOR
AND JAWS

J-6105
1/4-INCH RATCHET

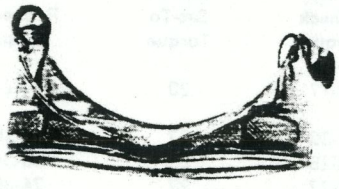


J-22974
SHAFT SEAL
PROTECTOR

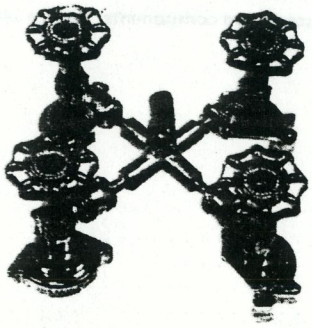
J-9392
SEAL REMOVER



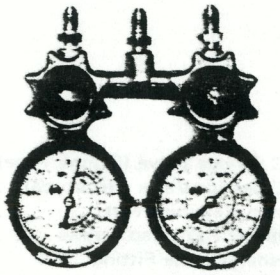
J-29635
CLUTCH HOLDER



J-5453
GOGGLES



J-6272-02
NO. 4 MULTI-REFRIGERANT
CAN OPENER



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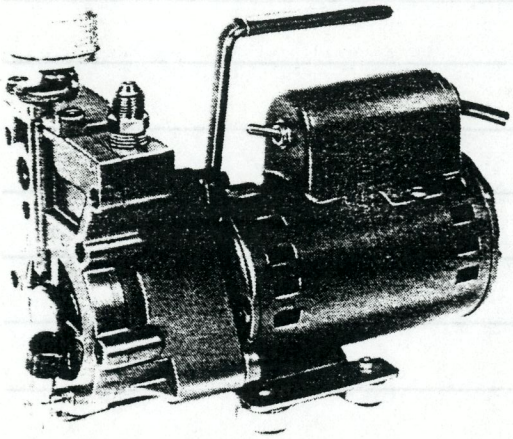
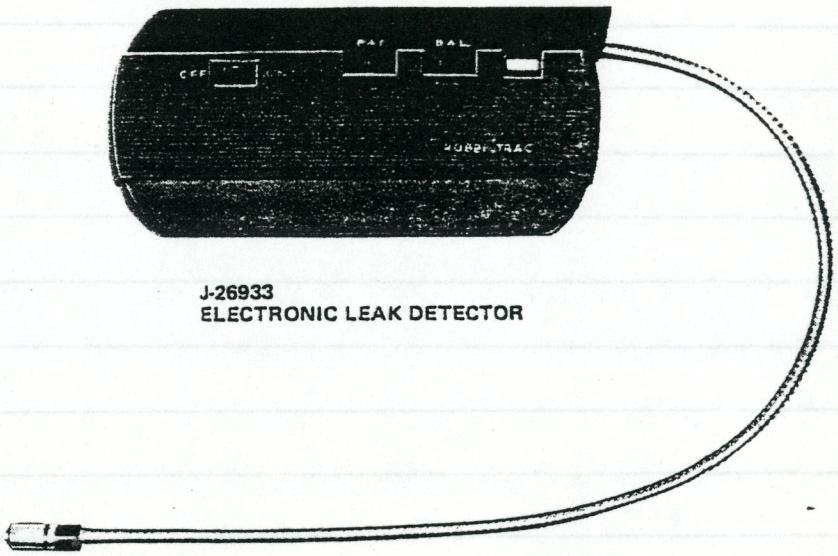
Tools

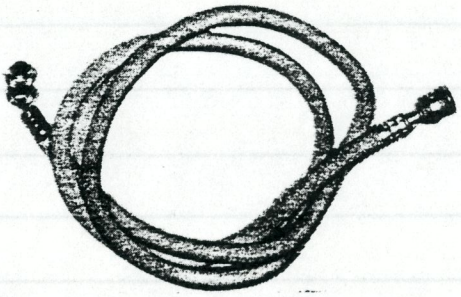


J-26695
VACUUM PUMP



J-26933
ELECTRONIC LEAK DETECTOR

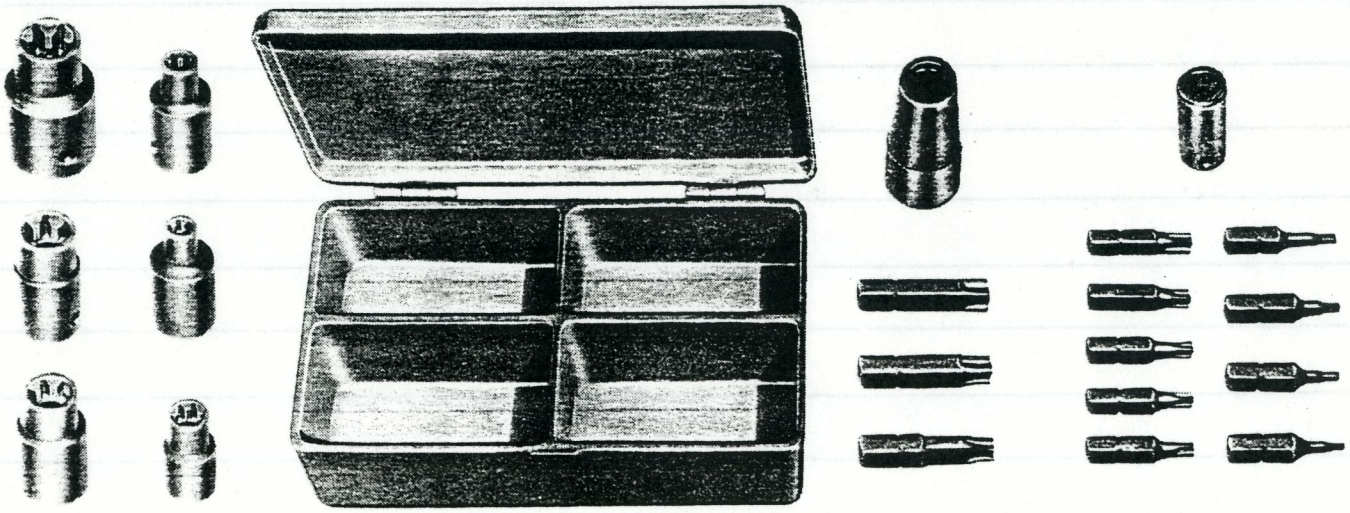
BLUE



WHITE

RED

J-23575 PRESSURE GAUGE AND MANIFOLD ASSEMBLY



J-25359-02
TORX BIT AND SOCKET SET

42866

NOTES

BODY AND FRAME COMPONENTS 3F

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BODIES

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BODY CONSTRUCTION

General

Jeep vehicles are of all-steel construction, with insulated body mounting points that provide a secure attachment to the chassis frame.

All major body panels are of heavy gauge steel, reinforced, flanged, and welded. The bodies are completely detachable from the chassis unit and are insulated from the frame by body spacers placed between the body and frame and held in position with body bolts.

Spacers are located between the body and chassis mounting points to insulate against vibrations and road noises.

Periodic inspection is necessary to determine the condition of body spacers and holddown bolts. Worn, loose, or fatigued spacers permit the body to settle causing body lean or possible interference between the floorpan and various chassis components.

BODY MOULDINGS

Trim Mouldings

Trim mouldings on the front fenders, front and rear doors and rear quarter are attached with adhesive backing and/or screws and snap-in clips. To replace mouldings, remove attaching screws and use a wedge-shaped fiber stick to pry mouldings from body.

Rocker Panel Mouldings

The CJ rocker panel mouldings are attached with studs and nuts. To replace rocker panel mouldings, remove attaching nuts and remove moulding.

FRAMES

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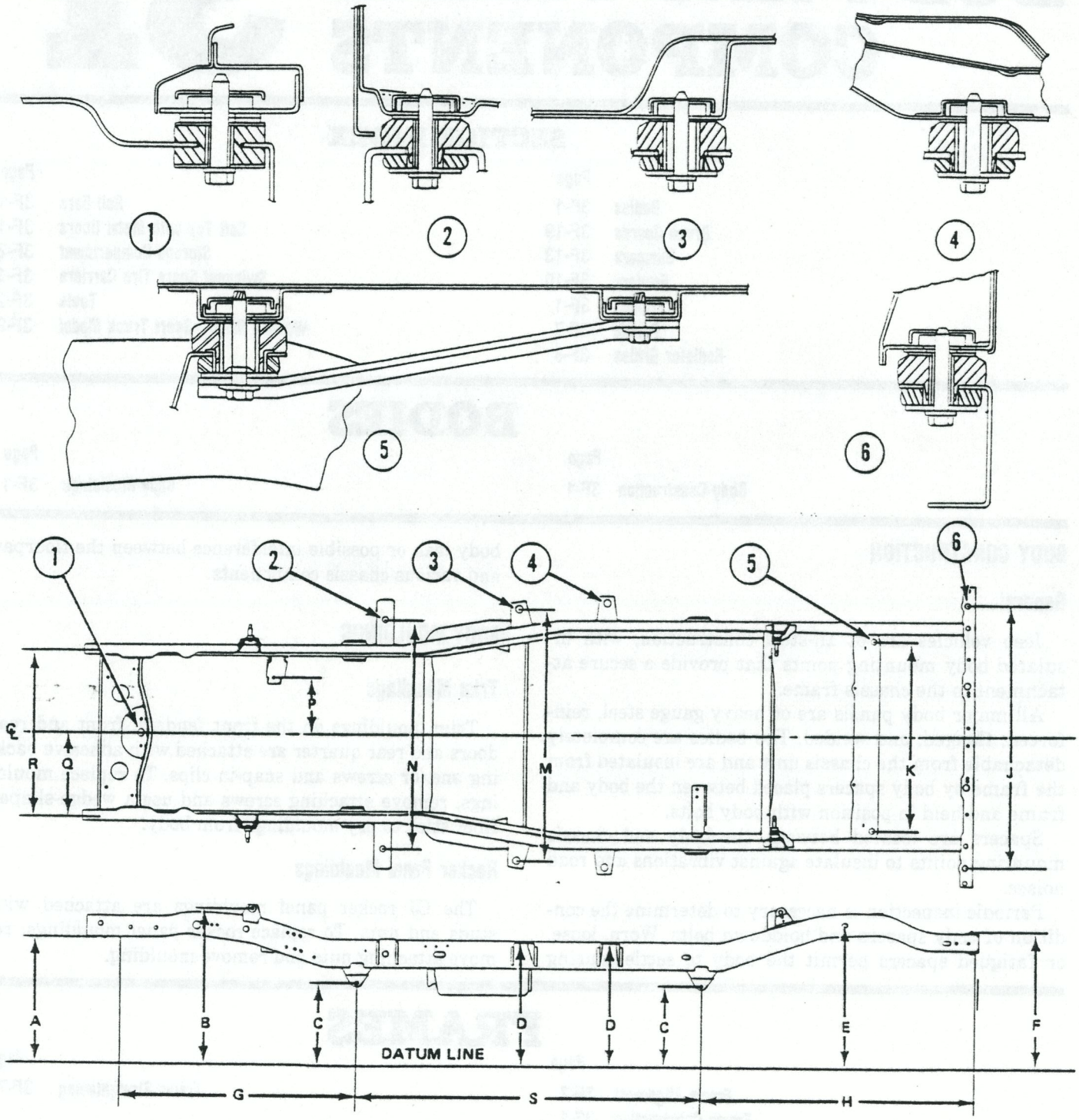
FRAME CONSTRUCTION

The frame is the foundation and structural center of the vehicle. In addition to carrying the load, it mounts and supports the power unit while maintaining correct relationship and alignment of the power train. This relationship assures normal functioning of the units and freedom from excessive wear, stress, and strain. The

frame is constructed of heavy channel steel side rails and crossmembers. The crossmembers maintain the proper positions of the side rails in direct relationship to each other, providing maximum resistance to torsional twist and strains.

In the event of collision damage, it is important that the frame alignment be checked and realigned to frame dimensions shown on the individual dimension charts (figs. 3F-1 through 3F-5). Wheel geometry and axle alignment should be checked.



A—	12.51	E—	15.73	J—	43.50	P—	9.39
B—	17.50	F—	14.57	K—	31.26	Q—	13.75
C—	5.20	G—	40.61	M—	41.52	R—	27.50
D—	12.19	H—	46.16	N—	37.84	S—	39.06

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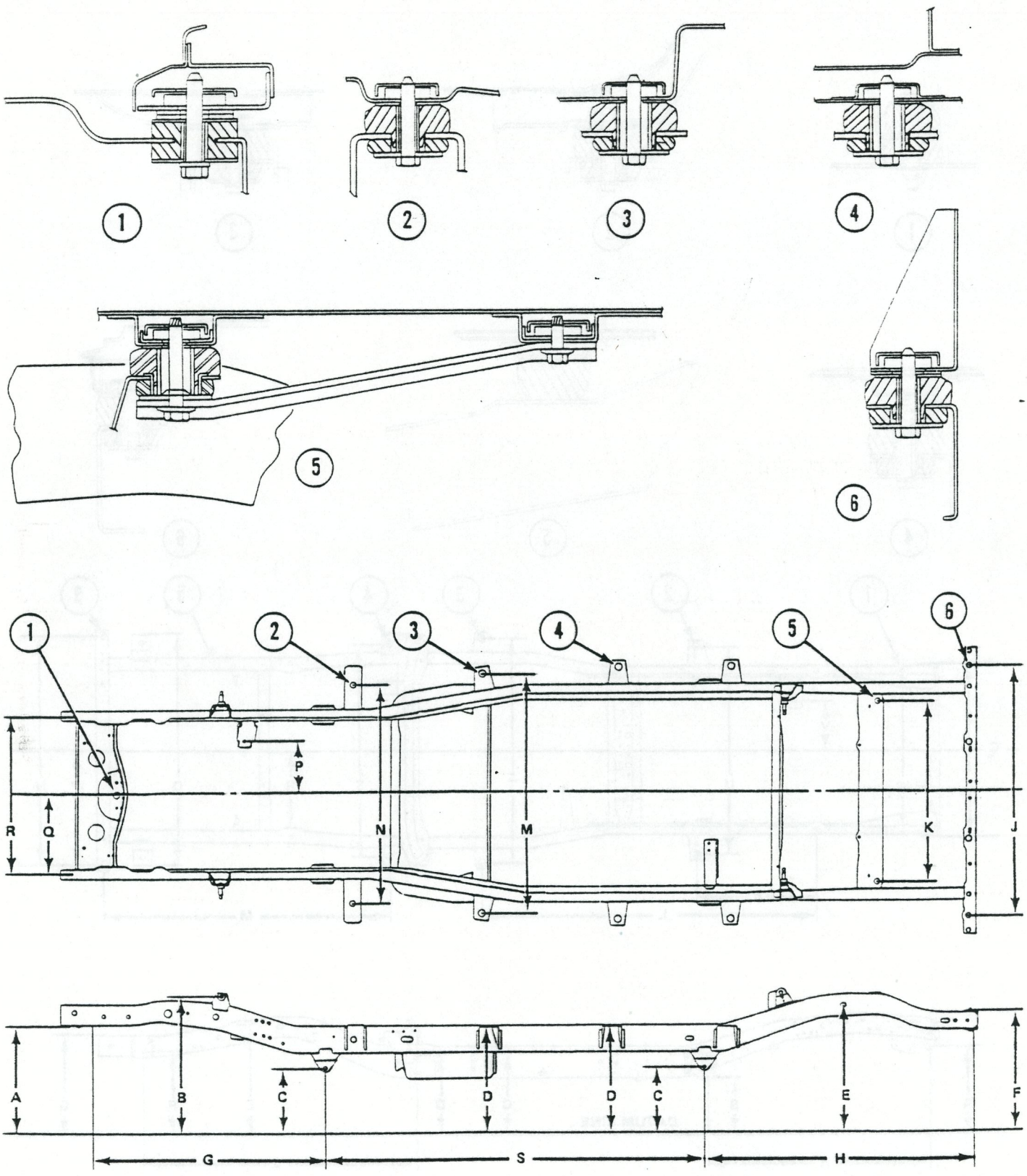
Fig. 3F-1 CJ-5 Model Frame Dimensions (Inches)



A—	12.51	F—	14.57	K—	31.26	Q—	13.75
B—	17.50	G—	40.61	M—	41.52	R—	27.50
C—	5.20	H—	46.16	N—	37,84	S—	49.06
D—	12.19	J—	43.50	P—	9.39		
E—	15.73						

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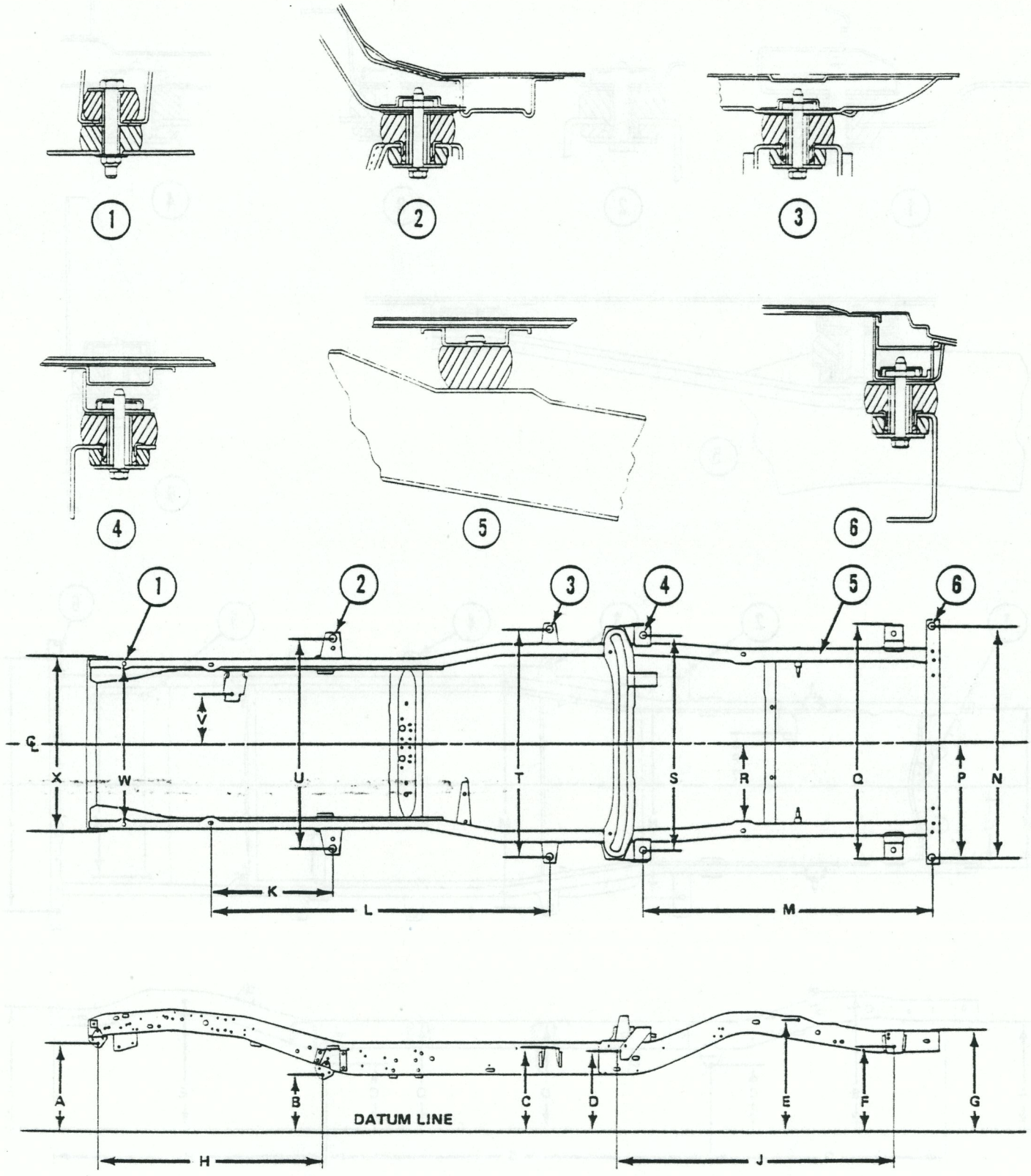
Fig. 3F-2 CJ-7 Model Frame Dimensions (Inches)



A –	12.05	G –	14.03	M –	59.63	T –	45.88
B –	5.46	H –	45.26	N –	46.76	U –	42.50
C –	10.60	J –	57.25	P –	23.38	V –	11.52
D –	9.94	K –	24.68	Q –	47.02	W –	32.40
E –	16.17	L –	69.00	R –	17.88	X –	34.22
F –	10.82			S –	43.54		

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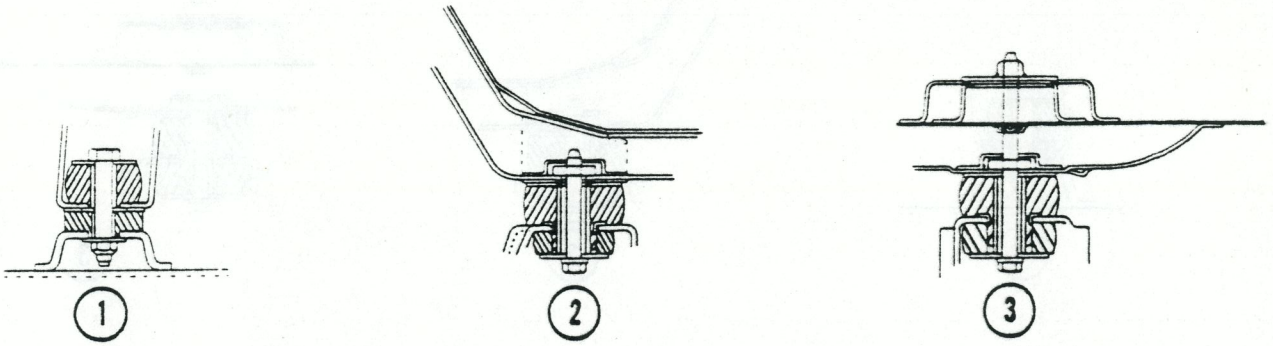
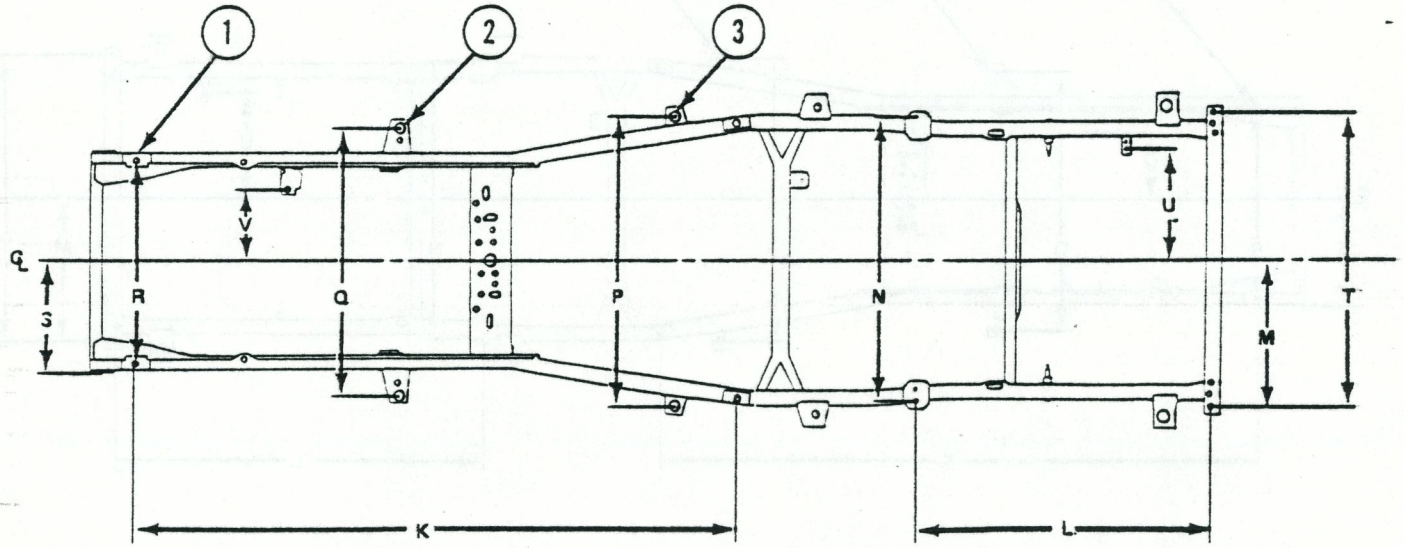
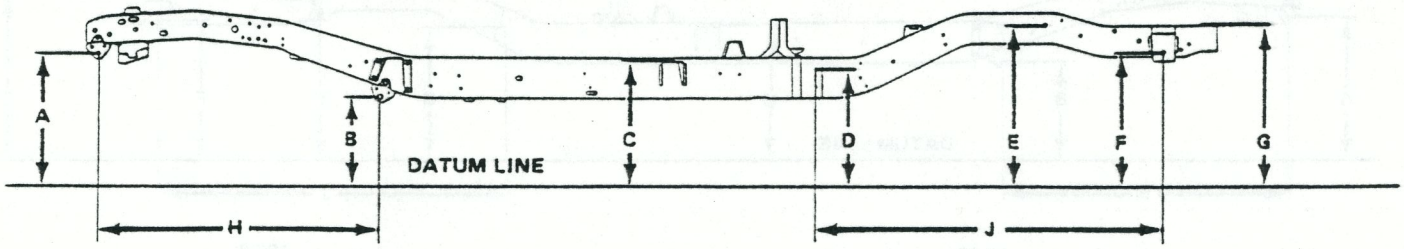
Fig. 3F-3 Cherokee and Wagoneer Frame Dimensions (Inches)







A –	11.97	L –	48.79
B –	5.39	M –	23.38
C –	11.35	N –	45.72
D –	9.94	P –	45.92
E –	16.80	Q –	42.52
F –	12.55	R –	32.40
G –	16.78	S –	17.89
H –	45.23	T –	46.75
J –	57.22	U –	17.06
K –	96.80	V –	11.52

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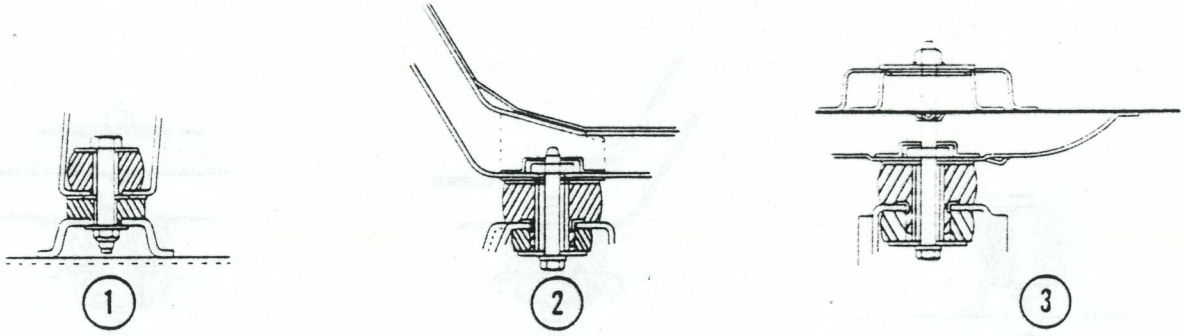
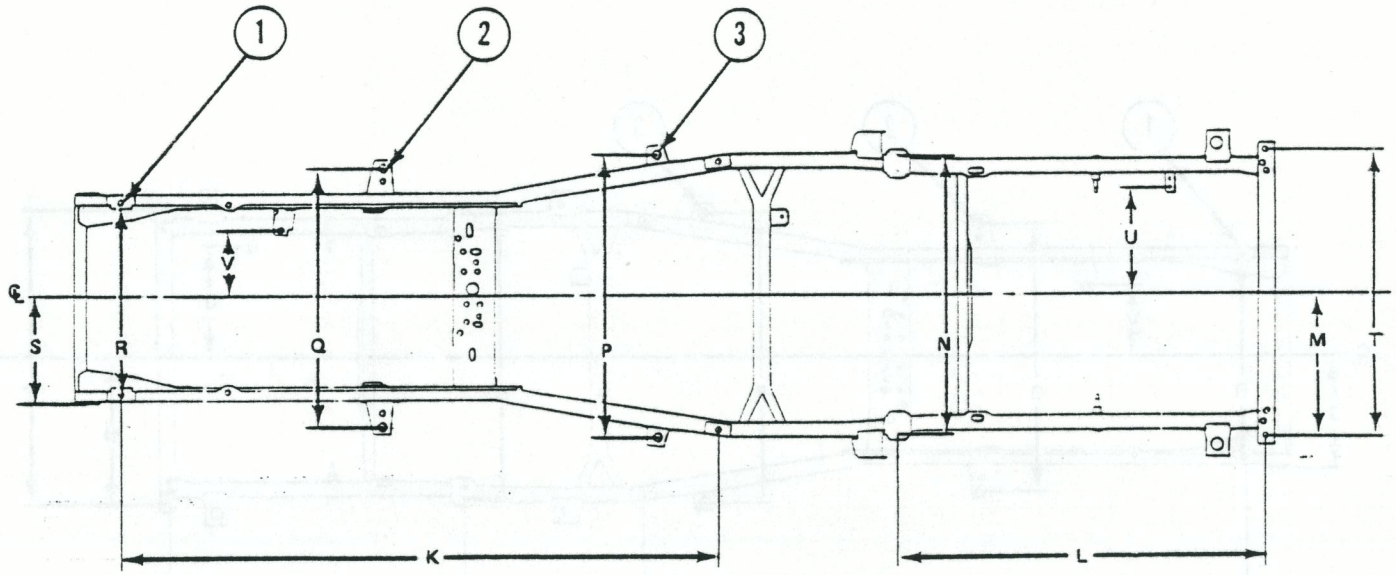
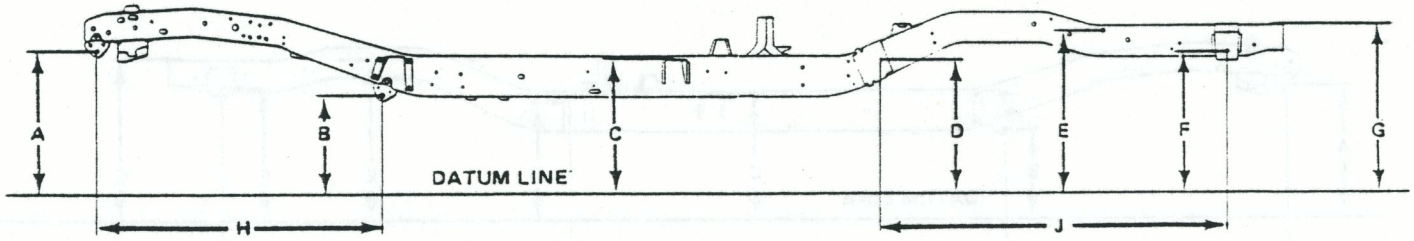
Fig. 3F-4 Truck Frame Dimensions—119-Inch Wheelbase (Inches)







A –	11.97
B –	5.39
C –	11.35
D –	9.94
E –	15.92
F –	12.57
G –	16.78
H –	45.23
J –	56.47
K –	96.80

L –	60.79
M –	23.38
N –	45.72
P –	45.92
Q –	42.52
R –	32.40
S –	17.69
T –	46.75
U –	17.06
V –	11.52

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Fig. 3F-5 Truck Frame Dimensions—131-inch Wheelbase (Inches)

FRAME ALIGNMENT

The most efficient method of checking frame alignment is with a frame alignment machine.

NOTE: *The following procedure is adequate for checking most frame dimensions. However, if torsional twist or frame rail height is in question, the vehicle must be checked on an alignment machine using datum gauges. Follow alignment machine manufacturer's instructions.*

If a frame straightening machine is not available, frame alignment may be determined by using the "X" or diagonal method. Figures 3F-1 through 3F-5 provide all frame dimensions.

The most convenient method of checking frame dimensions is to locate with a plumb-bob and chalk mark on a level floor all dimensional points from which measurements are taken. This is known as "plumb-bobbing" the frame. If working on a cement floor, clean it so that the chalk marks will be visible underneath the frame. If working on a wooden floor, lay sheets of paper underneath the vehicle. Drop a plumb-bob from each point indicated in figures 3F-1 through 3F-5, marking the floor directly underneath the point. Satisfactory checking depends on the accuracy of the marks in relation to the frame.

To check points that have been marked, carefully move the vehicle away from the layout on the floor, and proceed as follows:

Check the frame at front and rear end using corresponding marks on the floor. If widths correspond to frame specifications, draw a centerline the full length of the vehicle, halfway between the marks indicating front and rear widths. If frame width is not correct and the centerline cannot be laid out from checking points at the end of the frame, it can be drawn through intersections of any two pairs of equal dimensions.

With the centerline correctly laid out, measure the distance to several opposite points over the entire length of the frame. If the frame is in proper alignment, opposite measurement should be the same.

To locate the points at which the frame is sprung, measure the diagonals between selected points on the frame (figs. 3F-1 through 3F-5).

If the diagonals in each pair are within 1/8 inch, that part of the frame included between points of measurement may be considered as properly aligned. These diagonals should also intersect at the centerline. If the measurements do not agree within the above limits, it means that a frame alignment correction is necessary and will have to be made between those points that are not equal.

NOTE: *During the process of straightening the frame, be extremely careful not to overstretch the frame. This could cause the already aligned sections of the frame to become misaligned or weakened.*

FRAME STRAIGHTENING

A bent or twisted frame may be straightened, provided the extent of misalignment is not excessive. Severely damaged frame parts should be replaced.

PANELS

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GENERAL

Assembled sections or any of the individual panels available for replacement are complete and may be installed as a unit. When only a portion of the unit is damaged, the damaged unit may be cut from the body at the location best suited for welding, and the new unit cut to the desired size and welded in place.

Galvanized Panels

For protection against corrosion, vulnerable panels on all models are galvanized. A conversion coating must be applied to these panels prior to painting to ensure good adhesion of the paint.

Replacement

Where replacement is required, careful examination should be made as to the extent of damage to determine which panels require replacement.

In most cases, the weld joints of one panel to another are visible and can be separated for installation of a new panel.

DOORS

The complete door, with outer and inner door panels flanged and welded together and primed, is available as well as the outer panel only.

These outer panels may be used in cases in which the inner panel and pillar assemblies are not damaged to avoid the extra expense of using a complete door.

REAR QUARTER PANELS

The rear quarter panels are welded to the body as indicated in figures 3F-6 through 3F-8.

Whenever a rear quarter panel is replaced, it is very important to apply a suitable corrosion preventive such as a weld primer to all mating surfaces prior to welding.

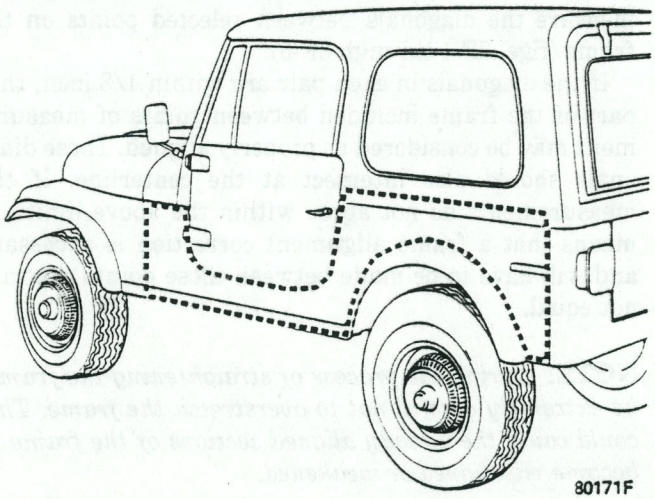

Fig. 3F-6 Rear Quarter Panel—CJ Models

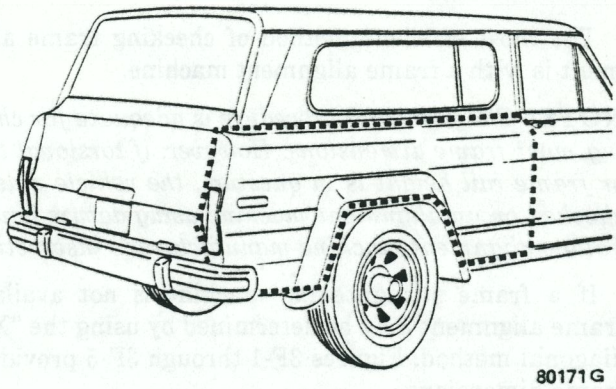

Fig. 3F-7 Rear Quarter Panel—2-Door Cherokee

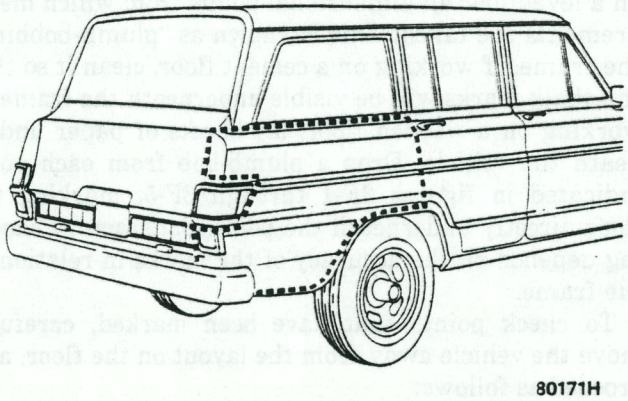

Fig. 3F-8 Rear Quarter Panel—Wagoneer (4-Door Cherokee Similar)

RADIATOR GRILLES

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Wagoneer Models	3F-9
CJ Models	3F-8
CJ Model Applique	3F-9

CJ MODELS

The CJ grille and the support and baffle are welded together to form a maximum-strength radiator grille guard (fig. 3F-9).

Removal

(1) Remove front crossmember cover, if equipped.

(2) Remove screws and washers attaching radiator and shroud to radiator grille guard panel.

(3) Remove bolts and washers attaching guard panel to fenders.

(4) Remove radiator grille to frame crossmember holddown assembly. Note sequence of parts.

(5) Loosen nuts attaching two radiator support rods to radiator grille guard support brackets.

(6) Remove rods from brackets.

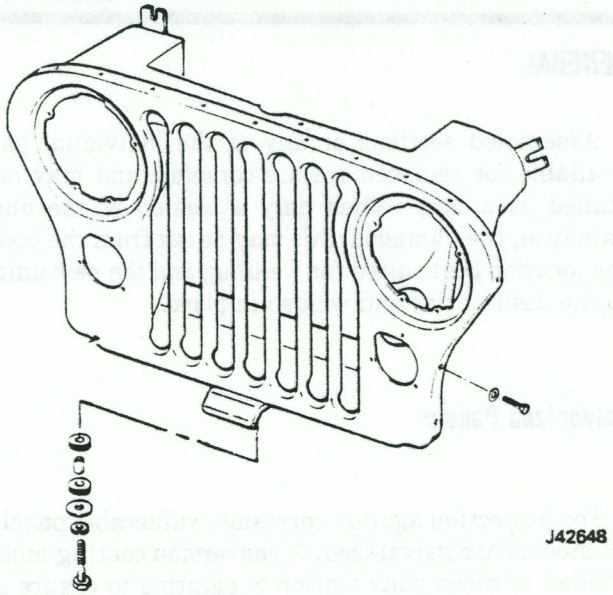

Fig. 3F-9 Grille Panel—CJ Models

(7) Tilt grille panel forward and disconnect electrical wiring at head lamp sealed beam unit and parking lamp assembly wiring harness at connectors.

(8) If equipped with air conditioning, proceed as follows:

(a) Discharge air conditioning system as outlined in Chapter 3E—Air Conditioning.

(b) Disconnect air conditioning high pressure hose at sight glass connection and cap hose and sight glass fitting to prevent entry of dirt and moisture.

(c) Disconnect air conditioning high pressure hose at fitting on compressor and cap hose and compressor fitting to prevent entry of dirt and moisture.

(9) Lift radiator grille panel from vehicle.

Installation

(1) Position guard panel and connect electrical wiring at headlamp sealed beam unit and parking lamps.

(2) If equipped with air conditioning, proceed as follows:

(a) Remove caps from high pressure hose and compressor and connect hose to compressor.

(b) Remove caps from sight glass and high pressure hose and connect hose to sight glass.

(3) Position radiator support rods in radiator grille support brackets and install attaching hardware.

(4) Install radiator grille to frame crossmember holddown assembly.

(5) Position grille panel to fenders and install attaching bolts and washers.

(6) Install radiator and radiator shroud to radiator grille panel attaching screws and washers.

(7) Install front crossmember cover, if equipped.

(8) If equipped with air conditioning, evacuate, leak test, and charge the system as outlined in Chapter 3E—Air Conditioning.

CJ MODEL GRILLE APPLIQUE

General

The chrome grille applique is installed over the grille assembly requiring the use of weil nuts and screws as well as using the headlight and parking light attaching screws to retain the applique.

Removal

(1) Raise hood.

(2) Remove headlamp doors.

(3) Remove headlamp body retaining screws.

(4) Disconnect and remove headlamp and body assemblies.

(5) Remove parking lamp retaining screws.

(6) Disconnect and remove parking lamp assemblies.

(7) Remove front crossmember cover, if equipped.

(8) Remove torx bit screws and bumpers across top of radiator grille using Torx Bit Tool J-25359-C.

(9) Remove grille applique.

(10) Remove double back tape along bottom of applique.

Installation

(1) Install double-back tape along bottom on backside of applique.

(2) Position grille applique over grille assembly and press along bottom.

CAUTION: *Torx screws are installed into well nuts, do not overtighten.*

(3) Install torx screws and bumpers using Torx Bit Tool J-25359-C.

(4) Connect and position headlamp and body assemblies.

(5) Install retaining screws.

(6) Install headlamp doors.

(7) Connect and position parking lamp assemblies.

(8) Install parking lamp retaining screws.

(9) Close hood.

(10) Install front crossmember cover, if equipped.

CHEROKEE-TRUCK MODELS

Removal

(1) Remove headlamp doors.

(2) Remove plastic drive rivets attaching grille insert to grille housing (fig. 3F-10).

(3) Remove grille insert.

(4) Remove screws attaching grille housing to face panel (fig. 3F-10).

(5) Remove grille housing.

Installation

(1) Position grille housing in body opening.

(2) Install attaching screws.

(3) Position grille insert in grille housing.

(4) Install attaching rivets.

(5) Install headlamp doors.

WAGONEER MODELS

Removal

(1) Remove screws attaching grille panel (fig. 3F-10).

(2) Remove grille panel.

Installation

(1) Position grille in body opening.

(2) Install attaching screws and washers.

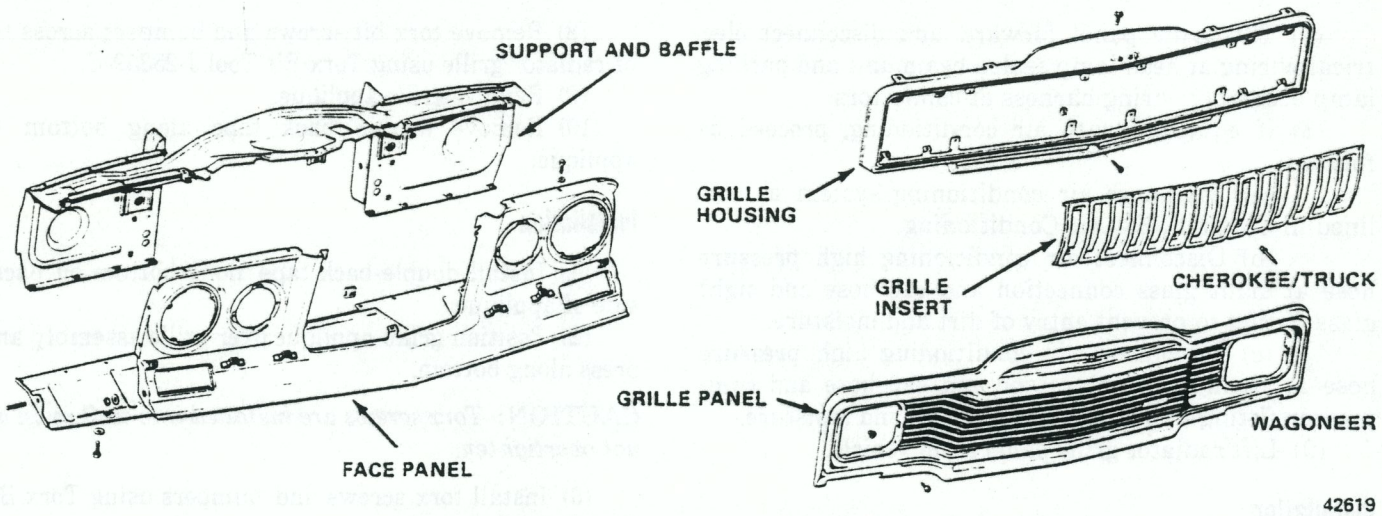

Fig. 3F-10 Grille Panels—Wagoneer-Cherokee-Truck Models

FENDERS

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Cherokee-Wagoneer-Truck Models	3F-10	CJ Models	3F-10
CJ Fender Extensions	3F-11	Rear Fenders—Sport Truck	3F-11

CJ MODELS

Replacement

(1) Remove or disconnect all items attached to apron of fender.

(2) Disconnect electrical connector at side marker lamp.

(3) Remove rocker panel moulding, if equipped.

(4) Remove bolts and washers attaching fender and brace to dash panel (fig. 3F-11).

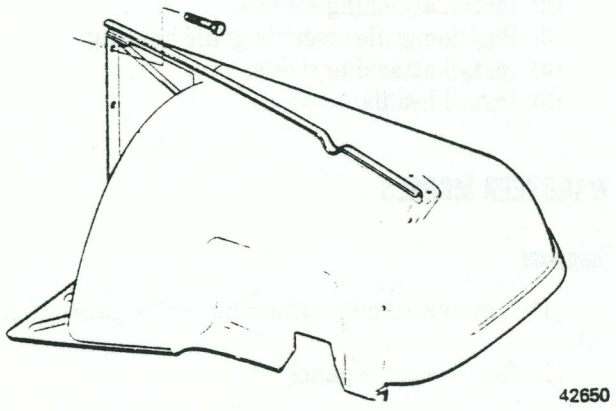

Fig. 3F-11 Front Fender—CJ Models

(5) Remove bolts, washers, and nuts attaching fender to radiator grille panel.

(6) Pull fender outboard and lift from vehicle.

(7) Position fender on vehicle and install fender-to-radiator grille panel attaching bolts, washers, and nuts.

(8) Install fender and brace-to-dash panel attaching bolts and washers.

(9) Connect side marker lamp electrical connector.

(10) Install and connect items previously removed from apron of fender.

(11) Install rocker panel moulding, if equipped.

CHEROKEE-WAGONEER-TRUCK MODELS

Removal

(1) Remove front bumper.

(2) Remove headlamp to gain access through opening.

(3) Reach through headlamp opening and remove bolts and washers attaching fender to grille face panel.

(4) Remove side marker lamp reflector lens and disconnect lamp socket assembly from lens.

(5) Remove bolts and washers attaching fender to grille face panel.

(6) Disconnect brace at fender (fig. 3F-12).

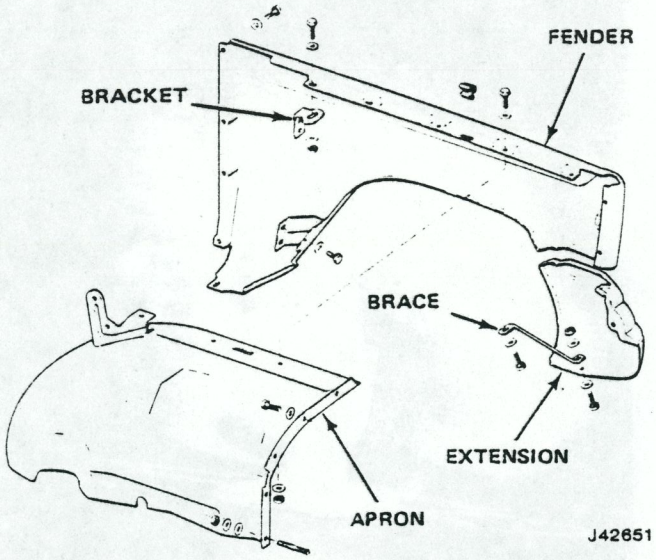

Fig. 3F-12 Front Fender—Cherokee-Wagoneer-Truck Models

(7) Remove bolts and washers attaching fender to rocker panel just below the hinge pillars.

(8) Remove bolts and washers attaching top of fender to fender apron, hood hinge support bracket, and fender-to-dash panel bracket.

NOTE: *Note the number and position of shims between fender and rocker panels so they can be assembled in the same position.*

(9) Open doors and remove fender from vehicle.

(10) Remove or disconnect all items attached to fender apron.

(11) Remove bolts and washers attaching fender apron to radiator support and two brackets on dash panel.

Installation

(1) Spread sealer evenly over and along surfaces where fender and apron make metal-to-metal contact with other sheet metal parts.

(2) Install apron and fender in place and finger tighten bolts until all bolts and washers have been installed. Tighten all nuts and bolts.

(3) Install and reconnect all items removed from fender and apron, such as wiring harness, electrical components.

(4) Secure items, such as headlamp, grille and front bumper, which were released or removed to facilitate removal of fender and apron.

CJ FENDER EXTENSIONS

Removal

(1) Remove screws and nuts attaching inner and outer reinforcements and fender extension to fender (fig. 3F-13).

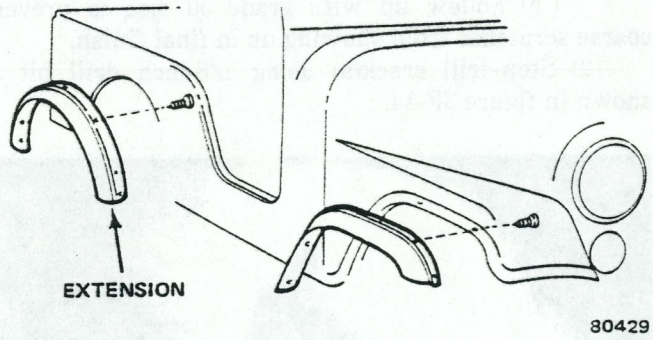

Fig. 3F-13 Fender Extension—CJ Models

(2) Remove inner and outer reinforcements and extension from fender.

Installation

(1) Position fender extension and inner and outer reinforcements on fender and align screw holes.

(2) Install screws and nuts attaching fender extension and reinforcements to fender.

REAR FENDERS—SPORT TRUCK

General

The Sport Truck model rear fenders are constructed of lightweight, dent resistant fiberglass. No special paint system is required for refinishing the fenders.

Removal

(1) Support fender.
(2) Remove all attaching hardware.
(3) Remove fender from vehicle.

Installation

(1) Position fender on vehicle and support.
(2) Install all attaching hardware.

Repair

In the event of damage, the following materials are necessary for a quality repair.

- Fiberglass mat or cloth
- Fiberglass resin and hardener
- Structural Adhesive (3M brand or equivalent)
- Auto Body Repair Tape (3M brand or equivalent)
- Glazing Putty
- Aluminum Foil
- Plastic Spreader

Crack Repair

(1) Use grinder to remove paint and to outline damaged area.

(a) Use grade 24 disc for initial grinding.

(b) Follow up with grade 50 disc to prevent coarse scratches from showing up in final finish.

(2) Stop-drill crack(s) using 1/8-inch drill bit as shown in figure 3F-14.

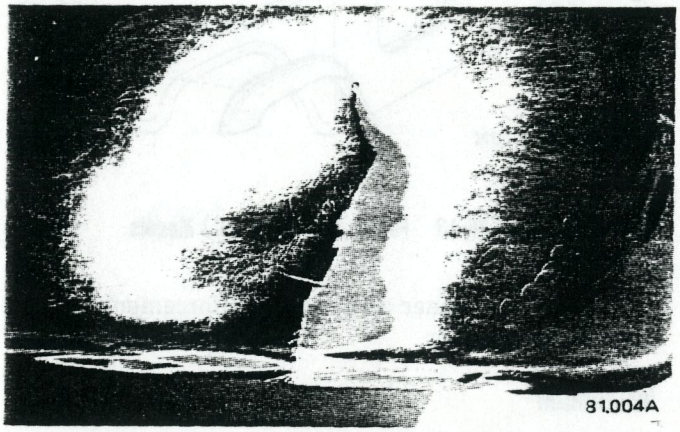

Fig. 3F-14 Stop-Drilling Cracks

(3) Bevel edges of crack(s) using rotary file.

NOTE: *Edges should be beveled to ensure sufficient surface area for good bonding.*

(4) Clean inside of fender repair area and apply Auto Body Repair Tape (fig. 3F-15), fiberglass or equivalent.

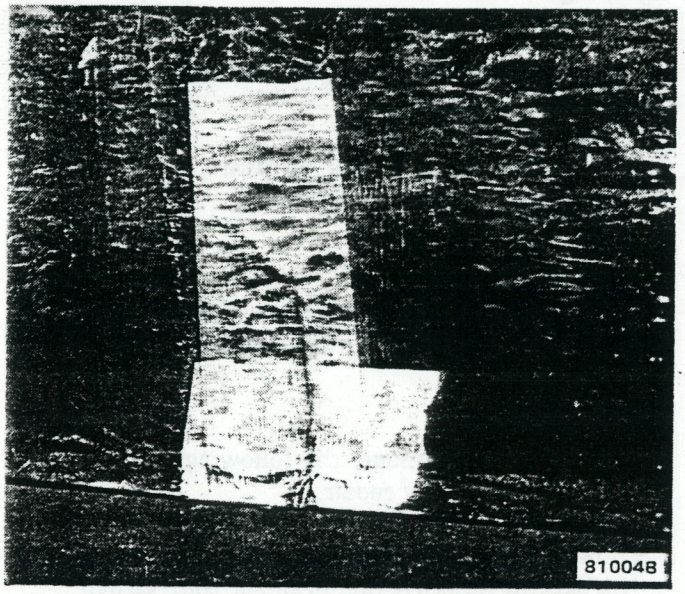

Fig. 3F-15 Installation of Auto Body Repair Tape

NOTE: *The application of Auto Body Repair Tape or fiberglass to the inside of the fender is essential to prevent moisture from entering the repair area.*

(5) Mix Structural Adhesive, according to manufacturer's instructions, apply liberally to break as shown in figure 3F-16.

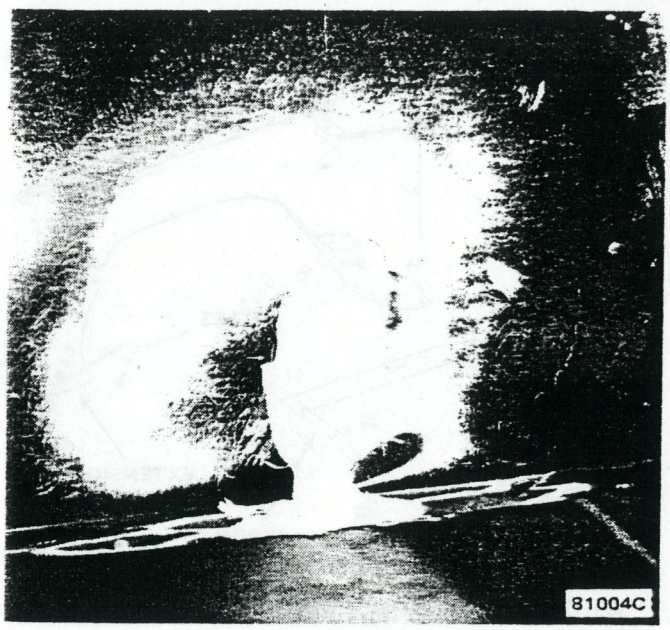

Fig. 3F-16 Structural Adhesive Applied to Fractured Area

(6) Use air file or hand file board for shaping of hardened Structural Adhesive.

(a) For initial shaping, use grade 24 paper.

(b) For shaping and sanding contour in Structural Adhesive, use grade 220 paper.

(c) For finish sanding, use grade 360 paper.

(7) Apply glazing putty over repair area for smooth finish.

(8) Finish repair area using grade 400 paper.

(9) Apply sealer and color coat fender (refer to Chapter 3B).

Hole Repair

(1) Use grinder to remove paint and to outline damaged area.

(a) Use grade 24 disc for initial grinding.

(b) Follow up with grade 50 disc to prevent coarse scratches from showing up in final finish.

NOTE: *If there are any cracks extending out from the hole, it will be necessary to stop-drill the crack(s) using a 1/8-inch drill bit.*

(2) Clean inside of fender around hole.

NOTE: *It may be necessary to grind inside of fender to ensure proper adhesion of fiberglass resin.*

(3) Position fiberglass mat or cloth on repair area, cut out piece, allow one inch extension beyond damaged area.

(4) Clean damaged area.

(5) Place fiberglass on piece of aluminum foil.

(6) Pour fiberglass resin into clean container.

(7) Mix appropriate amount of hardener with resin, according to manufacturer's instructions.

(8) Apply resin mixture to both sides of fiberglass.

(9) Apply fiberglass and aluminum foil over repair area, on inside of fender, with plastic spreader. Use firm pressure with spreader to remove air bubbles. Allow resin to cure. Remove aluminum foil.

(10) Sand top surface of fender with grade 180 paper.

(11) Mix Structural Adhesive, according to manufacturer's instructions, apply liberally to repair area.

(12) Use an air file or hand file board for shaping hardened Structural Adhesive.

(a) For initial shaping, use grade 24 paper.

(b) For shaping and sanding contour in Structural Adhesive, use grade 220 paper.

(c) For finish sanding, use grade 360 paper.

(13) If necessary, apply glazing putty over repair area according to manufacturer's instructions.

(14) Finish sanding repair area with grade 400 paper.

(15) Apply sealer and color coat fender (refer to Chapter 3B).

BUMPERS

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Front Bumpers	3F-13	Rear Bumpers	3F-13
General	3F-13		

GENERAL

Front bumpers on CJ models are of one-piece construction. When vehicle is equipped with rear mounted spare, two separate bumperettes are used.

Front bumpers on the Cherokee, Wagoneer, and Truck models are one-piece chromed aluminum. Rear bumpers are the same construction and are used on the Cherokee and Wagoneer. Trucks, when equipped with a rear bumper, have a one-piece step bumper.

Front bumper guards are available as an option on standard bumpers on all except CJ models. All CJ models have a new front crossmember cover which covers the area between the grille panel and front bumper rail (fig. 3F-17).

FRONT BUMPERS

CJ Models

Removal

(1) Disconnect and remove fog lamps, if equipped.

(2) Remove nuts and bolts attaching front bumper rail (fig. 3F-17) to frame extensions.

(3) Remove front bumper rail from frame extensions.

Installation

(1) Position front bumper rail on frame extension.

(2) Install bolts and nuts attaching front bumper rail to frame extension.

(3) Install and connect fog lamps, if equipped.

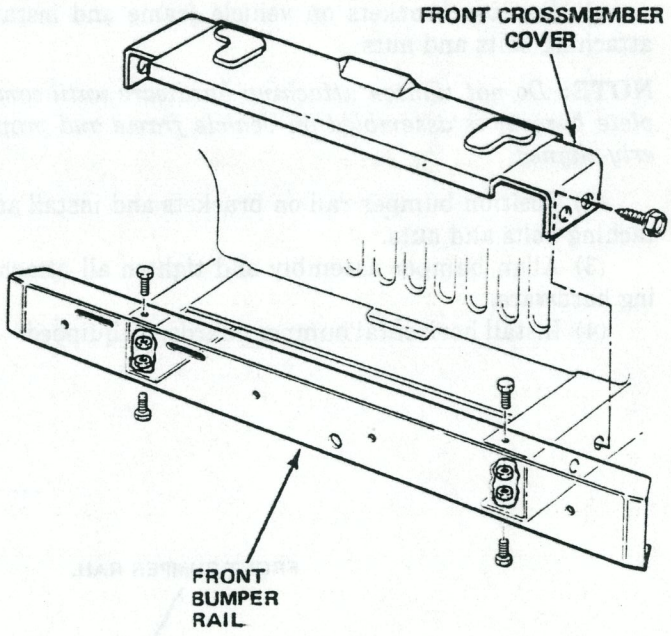


Fig. 3F-17 Front Bumper—CJ Models

Front Crossmember Cover—CJ Models

Removal

(1) Remove nuts and bolts attaching front crossmember cover (fig. 3F-17) to frame extensions.

(2) Remove front crossmember cover from frame extensions.

Installation

(1) Position front crossmember cover on frame extensions.

(2) Install bolt and nuts attaching front crossmember cover to frame extensions.

Cherokee-Wagoneer-Truck Models

Removal

(1) Disconnect and remove fog lamps, if equipped.
(2) Remove vertical bumper guards (fig. 3F-18) from bumper rail, if equipped.
(3) Remove horizontal bumper guards from bumper rail, if equipped.
(4) Remove front air deflector (fig. 3F-18), if equipped.
(5) Remove nuts and bolts attaching bumper rail to frame mounted bumper brackets. Remove bumper rail from vehicle.
(6) Remove nuts and bolts attaching bumper brackets to vehicle frame. Remove brackets from vehicle frame.

Installation

(1) Position brackets on vehicle frame and install attaching bolts and nuts.

NOTE: *Do not tighten attaching hardware until complete bumper is assembled on vehicle frame and properly aligned.*

(2) Position bumper rail on brackets and install attaching bolts and nuts.
(3) Align bumper assembly and tighten all attaching hardware.
(4) Install horizontal bumper guards, if equipped.
(5) Install and connect fog lamps, if equipped.
(6) Install vertical bumper guards, if equipped.
(7) Install front air deflector, if equipped.

Replacement

(1) Remove bumper rail as described above.
(2) Position replacement bumper rail on work bench and secure.
(3) Position horizontal bumper guards on bumper rail and mark hole locations on bumper rail.
(4) Center punch and drill 1/2-inch holes at marked locations.
(5) Position horizontal bumper guards on bumper rail and install screws attaching bumper guards to bumper rail.

NOTE: *Some filing of holes may be required for proper fit.*

(6) Position vertical bumper guards on bumper rail at desired locations and mark hole location on bumper rail.
(7) Center punch and drill 3/8-inch holes at marked locations.
(8) Position vertical bumper guards on bumper rail and install screws attaching bumper guards to bumper rail.

NOTE: *Some filing of holes may be required for proper fit.*

(9) Install bumper rail as described above.

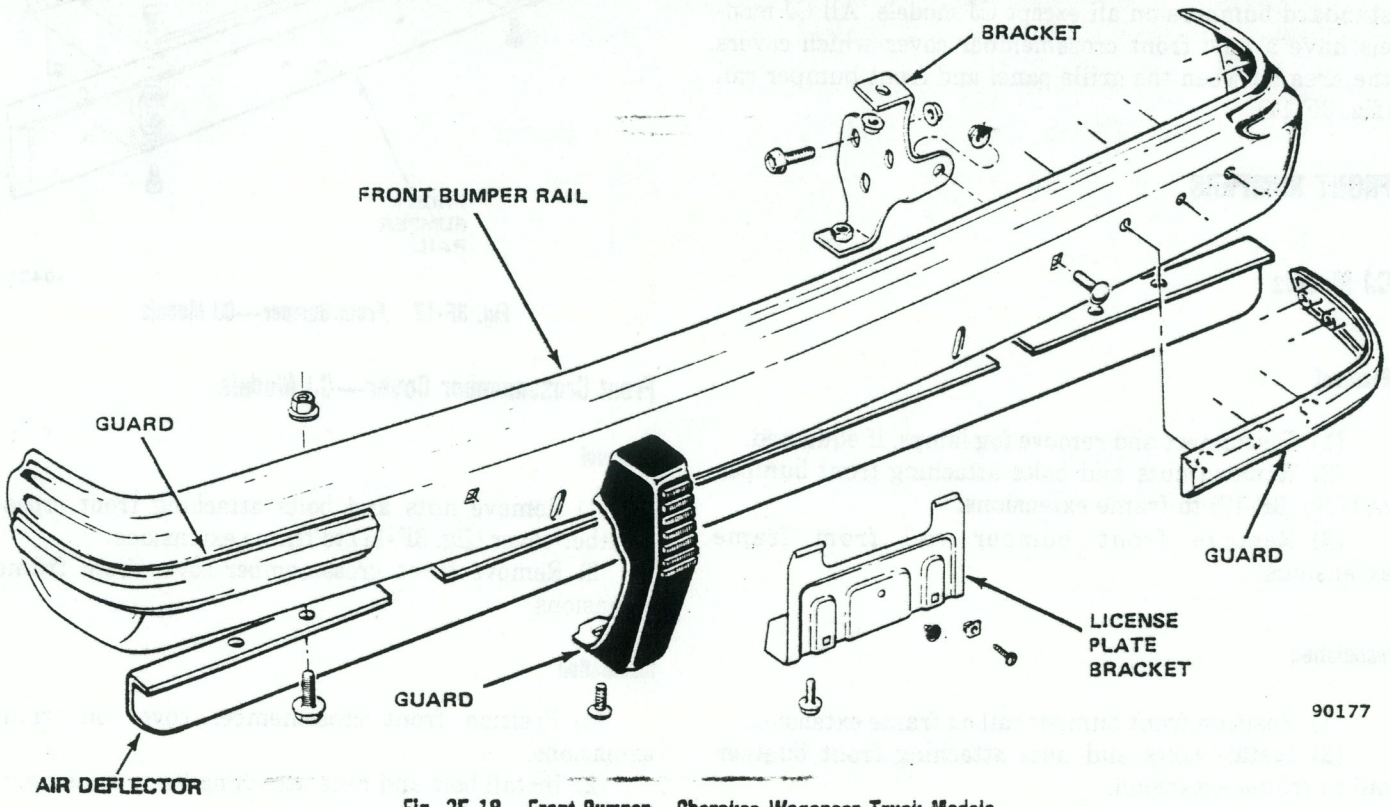


Fig. 3F-18 Front Bumper—Cherokee-Wagoneer-Truck Models

REAR BUMPERS

CJ Models

Removal

(1) Remove nuts and bolts attaching rear bumperettes (fig. 3F-19) to vehicle frame.

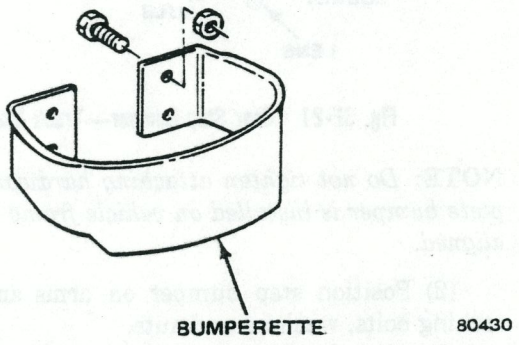


Fig. 3F-19 Rear Bumperette—CJ Models

(2) Remove rear bumperettes from vehicle frame.

Installation

(1) Position rear bumperettes on vehicle frame.
(2) Install bolts and nuts attaching rear bumperettes to vehicle frame.

Cherokee-Wagoneer Models

Removal

(1) Remove bumper guards (fig. 3F-20) from bumper rail, if equipped.
(2) Remove nuts and bolts attaching bumper rails to bumper brackets.
(3) Remove bumper rail from vehicle.
(4) Remove nuts and bolts attaching brackets to vehicle frame.
(5) Remove brackets from vehicle frame.

Installation

(1) Position brackets on vehicle frame and install attaching bolts, washers and nuts.

NOTE: *Do not tighten attaching hardware until complete bumper is assembled on vehicle frame and properly aligned.*

(2) Position bumper rail on brackets and install attaching bolts and nuts.
(3) Align bumper assembly and tighten all attaching hardware.
(4) Install horizontal bumper guards on bumper end rails, if equipped.

Replacement

(1) Remove bumper rail as described above.
(2) Position replacement bumper rail on work bench and secure.

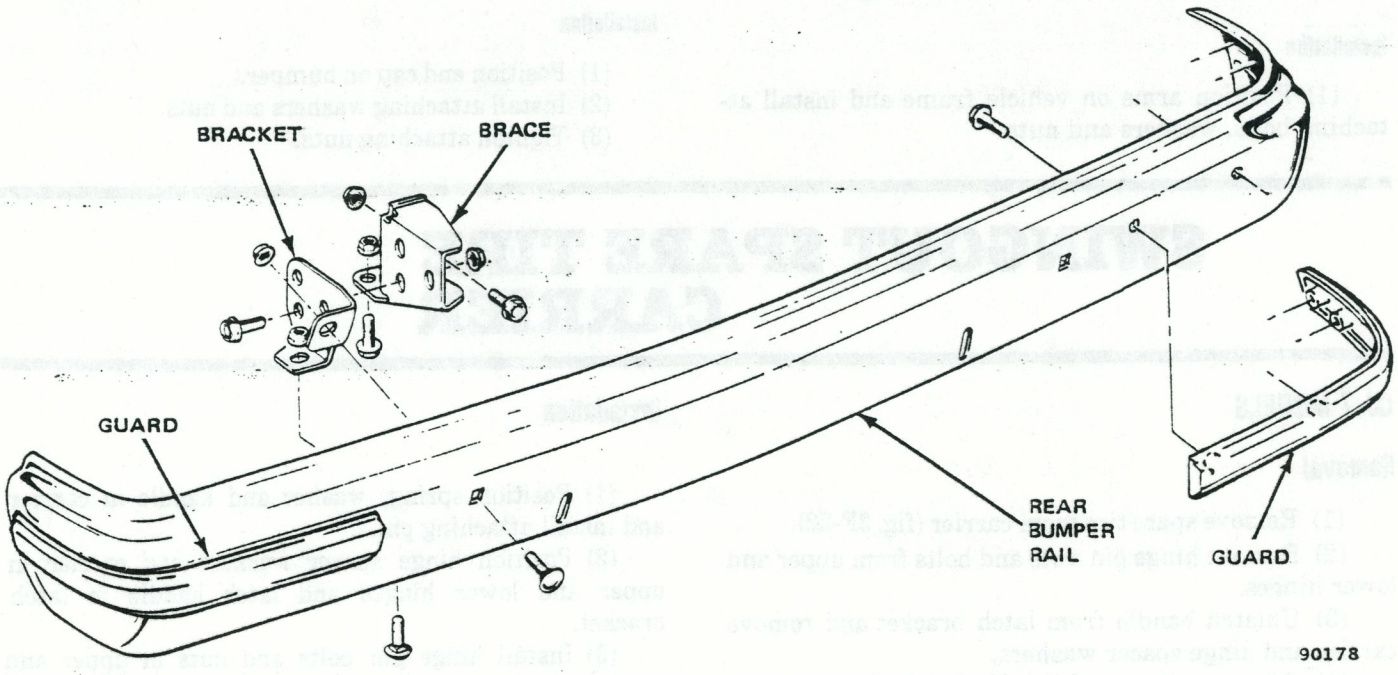


Fig. 3F-20 Rear Bumper—Cherokee-Wagoneer Models

(3) Position horizontal bumper guards on bumper rail and mark hole locations on bumper rail.

(4) Center punch and drill 1/2-inch holes at marked locations.

(5) Position horizontal bumper guards on bumper rail and install screws attaching bumper guards to bumper rail.

NOTE: *Some filing of holes may be required for proper fit.*

(6) Position vertical bumper guards on bumper rail at desired locations and mark hole location on bumper rail.

(7) Center punch and drill 3/8-inch holes at marked locations.

(8) Position vertical bumper guards on bumper rail and install screws attaching bumper guards to bumper rail.

NOTE: *Some filing of holes may be required for proper fit.*

(9) Install bumper rail as described above.

Truck Models Rear Step Bumper

Removal

(1) Disconnect license lamp wiring (fig. 3F-21) from vehicle wiring.

(2) Remove nuts, washers and bolts attaching step bumper to arms.

(3) Remove step bumper from arms.

(4) Remove nuts, washers and bolts attaching arms to vehicle frame. Remove arms from vehicle.

Installation

(1) Position arms on vehicle frame and install attaching bolts, washers and nuts.

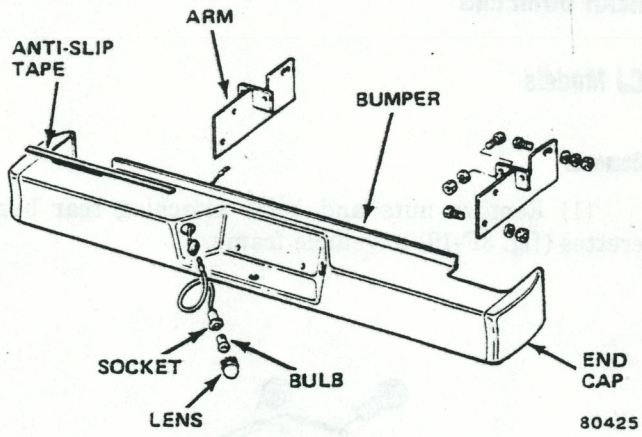


Fig. 3F-21 Rear Step Bumper—Truck Models

NOTE: *Do not tighten attaching hardware until complete bumper is installed on vehicle frame and properly aligned.*

(2) Position step bumper on arms and install attaching bolts, washers and nuts.

(3) Align bumper assembly and tighten all attaching hardware.

(4) Connect license lamp wiring to vehicle wiring.

End Cap

Removal

(1) Remove end cap attaching nuts and washers from studs.

(2) Remove end cap.

Installation

(1) Position end cap on bumper.

(2) Install attaching washers and nuts.

(3) Tighten attaching nuts.

SWINGOUT SPARE TIRE CARRIER

CJ-7 MODELS

Removal

(1) Remove spare tire from carrier (fig. 3F-22).

(2) Remove hinge pin nuts and bolts from upper and lower hinges.

(3) Unlatch handle from latch bracket and remove carrier and hinge spacer washers.

(4) Remove pin attaching latch handle to carrier and remove handle, spring and washer.

Installation

(1) Position spring, washer and handle in carrier and install attaching pin.

(2) Position hinge spacer washers and carrier in upper and lower hinges and latch handle in latch bracket.

(3) Install hinge pin bolts and nuts in upper and lower hinges.

(4) Install spare tire on carrier.

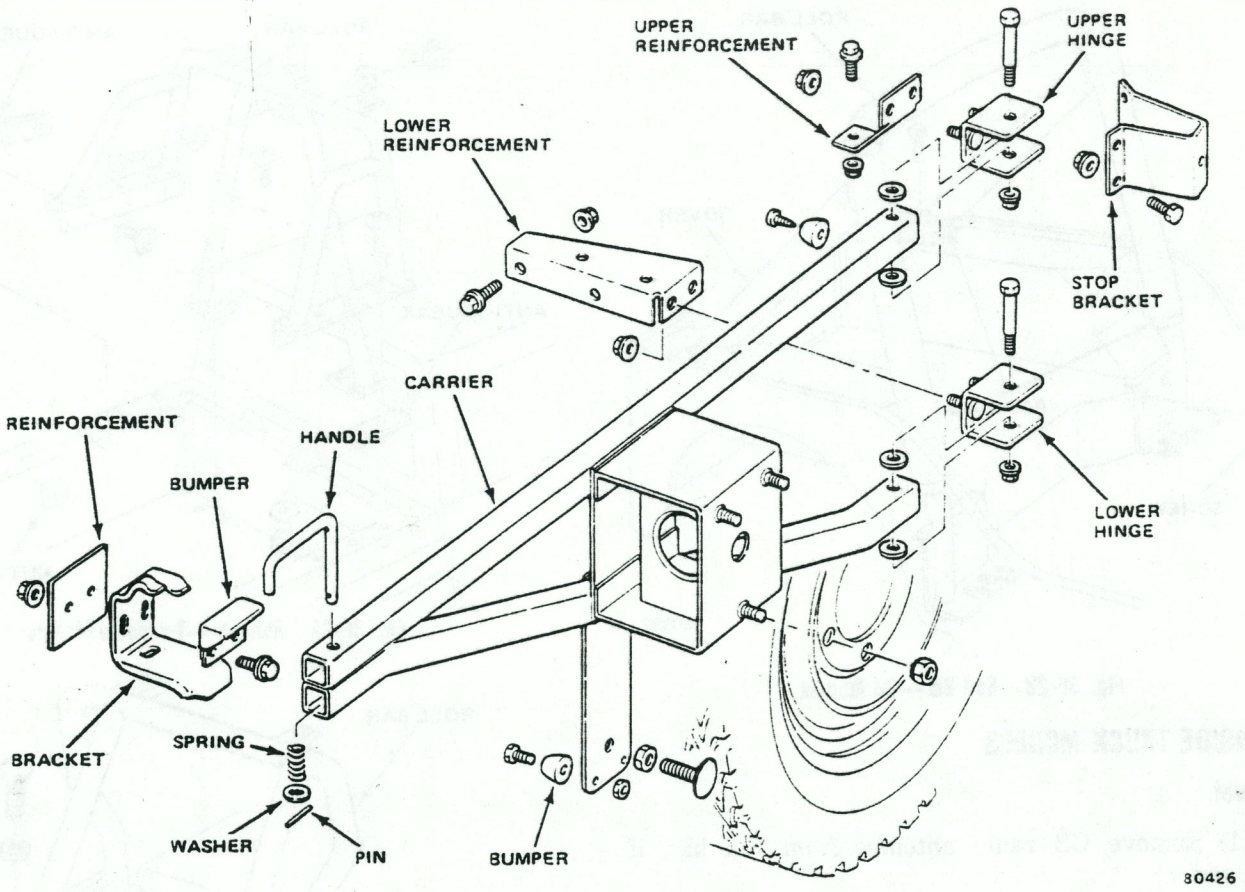


Fig. 3F-22 Swingout Spare Tire Carrier—CJ-7 Models

ROLL BARS

	Page		Page
CJ Models	3F-17	Truck Models with Townside Pickup Box	3F-18
Truck Models with Sport Truck Pickup Box	3F-18		

CJ MODELS

Removal

(1) Remove left front seat assembly.

(2) Remove hardtop or fold soft top back, if equipped.

(3) Tilt right front seat to forward position.

(4) Remove necessary carpeting, if equipped.

(5) Remove screws attaching roll bar to body (fig. 3F-23) using Torx Bit Tool J-25359-C.

(6) Heat area around mounting brackets (to soften sealer) with Heat Gun J-25070 and remove roll bar assembly.

Installation

(1) Position roll bar on body and align screw holes with body.

(2) Install screws attaching roll bar to body using Torx Bit Tool J-25359-C.

NOTE: *Do not tighten attaching screws until roll bar is completely installed and properly aligned.*

(3) Align roll bar assembly and tighten all attaching hardware using Torx Bit Tool J-25359-C.

(4) Install left front seat assembly.

(5) Install carpeting, if removed.

(6) Install hardtop or soft top, if equipped.

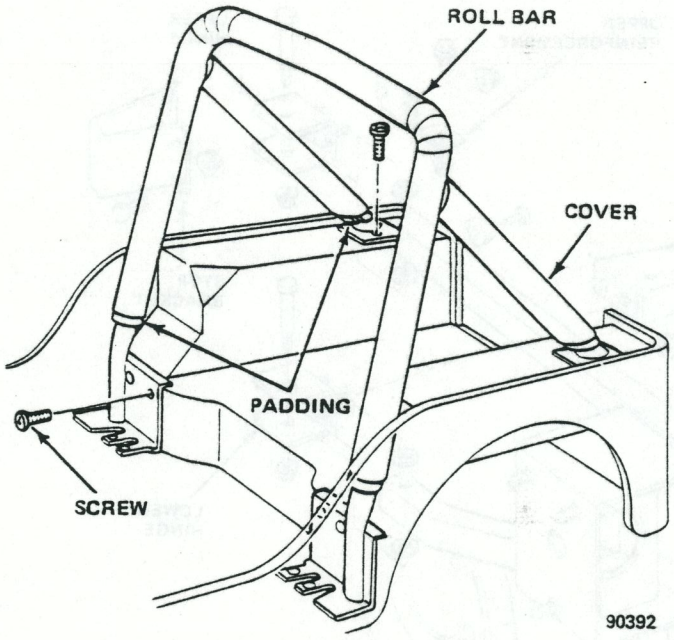


Fig. 3F-23 Roll Bar—CJ Models

TOWNSIDE TRUCK MODELS

Removal

(1) Remove CB radio antenna from roll bar, if equipped.

(2) Remove nuts, washers, bolts and nut plates (fig. 3F-24) attaching roll bar to side of pickup box, using Torx Bit Tool J-25359-C.

(3) Remove nuts, washers and bolts attaching roll bar to bed of pickup box, using Torx Bit Tool J-25359-C.

(4) Remove roll bar assembly and anti-squeak material from pickup box.

Installation

(1) Position anti-squeak material and roll bar assembly on pickup box.

(2) Install bolts, washers and nuts attaching roll bar to bed of pickup box, using Torx Bit Tool J-25359-C.

NOTE: *Do not tighten attaching hardware until roll bar is completely installed and properly aligned.*

(3) Install bolts, washers, nuts and nut plates attaching roll bar to side of pickup box.

(4) Align roll bar assembly and tighten all attaching hardware using Torx Bit Tool J-25359-C.

(5) Install CB radio antenna on roll bar, if equipped.

SPORT TRUCK MODELS

Removal

(1) Remove CB radio antenna from roll bar, if equipped.

(2) Remove wooden side rails, if equipped.

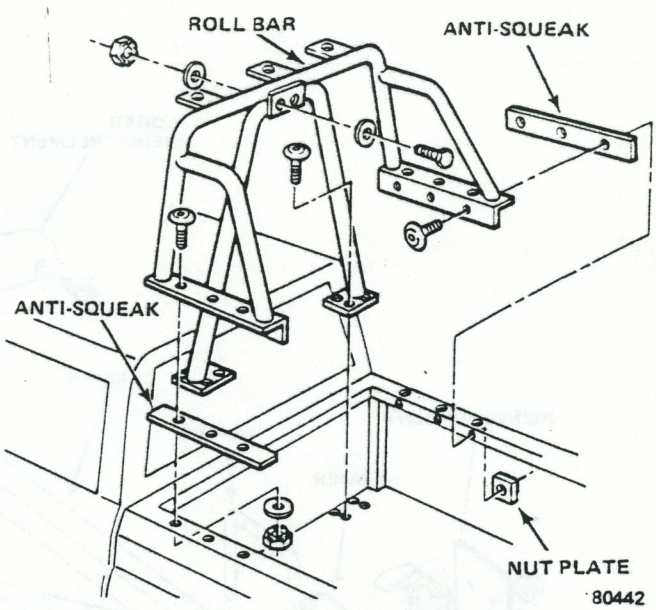


Fig. 3F-24 Roll Bar—Townside Models

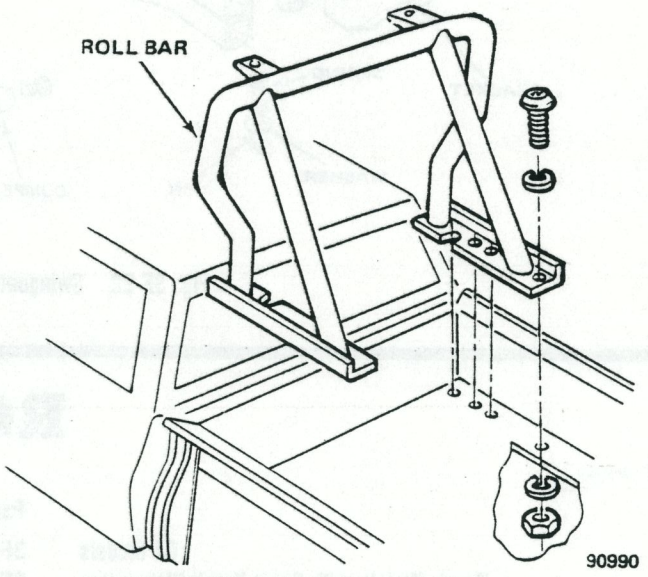


Fig. 3F-25 Roll Bar—Sport Truck Models

(3) Remove nuts, washers and bolts attaching roll bar to bed of pickup box, using Torx Bit Tool J-25359-C (fig. 3F-25).

(4) Remove roll bar assembly from pickup box.

Installation

(1) Position roll bar on bed of pickup box.

(2) Install bolts, washers and nuts attaching roll bar to bed of pickup box using Torx Bit Tool J-25359-C.

NOTE: *Do not tighten attaching hardware until roll bar is completely installed and properly aligned.*

(3) Align roll bar assembly and tighten all attaching hardware using Torx Bit Tool J-25359-C.

(4) Install wooden side rails, if equipped.

(5) Install CB radio antenna on roll bar, if equipped.

BRUSH GUARDS

CHEROKEE-TRUCK MODELS

Removal

(1) Disconnect and remove fog lamps, if equipped.

(2) Remove bolts and washers attaching brush guard (fig. 3F-26) to frame rails.

(3) Remove nuts and bolts attaching brush guard to bumper bolts and remove brush guard.

Installation

(1) Position brush guard on bumper and install attaching bolts and nuts.

NOTE: *Do not tighten attaching hardware until complete brush guard is assembled on vehicle and properly aligned.*

(2) Install bolts and washers attaching brush guard to frame rails.

(3) Align brush guard assembly and tighten all attaching hardware.

(4) Install and connect fog lamps, if equipped.

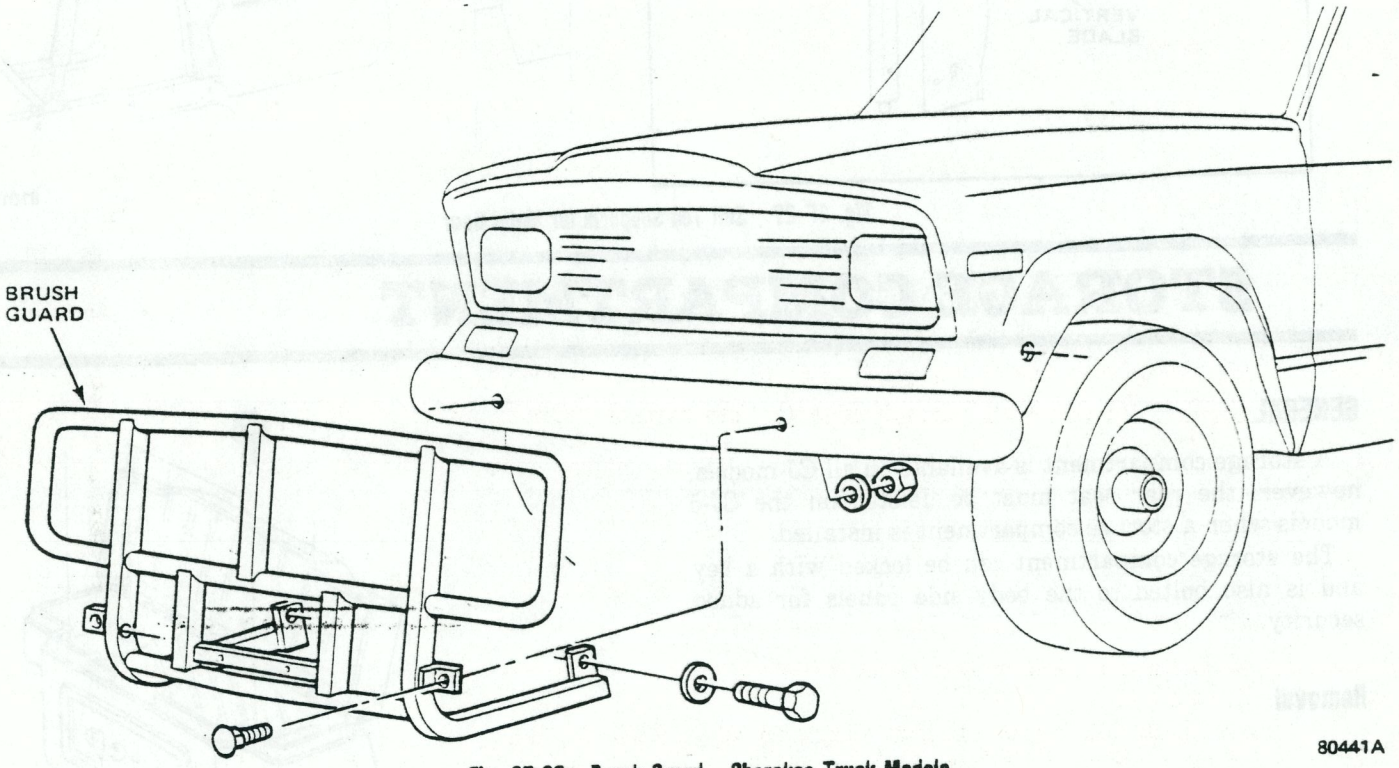


Fig. 3F-26 Brush Guard—Cherokee-Truck Models

SOFT TOP WITH METAL DOORS—CJ MODELS

GENERAL

A soft top with metal doors is available on the CJ-7 models. This option offers the convenience of a soft top with the security of metal doors. The adjustment of the doors remains the same as if equipped with a hard top.

See Chapter 3J for door and window service procedures.

It is possible to adjust the soft top at the rear of the door to achieve an air-tight seal between door and soft top.

ADJUSTMENT

(1) Unsnap soft top from vertical support blade (fig. 3F-27).

(2) Loosen adjusting screws.

(3) Reposition vertical support blade.

(4) Tighten adjusting screws.

(5) Reposition and snap soft top into place.

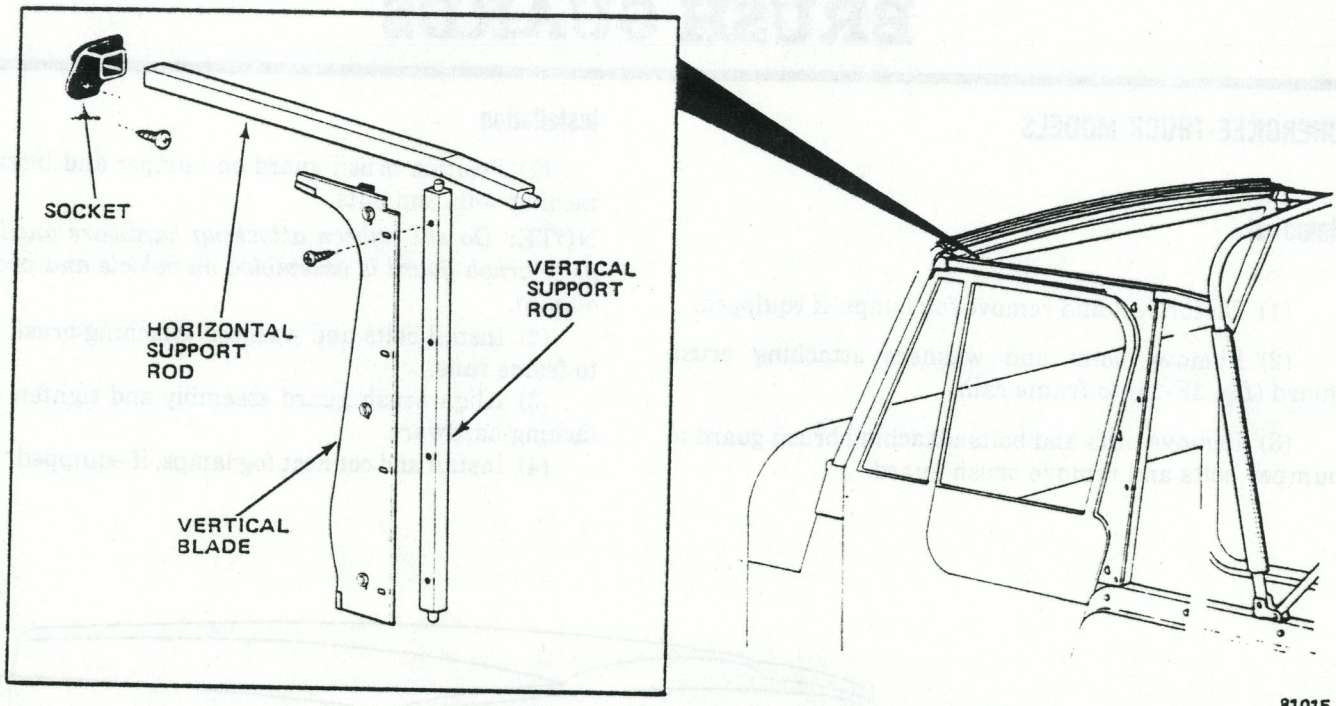


Fig. 3F-27 Soft Top Supports for Metal Door

STORAGE COMPARTMENT

GENERAL

A storage compartment is available on all CJ models, however, the rear seat must be deleted on the CJ-5 models when a storage compartment is installed.

The storage compartment can be locked with a key and is also bolted to the body side panels for added security.

Removal

(1) Open storage compartment and remove attaching screws and washers shown in figure 3F-28.

(2) Remove storage compartment assembly.

(3) Remove rubber washers from wheelhouse.

Installation

(1) Position rubber washers on storage compartment mounting holes.

(2) Position storage compartment assembly in vehicle and align holes with rubber washers and holes in wheelhouse.

(3) Install storage compartment attaching screws and washers, tighten to 10 to 15 foot-pounds torque.

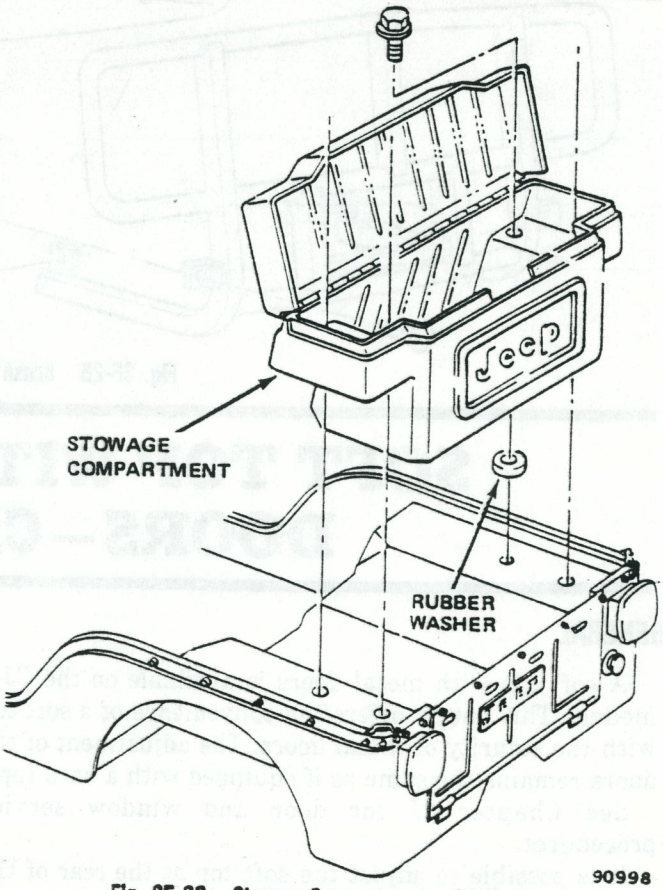


Fig. 3F-28 Storage Compartment—CJ Models

LOCK CYLINDER

Removal

(1) Open storage compartment and remove screw retaining lock rods.
(2) Remove lock rods from lock cylinder.
(3) Remove nut from lock cylinder.
(4) Remove lock cylinder.

Installation

(1) Position lock cylinder into storage compartment.
(2) Install nut on lock cylinder and tighten.
(3) Install lock rods onto lock cylinder and tighten retaining screw.

WOODEN RAILS— SPORT TRUCK MODEL

GENERAL

Wooden front and side rails are available for the Sport Truck models equipped with a roll bar. They are installed in the stake pockets and retained with special screws. The key type wrench located in the glove box or Torx Bit Tool J-25359-C may be used to remove the screws.

Removal

(1) Remove attaching screws from pickup box (fig. 3F-29) using Torx Bit Tool J-25359-C or key wrench located in glove box.
(2) Disengage side rails from roll bar bracket.
(3) Remove side rail assemblies.
(4) Remove front rail assembly.

Installation

(1) Position front rail assembly in pickup box stake pockets.
(2) Position side rail assemblies in pickup box stake pockets making sure end brackets are located in roll bar brackets.
(3) Install and tighten attaching screws using Torx Bit Tool J-25359-C or key wrench located in glove box.

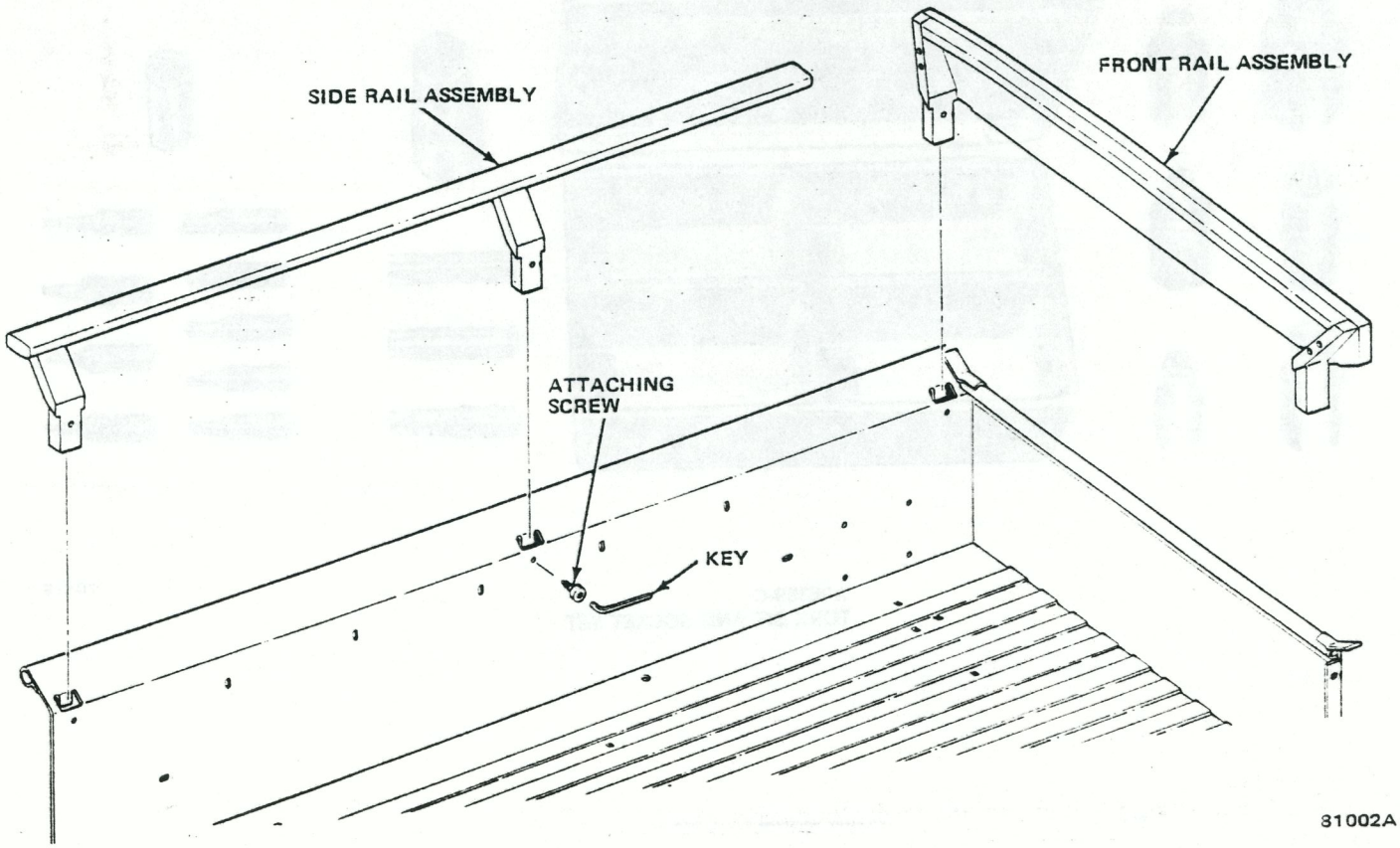
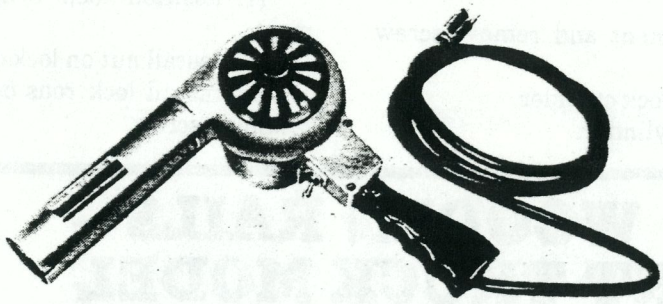


Fig. 3F-29 Wood Rails—Sport Truck Models

Tools



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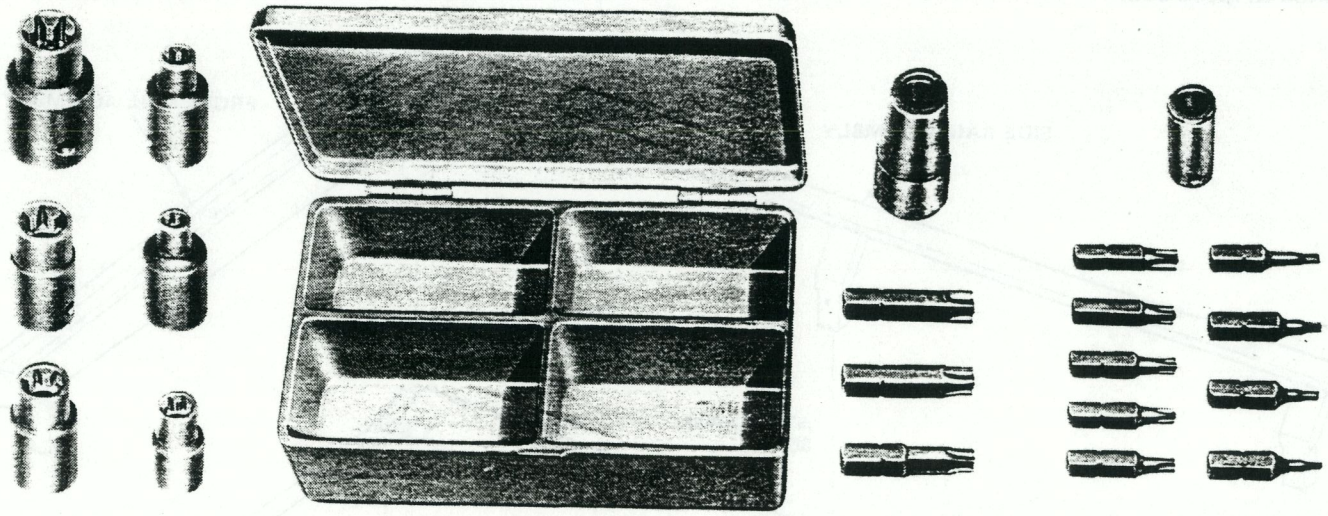
J-25070 HEAT GUN



J-25359-C
TORX BIT AND SOCKET SET

70119

HOODS 3G

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Hood Bumper	3G-3		

CJ MODELS

General

The CJ hood consists of an outer flanged panel with inner U-channels welded at the front and rear of the hood panel.

Removal and Disassembly

(1) Mark position of hinges on their respective mounting panels before removing hood.

(2) Detach hood panel from hinges by removing attaching screws, lockwashers, and flat washers.

(3) Disassembly of CJ hood is accomplished by removing hood prop rod, hood prop rod retainer clip, hood side catch brackets, footman loop, and windshield bumpers (fig. 3G-1).

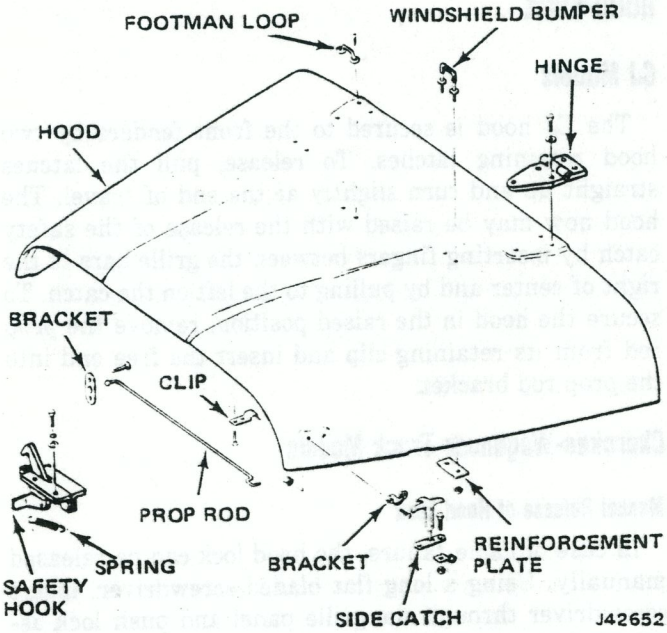


Fig. 3G-1 Hood and Related Parts—CJ Models

Assembly and Installation

(1) Finger-tighten related component parts and assemblies to hood panel.

(2) Position hood panel assembly and align hinges with scribe marks on the respective mounting panels. Tighten all attaching screws.

(3) Check hood alignment. Adjust if necessary.

Alignment

The hood hinge mounting holes are oversized to permit adjustment when aligning the hood.

(1) Loosen hinge mounting screws slightly on one side and tap hinge in opposite direction hood is to be moved.

(2) Tighten screws.

(3) Repeat procedure on opposite hinge.

CHEROKEE-WAGONEER-TRUCK MODELS

General

The Cherokee, Wagoneer, and Truck hood consists of an outer flanged panel with reinforcements welded at front, rear and both sides.

Removal and Disassembly

(1) Mark position of hinges on their respective mounting panels before removing hood.

(2) Disconnect hood release cable from lock assembly and remove cable support bracket and lower cable.

(3) Remove tie straps from hood panel brace rod.

(4) Detach hood panel from hinges by removing attaching screws, lockwashers, and flat washers.

(5) Disassembly of hood is accomplished by removing hood lever lock assembly, left and right hood panel brace rods, and insulation pad (Cherokee and Wagoneer) cemented to hood panel (fig. 3G-2).

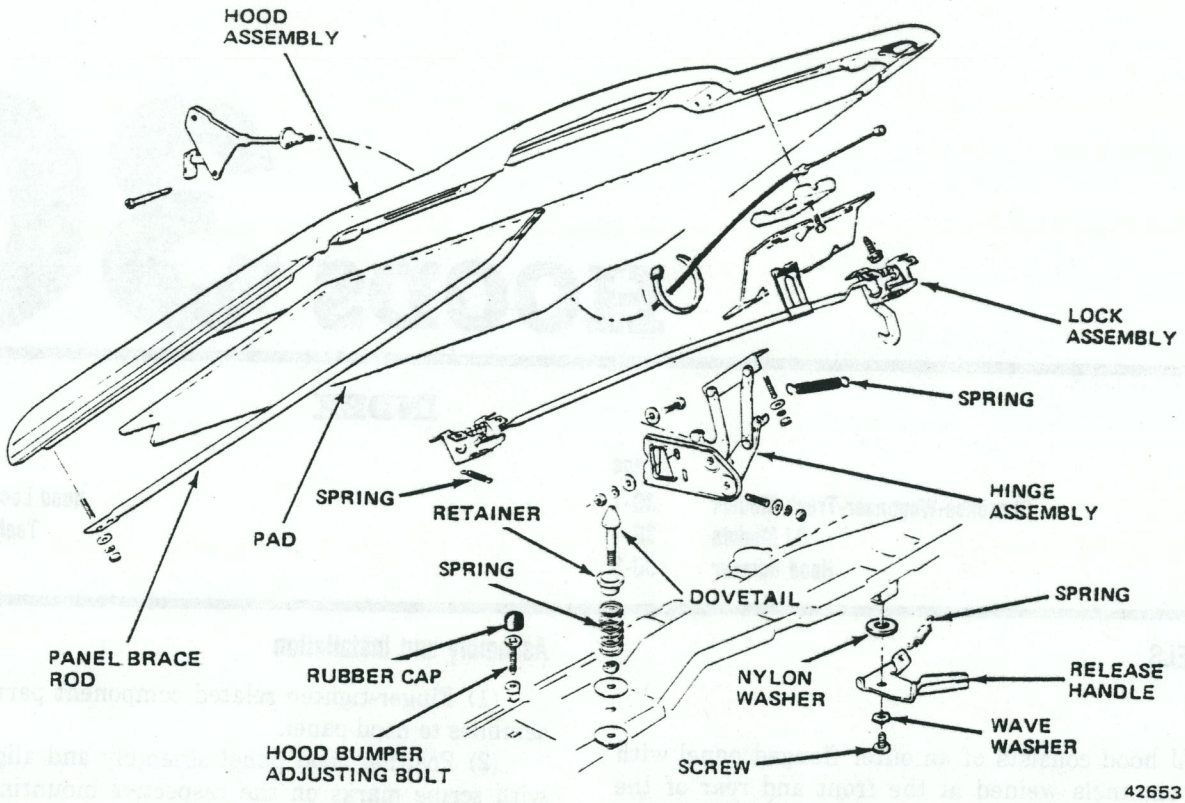


Fig. 3G-2 Hood and Related Parts—Cherokee-Wagoneer-Truck Models

Assembly and Installation

(1) Finger-tighten related component parts and assemblies to hood panel.

(2) If Cherokee or Wagoneer hood panel insulation pad has been removed, clean off all loose cement and pad particles from panel to ensure good adhesion when recemented.

(3) Position hood panel assembly and align hinges with scribe marks on respective mounting panels. Tighten all attaching screws.

(4) Position hood release cable on hood panel brace rod and attach with tie straps.

(5) Install cable assembly and cable support bracket. Tighten to 15 foot-pounds (20 N•m) torque.

(6) Attach cable end to lock assembly.

(7) Check hood alignment. Adjust if necessary.

Alignment

The hood hinge mounting holes are oversized to permit adjustment when aligning the hood.

NOTE: *If the hood must be moved to either side, the hood lock assembly and dovetail assembly must first be loosened.*

(1) Loosen hinge mounting screws slightly on one side and tap hinge in opposite direction hood is to be moved.

(2) Tighten screws.

(3) Repeat procedure on opposite hinge.

(4) Hook lock assembly and dovetail assembly must be adjusted to ensure positive locking.

(5) Shim between hinge and hood with shims or flat washers at rear screw if hood is low in relation to the cowl top.

(6) Shim at front screw if hood is too high at cowl.

HOOD LOCK

CJ Models

The CJ hood is secured to the front fenders by two hood retaining latches. To release, pull the latches straight up and turn slightly at the end of travel. The hood now may be raised with the release of the safety catch by inserting fingers between the grille bars to the right of center and by pulling to the left on the catch. To secure the hood in the raised position, remove the prop rod from its retaining clip and insert the free end into the prop rod bracket.

Cherokee-Wagoneer-Truck Models

Manual Release of Hood Lock

In case of cable failure, the hood lock can be released manually. Using a long flat bladed screwdriver, insert screwdriver through the grille panel and push lock assembly lever rearward.

Hood Lock

The hood lock assembly incorporates two locks and two strikers. A safety catch is incorporated in the hood lock.

A cable-controlled inside hood lock release is standard on all models. It is located to the left of the parking brake handle and is operated by rotating the handle upward.

Removal

(1) Disconnect inside release cable from lock assembly.
(2) Remove screws attaching lock assembly to hood panel.
(3) Remove lock assembly.

Installation

(1) Position lock assembly on hood panel and install attaching screws.
(2) Connect inside release cable.
(3) Adjust lock.

Inside Release Cable

Removal

(1) Remove screws attaching inside release cable bracket to cowl side trim panel using Torx Bit Tool J-25359-C.
(2) Disconnect hood release cable from lock assembly and remove cable support bracket (fig. 3G-2).
(3) Remove hood cable tie straps.
(4) Remove cable and rubber grommet from dash panel and remove cable.

Installation

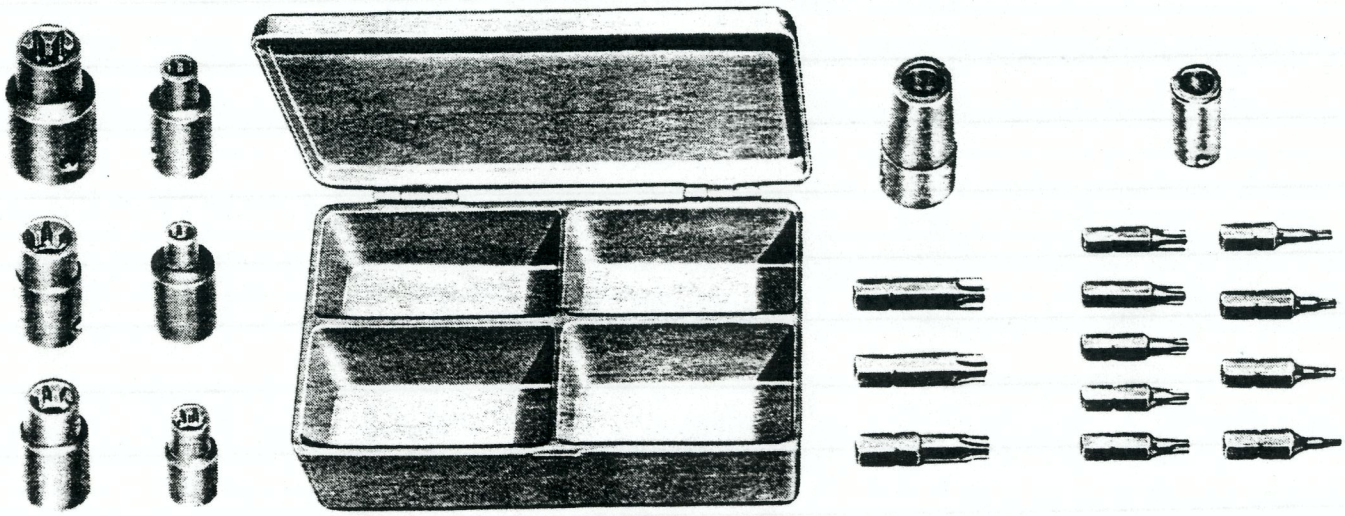
(1) Place cable through dash panel and install rubber grommet.
(2) Install screws attaching inside release cable bracket to cowl trim panel using Torx Bit Tool J-25359-C.
(3) Route cable along hood brace rod and attach with tie straps.
(4) Install cable assembly and cable support bracket tighten to 15 foot-pounds (20 N•m) torque.
(5) Attach cable end to lock assembly.

HOOD BUMPER

The hood bumpers on CJ models are located across the top of the radiator grille guard and are not adjustable.

The hood bumpers on the Cherokee, Wagoneer and Truck models are adjustable. Rubber caps must be removed to adjust the bumper screws.

Tools



J-25359-C
TORX BIT AND SOCKET SET

NOTES

LIFTGATES - TAILGATES 3H

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CJ-7 LIFTGATES

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SEALING SYSTEM

Rubber Sealer

The liftgate rubber sealer is made of molded latex foam with a smooth rubber skin on the outside.

Plastic retainers are used to retain the rubber sealer to the liftgate. Barbs on the retainers depress when inserted in the holes and spread when fully inserted.

Maintenance of Rubber Sealers

Cold weather may cause the rubber sealer to harden and lose resiliency. This may cause the liftgate to loosen in its opening, resulting in noise. When servicing, use a dampened cloth to clean rubber sealer. Clean dirt from all points where rubber sealer contacts the molded top and tailgate. Apply AMC Silicone Lubricant, or equivalent, to rubber sealer.

CAUTION: *Do not use graphite, brake fluid, or wax on rubber sealer.*

Replacement

Replacement rubber sealers are coated with powder to prevent stickiness in storage. Remove all powder with a cloth dampened with 3M General Purpose Adhesive Cleaner, or equivalent, before installation.

(1) Carefully remove rubber sealer from liftgate, using needlenose pliers to remove plastic retainers from liftgate panel holes.

(2) Remove dust, dirt and old sealer from rubber sealer, liftgate and enclosure.

(3) Install lower corner of sealer to liftgate first.

(4) Press retainers, starting at lower edge of liftgate, into liftgate panel holes.

(5) Apply a bead of 3M Auto Joint and Seam Sealer, or equivalent, around perimeter of liftgate between rubber sealer and liftgate flange to prevent water from passing seal and entering vehicle.

WINDOW SYSTEM

Replacement

(1) Unlock rubber weatherstrip (fig. 3H-1) using wood wand or fiber stick.

(2) Use fiber stick to break seal between glass and rubber weatherstrip.

(3) Push glass and weatherstrip toward outside of vehicle and remove glass.

(4) Remove weatherstrip from liftgate opening.

(5) Inspect weatherstrip and clean sealer from glass cavity and flange cavity.

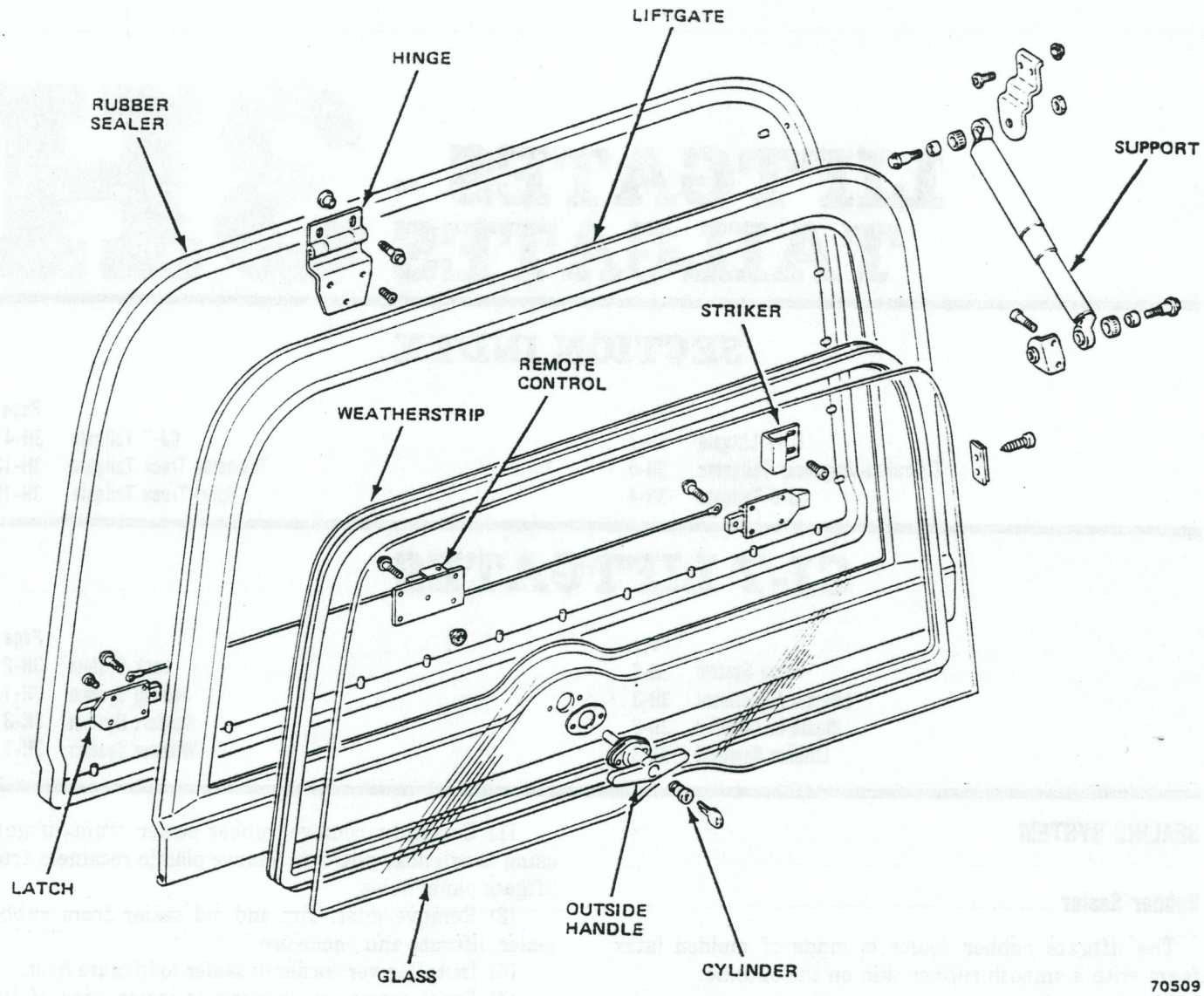

Fig. 3H-1 Liftgate Components

NOTE: *Inspect for uneven surfaces or irregularities in the opening flange that could cause stress damage to the glass.*

(6) Before installing weatherstrip on glass, apply 3/16-inch bead of 3M Auto Bedding and Glazing Compound, or equivalent, in weatherstrip flange cavity using pressure-type applicator.

(7) With glass installed in weatherstrip and before installing glass and weatherstrip into opening, insert 1/4-inch cord completely around weatherstrip in flange cavity.

NOTE: *The ends of the cord should hang out over the outside surface of the glass approximately in the center of the upper weatherstrip.*

(8) Place glass and weatherstrip into position in window opening with ends of cord hanging outside vehicle.

(9) Pull on ends of cord to pull lip of weatherstrip over body panel. With cord removed, weatherstrip should be positioned correctly.

(10) Use wooden wand to lock weatherstrip.

(11) Using pressure-type applicator, apply 3M Windshield Sealer, or equivalent, between weatherstrip and glass on outside of glass around entire perimeter.

(12) Clean excess sealer from glass and exterior body surface.

(13) Test window for water leaks.

LOCK SYSTEM

Outside Handle Replacement

(1) Remove screws attaching remote control to liftgate using Torx Bit Tool J-25359-C.

(2) Remove nuts attaching outside handle to liftgate and remove handle.

NOTE: *The replacement outside handle is furnished without the lock cylinder. The lock cylinder is furnished uncoded without keys.*

(3) Code existing door lock key to replacement cylinder.

(a) Insert key in replacement cylinder.

(b) File tumblers until flush with cylinder body.

(c) Remove and install key, and check that tumblers are flush with body.

(d) Install cylinder in replacement outside handle.

(4) Position outside handle in liftgate and install attaching nuts.

(5) Position remote control on liftgate and install attaching screws using Torx Bit Tool J-25359-C.

Remote Control Replacement

(1). Loosen screws attaching remote control cables to latch. Disconnect cables from screws.

(2) Remove screws attaching remote control (fig. 3H-1) to liftgate using Torx Bit Tool J-25359-C.

(3) Position remote control on liftgate and install attaching screws using Torx Bit Tool J-25359-C.

(4) Connect remote control cables to latch screws and tighten screws.

Latch Replacement

(1) Loosen screws attaching remote control cable to latch. Disconnect cable from screw.

(2) Remove screws attaching latch (fig. 3H-1) to liftgate using Torx Bit Tool J-25359-C. Remove latch.

(3) Position latch on liftgate and install attaching screws using Torx Bit Tool J-25359-C.

(4) Connect remote control cable to latch screw and tighten screw.

Striker Adjustment

The strikers provide durable retention points for the latches and prevent movement of the liftgate. Strikers may be moved in or out to compensate for body and enclosure variations. Use Torx Bit Tool J-25359-C for removal and adjustment.

SUPPORT SYSTEM

Replacement

(1) Open liftgate, support to prevent closing.

(2) Remove screws attaching supports and remove supports.

(3) Install supports and attaching screws.

HINGE SYSTEM

Replacement

(1) Open liftgate, support to prevent closing.

(2) Remove screws attaching supports to liftgate and fold supports downward.

WARNING: *Never remove supports with liftgate closed. The supports are under spring tension and may cause damage or personal injury if removed with liftgate closed. After removal, do not attempt to dismantle or repair the supports.*

(3) Using Torx Bit Tool J-25359-C, remove screws attaching hinge to liftgate.

(4) Using Torx Bit Tool J-25359-C, remove screws attaching hinge to enclosure. Remove hinge from enclosure.

(5) Clean replacement hinge in suitable solvent and blow dry with compressed air.

(6) Color-coat hinge to match enclosure.

(7) Lubricate hinge with 3M 4-Way Spray lubricant, or equivalent.

(8) Position hinge on enclosure and install attaching screws, using Torx Bit Tool J-25359-C.

(9) Position liftgate on hinge and install hinge-to-liftgate attaching screws using Torx Bit Tool J-25359-C.

(10) Position supports on liftgate and install attaching screws.

LIFTGATE REMOVAL

(1) Open liftgate, support to prevent closing.

(2) Remove screws attaching supports to liftgate and fold supports downward.

WARNING: *Never remove supports with liftgate closed. The supports are under spring tension and may cause damage or personal injury if removed with liftgate closed. After removal, do not attempt to dismantle or repair the supports.*

(3) Using Torx Bit Tool J-25359-C, remove screws attaching hinges to liftgate and remove liftgate.

LIFTGATE INSTALLATION

(1) Position liftgate on hinges and install hinge-to-liftgate attaching screws using Torx Bit Tool J-25359-C.

(2) Position supports on liftgate and install attaching screws.

(3) Check liftgate alignment. Adjust if necessary. (Refer to Liftgate Adjustment.)

LIFTGATE ADJUSTMENT

(1) Open liftgate, support to prevent closing.

(2) Remove screws attaching supports to liftgate and fold supports downward (fig. 3H-1).

WARNING: *Never remove supports with liftgate closed. The supports are under spring tension and may cause damage or personal injury if removed with liftgate closed. After removal, do not attempt to dismantle or repair the supports.*

(3) Using Torx Bit Tool J-25359-C, remove screws attaching latches to liftgate.

NOTE: *Do not disconnect remote control cables from latches.*

(4) Loosen screws, using Torx Bit Tool J-25359-C, attaching hinges.

(5) Close liftgate and shift liftgate to obtain desired gap (side-to-side).

(6) Open liftgate and tighten hinge-to-liftgate screws using Torx Bit Tool J-25359-C.

(7) Position latches on liftgate and install attaching screws using Torx Bit Tool J-25359-C.

(8) Position supports on liftgate and install attaching screws.

CJ-5 TAILGATE

GENERAL

The hinged tailgate is held in the closed, up position with hooks which pass through slotted brackets on the tailgate and on the body. The hinges are designed in such a way that the tailgate can be removed easily. The body half of the hinge is slotted and the tailgate half has a matching flat surface. However, to prevent accidental dropping of the tailgate, the flat surface on the left hinge pin is not in line with the flat surface on the right hinge pin.

REMOVAL

(1) Rotate tailgate approximately 45 degrees from full up position and disengage right hinge.

(2) Rotate tailgate an additional few degrees and then disengage left hinge.

INSTALLATION

(1) Hold tailgate at approximately 45 degrees from full up position and engage right hinge.

(2) Rotate tailgate an additional few degrees and then engage left hinge.

ADJUSTMENT

(1) Loosen hinge attaching bolts and slide body half of hinge up, down, or to side as needed.

(2) Tighten bolts.

CJ-7 TAILGATE

GENERAL

The new tailgate is hinged at the bottom and held in the closed up position with dual latches. The tailgate is supported in the open position by two steel cables.

REMOVAL

(1) Remove screws and wave washers attaching support cables to tailgate.

(2) With tailgate closed, remove screws attaching hinges to tailgate using Torx Bit Tool J-25359-C. Disengage latches and remove tailgate.

INSTALLATION

(1) Position and align tailgate in body opening and engage latches.

(2) Install hinge attaching screws using Torx Bit Tool J-25359-C.

(3) Position support cables on tailgate and install attaching screws and wave washers.

ADJUSTMENT

(1) Loosen hinge-to-body attaching screws and align tailgate to body opening.

(2) Tighten hinge attaching screws.

HINGE REPLACEMENT

(1) Remove all hinge attaching screws using Torx Bit Tool J-25359-C and remove hinge.

(2) Clean replacement hinge in suitable solvent and blow dry with compressed air.

(3) Paint hinge to match body with Jeep exterior spray paint.

(4) Lubricate hinge with 3M 4-Way Spray lubricant or equivalent.

(5) Position hinge on body and tailgate and install attaching screws using Torx Bit Tool J-25359-C.

RUBBER SEALER

The tailgate rubber sealer is made of molded latex foam with a smooth rubber skin on the outside.

Plastic retainers are used to retain the rubber sealer to the tailgate. Barbs on the retainers depress when inserted in the holes and spread when fully inserted.

Maintenance of Rubber Sealers

Cold weather may cause the rubber sealer to harden and lose resiliency. This may cause the tailgate to loosen in the opening, resulting in vibration and noise. When servicing, use a dampened cloth to clean rubber sealer. Clean dirt from all points where the rubber sealer contacts the body. Apply AMC Silicone Lubricant, or equivalent, to rubber sealer.

CAUTION: *Do not use graphite, brake fluid, or wax on rubber sealer.*

Replacement

Replacement rubber sealers are coated with powder to prevent stickiness in storage. Remove all powder with a cloth dampened with 3M General Purpose Adhesive Cleaner, or equivalent, before installation.

(1) Carefully remove rubber sealer from tailgate using needlenose pliers to remove plastic retainers from tailgate panel holes.

(2) Remove dust and dirt from rubber sealer, tailgate, and body.

(3) Install lower corner of rubber sealer to tailgate first.

(4) Press plastic retainers into tailgate panel holes.

CHEROKEE - WAGONEER TAILGATES

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GENERAL

The tailgate is a horizontally hinged unit equipped with a manual or electrically operated window regulator. An access hole in the inner panel is for installing and servicing the window regulator and latch assemblies (fig. 3H-2).

The torque rods serve to counterbalance and assist in opening as well as closing the tailgate.

Tailgate hinges are accessible at the body side of the hinge for easier adjustment or replacement.

Tailgate weatherseal is body-mounted for better wind and water-leak resistance.

ADJUSTMENT

Tailgate adjustment is similar to side door adjustments; proper alignment is obtained by changing the position of the hinges relative to the body and tailgate. On models equipped with carpeting, remove carpeting to gain access to hinge cover plates. Cherokee and Wagoneer vehicles have hinge cover plates in the body floor and tailgate for easy access to hinge screws (fig. 3H-2). The dovetail assemblies, which stabilize the tailgate and function as an overslam bumper, are adjusted by bringing the dovetail studs into alignment with the dovetail cap. The dovetail studs are located on the body pillars near the striker plates, and are adjustable. The dovetail caps are located on the tailgate and are nonadjustable.

Hinges

(1) Remove dovetail studs from body pillars.

(2) If equipped with carpeting, remove carpeting to gain access to hinge cover plates.

(3) Remove two body hinge cover plates.

(4) Loosen screws attaching hinges to body and adjust floating plates until lower portion of tailgate closes flush or underflush with body sheet metal to ensure proper compression of weatherseal. Tighten hinge screws to 15 to 20 foot-pounds (20 to 27 N•m) torque.

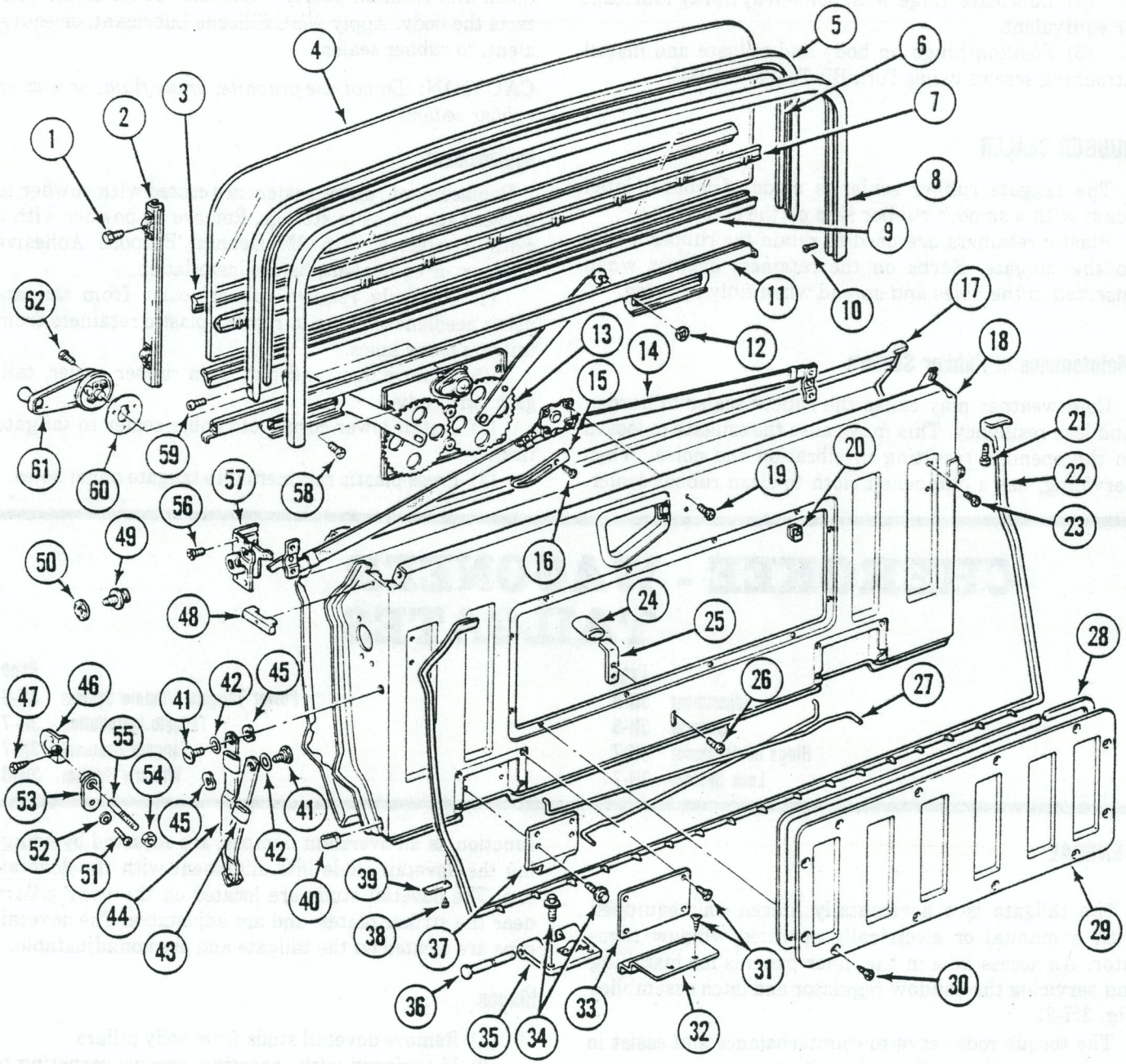
(5) Install body hinge cover plates and carpeting, if equipped.

(6) Install and adjust dovetail studs.

Dovetail Assemblies

(1) Loosen dovetail stud locking nuts.

(2) Close tailgate into locks.



1. HEXAGON SCREW
2. LOWER CHANNEL
3. WEATHERSTRIP
4. TAILGATE GLASS
5. RUN CHANNEL
6. UPPER CUSHION
7. WEATHERSTRIP
8. GLASS FRAME
9. CHANNEL SEALER
10. TAPPING SCREW
11. BOTTOM CHANNEL
12. STUD RETAINER
13. WINDOW REGULATOR
14. REMOTE CONTROL
15. RELEASE HANDLE
16. OVAL HEAD SCREW
17. OUTER PANEL
18. TAILGATE
19. MACHINE SCREW
20. SPEED NUT
21. PLASTIC RIVET
22. TAILGATE SEALER
23. MACHINE SCREW
24. BRACKET BUMPER
25. STOP BRACKET
26. MACHINE SCREW
27. TORQUE ROD
28. COVER GASKET
29. ACCESS COVER
30. TAPPING SCREW
31. TAPPING SCREW
32. COVER PLATE
33. COVER PLATE
34. HINGE SCREW
35. BODY HALF HINGE
36. HINGE PIN
37. TAILGATE HALF HINGE
38. PLASTIC RIVET
39. DUST SEAL
40. ARM BUMPER
41. SHOULDER BOLT
42. SPRING WASHER
43. ARM SLEEVE
44. SUPPORT ARM
45. LOCKWASHER
46. DOVETAIL CAP
47. TAPPING SCREW
48. END CAP
49. TAILGATE STRIKER
50. STRIKER WASHER
51. MACHINE SCREW
52. LOCKWASHER
53. TAILGATE DOVETAIL
54. HEXAGON NUT
55. DOVETAIL STUD
56. MACHINE SCREW
57. TAILGATE LATCH
58. MACHINE SCREW
59. MACHINE SCREW
60. HANDLE GASKET
61. REGULATOR HANDLE
62. MACHINE SCREW

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Fig. 3H-2 Tailgate with Manual Regulator—Cherokee-Wagoneer Models

(3) Adjust dovetail studs, using Torx Bit Tool J-25359-C, into dovetail caps and tighten stud locking nuts.

(4) Check tailgate for proper alignment and adjustment. Be sure tailgate latches properly with strikers and dovetails align into caps.

Striker Assemblies

(1) Loosen dovetail stud locking nuts.

(2) Latch forks should be aligned and nest in the center of the strikers.

(3) Add or remove striker shims to obtain this adjustment.

(4) Adjust strikers using Torx Bit Tool J-25359-C so latches engage strikers freely and tailgate fits flush with adjacent panels.

(5) Adjust dovetail studs.

HINGE REPLACEMENT

(1) Open tailgate. If vehicle is equipped with cargo area floor covering, remove mouldings and place floor covering aside.

(2) Remove access hole cover plates from body and tailgate.

(3) Raise tailgate to vertical position to unload counterbalance torque rods, and pry rods from clip welded to body half of hinge.

(4) Using wax pencil, mark outline of existing hinge(s) on body and tailgate for reference.

(5) Support tailgate in horizontal position, remove screws attaching hinge(s), and remove hinge(s).

(6) Clean replacement hinge(s) in suitable solvent and blow dry with compressed air.

CAUTION: *Do not immerse hinge in solvent.*

(7) Color coat hinges to match body.

(8) Lubricate hinges with 3M 4-Way Spray lubricant, or equivalent.

(9) Install replacement hinge(s), being careful to align with wax pencil marks. Tighten screws to 15 to 20 foot-pounds (20 to 27 N•m) torque.

(10) Raise tailgate to vertical position and install counterbalance torque rods in welded clips on body half of hinges.

(11) Check tailgate alignment and adjust if necessary.

(12) Install access hole cover plates on body and tailgate and, if equipped, replace cargo area floor covering and mouldings.

TAILGATE

Removal

(1) Remove carpeting from tailgate, if equipped.

(2) Remove tailgate access cover and disconnect wiring.

(3) Remove carpeting, if equipped, to gain access to hinge access hole cover plates.

(4) Remove hinge access hole cover plates on body.

(5) Close tailgate and drive out hinge pins.

(6) With tailgate in vertical position, counterbalance torque rods are unloaded and can be removed from clip which is attached to body half of hinge.

(7) Remove screws holding lower end of support arms to tailgate.

Installation

(1) Attach support arms to tailgate and raise tailgate to vertical position in tailgate opening.

(2) Insert curved end of one torque rod in hole at bottom edge of tailgate and right-angle tapered end of rod in clip which is attached to body half of hinge. Attach other torque rod in same manner.

(3) Install hinge pins with head of pin on inboard side of hinge.

(4) Install hinge access hole cover plates on body.

(5) Install carpeting, if equipped.

(6) Connect wiring and replace tailgate access cover and carpeting, if equipped.

(7) Adjust tailgate.

LOCK SYSTEM

Remote Control Replacement

(1) Lower tailgate and move tailgate glass to extreme out position so remote control assembly will be accessible. Tailgate glass should be supported to relieve stress on its lower edge.

(2) Remove carpeting from tailgate, if equipped.

(3) Remove access cover and tailgate release handle from remote control.

(4) Remove screws attaching center of remote control assembly.

(5) Remove screws from each end of remote control rods.

(6) Release lower edge of vinyl water shield on vehicle, if equipped.

(7) Pull rods down toward bottom of tailgate to obtain side clearance.

(8) Move remote control assembly toward side of tailgate and free remote control from latch opening in tailgate. Remove remote control assembly through access cover opening.

(9) Position remote control assembly in tailgate.

(10) Install screws attaching end of each remote control rod.

(11) Install screws attaching center of remote control assembly.

(12) Install tailgate access cover and carpeting, if equipped.

Latch Replacement

(1) Lower tailgate and move tailgate glass to extreme out position so remote control assembly will be accessible. Tailgate glass should be supported to relieve stress on its lower edge.

(2) Remove carpeting from tailgate, if equipped.

(3) Remove access cover and remove screws attaching ends of remote control rods to tailgate.

(4) Remove screws attaching latch assemblies to ends of gate and remove latch assembly.

(5) Clean replacement latch in suitable solvent and blow dry with compressed air.

CAUTION: *Do not immerse latch in solvent.*

(6) Color coat latch to match body.

(7) Position latch assembly in tailgate and install attaching screws.

(8) Install access cover and carpeting, if equipped.

(9) Adjust striker, if necessary.

WINDOW SYSTEM

Glass Replacement

Tailgate glass is operated by a double-arm window regulator which is connected directly to an outside window regulator handle. The complete window assembly will slide up and out of the run channels when the pins at the ends of the regulator arms are withdrawn from the slot in the lifter channel.

(1) Remove carpeting from tailgate, if equipped, and remove access cover on inside tailgate panel.

(2) Remove studs retainers from window regulator arm studs.

(3) Disconnect window regulator arm studs from bottom channel.

(4) Disconnect tailgate window defogger, if equipped.

(5) Remove tailgate glass assembly and discard.

(6) Check tailgate glass operating mechanism for bent or damaged components. Replace as necessary.

(7) Clean lower section of replacement tailgate glass with isopropyl alcohol or equivalent.

NOTE: *Do not wipe or rub grid area when cleaning glass.*

(8) Obtain replacement tailgate glass bottom sealer 8130418 and cut two pieces 53-1/2 inches long.

(9) Position one sealer on top of other with adhesive sides together forming a 0.090-inch thick strip 53-1/2 inches long. Firmly press together.

(10) Position glass with bottom edge facing up and top edge on cushion to prevent damage to glass.

(11) Remove release paper from one side of sealer. Starting at one end, center sealer over edge of glass. Lay sealer along complete bottom length of glass, keeping sealer centered over edge of glass.

NOTE: *Do not wrap sealer around the bottom edge of the glass at this time.*

(12) Remove second release paper from sealer and wrap sealer around bottom edge of glass.

(13) Install replacement bottom channel on glass by pressing or tapping channel into position.

NOTE: *Ensure channel is fully seated on glass.*

(14) Install glass and channel assembly in tailgate.

(15) Connect tailgate window defogger, if equipped.

(16) Connect window regulator arm studs to bottom channel.

NOTE: *Retainers can be damaged when removed and their condition should be checked. When installing retainers, the tabs must be firmly locked in groove of stud. If difficulty is experienced when installing the retainers, they were probably damaged during removal and should be replaced.*

(17) Install stud retainers on window regulator arm studs.

(18) Install access cover.

(19) Install carpeting, if equipped.

Regulator Replacement

(1) Remove carpeting from tailgate, if equipped, and remove access cover.

(2) Remove tailgate glass.

(3) Remove regulator by sliding dust cover aside and rotating handle until hole in handle is aligned with screws that attach handle assembly to tailgate. Remove attaching screws and handle.

(4) Remove screws that attach regulator assembly to tailgate.

(5) Remove regulator assembly through access cover opening.

(6) After installation and before access cover is replaced, raise and lower window to check that window fits properly. The window regulator can be adjusted by loosening attaching screws and moving regulator assembly in slotted screw holes until proper window adjustment is obtained.

(7) Adjust handle to be in vertical position when window is full up.

Glass Adjustment

The tailgate glass, when closed, must seat fully into the upper glass channel to obtain a positive seal at horizontal weatherstrip located at the top of the tailgate. If tailgate does not seat properly when closed, check the upper glass channel to be certain it is bottomed in the body opening, also check alignment of the tailgate glass run channel.

(1) If adjustment is necessary, loosen two capscrews on either side panel of tailgate (fig. 3H-3).

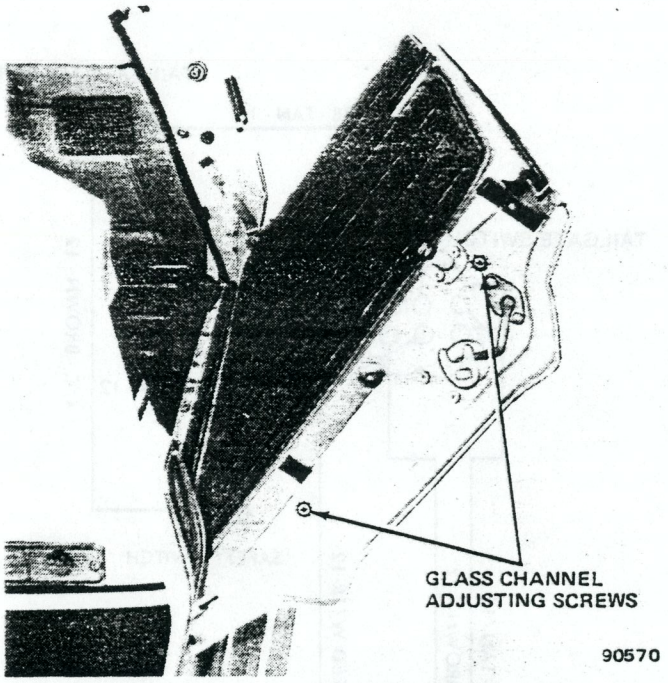

Fig. 3H-3 Glass Channel Adjustment

(2) Raise and lower glass several times with tailgate in closed position. This will align glass with channel.

(3) Open tailgate slightly and tighten adjusting screws with tailgate in vertical position.

POWER TAILGATE WINDOW SYSTEM

General

An electrically operated tailgate window is offered on Cherokee and Wagoneer models. When checking for tailgate window motor operation, be sure instrument panel switch black lead is properly grounded. The tailgate motor grounds through this switch. It is necessary to isolate the problem to one of the two operating circuits: (1) tailgate window operation from instrument panel switch and (2) tailgate window operation from tailgate window switch.

Operation

Instrument Panel Switch

Current is supplied from battery to ignition switch to fuse panel, through a 30-amp circuit breaker (located in the fuse panel), and to instrument panel tailgate window switch (fig. 3H-4).

NOTE: *If the vehicle is equipped with a tailgate window defogger, the defogger and tailgate switches are serviced as an assembly. They cannot be replaced separately. Both switches must be replaced when either is defective.*

Tailgate Window Switch

Current is supplied directly to fuse panel, through a 30-amp circuit breaker, and to red w/tr (No. 46) wire of tailgate window switch (fig. 3H-4).

Testing

Instrument Panel Tailgate Window Switch

NOTE: *Be sure instrument panel tailgate window switch black lead is properly grounded. The tailgate motor grounds through this switch.*

(1) Turn ignition switch to on position.

(2) Using 12-vdc test lamp, connect one end of test lamp to ground and place probe to red (No. 53) wire of switch. If lamp lights, voltage is present at switch. If lamp does not light, repair problem in feed circuit before proceeding.

(3) Place test lamp probe to brown (No. 47) wire of switch. Move switch to up position. If lamp lights, proceed to step (4). If lamp does not light, replace switch.

(4) Place test lamp probe to tan (No. 48) wire of switch. Move switch to down position. If lamp lights, proceed to Tailgate Window Switch Test. If lamp does not light, replace switch.

Tailgate Window Switch

NOTE: *Be sure instrument panel tailgate window switch black lead is properly grounded. The tailgate motor grounds through this switch.*

(1) Using 12-vdc test lamp, connect one end of test lamp to ground and place probe to red w/tr (No. 46) wire of tailgate window switch. If lamp lights, proceed to step (2). If lamp does not light, repair problem in feed circuit before proceeding.

(2) Place test lamp probe to tan (No. 48A) wire of tailgate switch. Turn tailgate window switch key to down position. If lamp lights, proceed to step (3). If lamp does not light, replace switch.

(3) Place test lamp probe to brown (No. 47B) wire of tailgate switch. Turn tailgate window switch key to up position. If lamp lights, proceed to next test. If lamp does not light, replace switch.

Tailgate Window Safety Switch

(1) Using 12-vdc test lamp, connect one end of test lamp to ground and place probe to brown wire of safety switch. Turn tailgate window switch to up position. If lamp lights, voltage is present at switch. If lamp does not light, repair feed circuits as necessary.

(2) Place test lamp probe to brown wire at switch. Turn tailgate window switch to up position and close safety switch. If lamp lights, proceed to next test. If lamp does not light, replace switch.

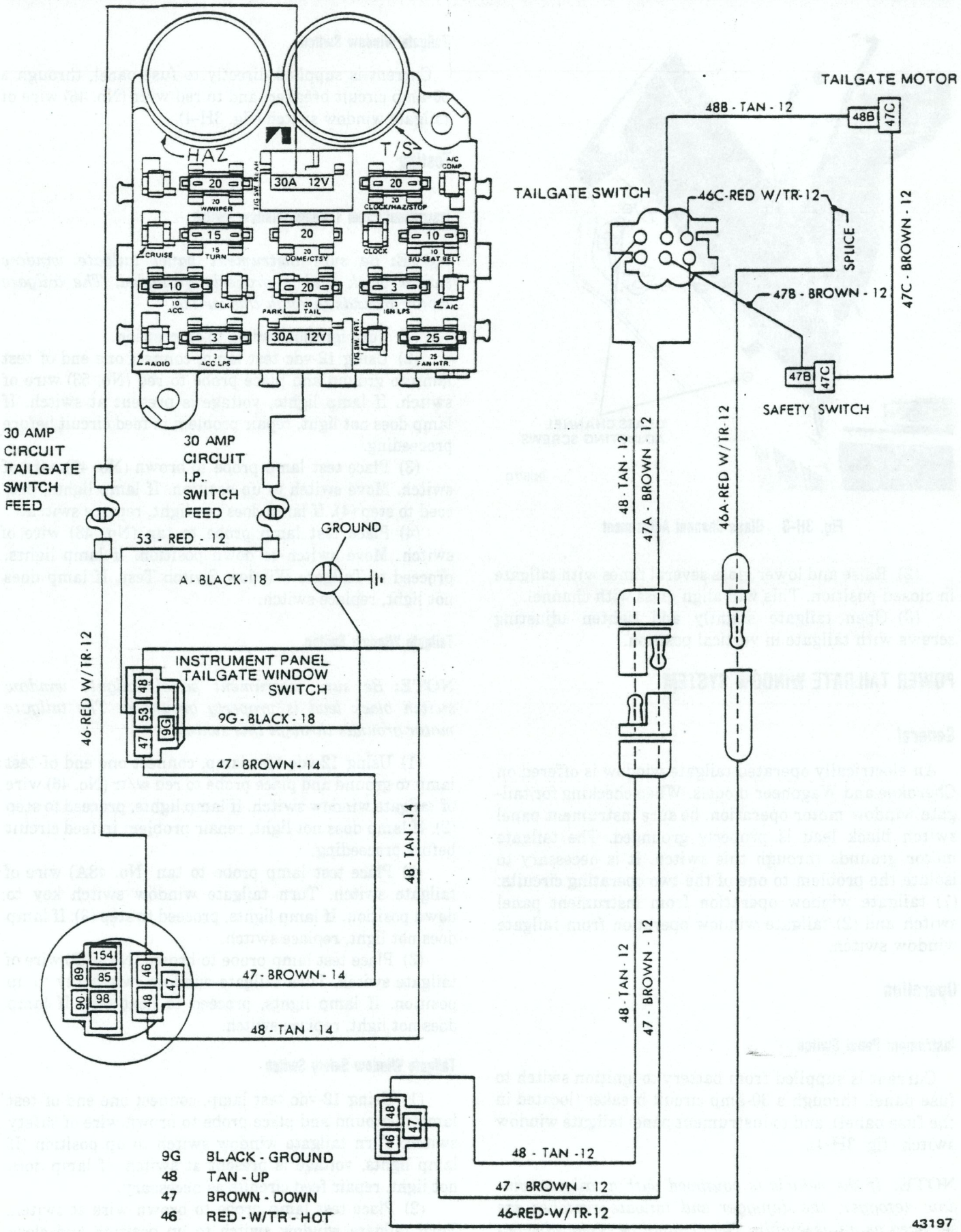

Fig. 3H-4 Power Tailgate Window Circuitry—Cherokee-Wagoneer Models

Tailgate Window Motor

NOTE: *Be sure instrument panel tailgate window switch black lead is properly grounded. The tailgate motor grounds through this switch.*

(1) Using 12-vdc test lamp, connect one end of test lamp to ground and place probe to tan (No. 48B) wire at electrical motor. Close safety switch. Turn tailgate window switch to down position. If lamp lights and motor does not operate, replace motor. If lamp does not light, check feed circuit to motor and repair as necessary.

(2) Place test lamp probe to brown (No. 47C) wire at electric motor. Close safety switch. Turn tailgate window switch to up position. If lamp lights and motor does not operate, replace motor. If lamp does not light, check feed to motor and repair as necessary.

The ignition switch must be in either the accessory or ignition position to energize the window lift circuit.

The rear window control switch is located to the left of the steering column on the instrument panel. The switch is spring-loaded and will return to the neutral position.

The tailgate glass also can be lowered or raised, by inserting the ignition key in the tailgate lock. Turn the key to the left to lower and to the right to raise the tailgate glass.

After the glass has been lowered, the tailgate can be opened by lifting up on the tailgate latch release handle on the inside of the tailgate at the center.

NOTE: *The tailgate safety switch is in series with the brown wire which feeds the up or down circuit of the tailgate motor. It prevents operation when the tailgate is open.*

The proper assembly of all movable parts is important for satisfactory operation of the tailgate window.

The glass assembly must be in alignment in the tailgate and glass slide channels to operate with free movement. The window regulator teeth in all gears, the coil springs, and the bottom channel slide sections must be lubricated with 3M 4-Way Spray lubricant, or equivalent, to ensure proper operation of the glass when it is raised or lowered.

Safety Switch

A safety switch, mounted in the upper left side of the tailgate, prevents operating the glass when the tailgate is in the open position to avoid possible damage to glass channels and regulator.

Circuit Breakers

The electric tailgate regulator motor and wiring harness are protected by two 30-ampere circuit breakers located in the fuse panel.

Instrument Panel Switch

The rear window switch is mounted at the lower left side of the instrument panel. For removal, remove knob by depressing spring clip. Remove attaching screws. Disconnect wiring and remove switch.

Wiring Harness

The tailgate circuit is a two-section wire harness: the body section, which is routed along the left side of the vehicle, and the section in the tailgate. The two harnesses are connected at the rear body crossmember.

Remove the tailgate access cover to gain access to the wiring harness.

Key Lock

The tailgate key lock assembly is held in place by two special screws located under the key hole cover. Remove the screws using Torx Bit Tool J-25359-C.

Window Switch

The tailgate window switch is mounted to the bottom side of the left regulator mounting support. It is fastened with two screws which are visible and accessible after the window regulator is removed.

Regulator

Removal

(1) Remove carpet from tailgate, if equipped.

(2) Remove tailgate access cover plate.

(3) Remove retainers attaching regulator arms to channel.

(4) Disengage regulator arm pins from channel and raise glass.

(5) Carefully support glass in the raised position.

(6) Disconnect wiring harness from motor.

(7) If regulator attaching screws are accessible, remove regulator attaching screws and regulator. If sector gears are covering attaching screws, proceed as follows:

(a) Remove motor attaching screws and disconnect motor drive from gear regulator.

(b) Grasp regulator arm as far outboard as access hole will allow.

(c) Push down on arm until holes in sector gears align with attaching screws and motor.

(d) While holding regulator in this position, wedge screw between meshing teeth, using other hand.

(e) Remove regulator attaching screws, regulator and motor.

(8) Release spring tension by using large screwdriver to snap spring from under tension bracket.

Installation

(1) Position spring on regulator and snap over tension bracket using large screwdriver.

(2) Position motor on regulator and install attaching screws.

(3) Position regulator in tailgate and install attaching screws.

(4) Connect wiring harness to motor.

(5) Position channel over regulator arm pins and install replacement retainers.

(6) Install access cover plate.

(7) Install carpet, if equipped.

Motor

Removal

(1) Remove tailgate window regulator, as outlined above.

(2) Remove motor attaching screws (fig. 3H-5) and motor from regulator.

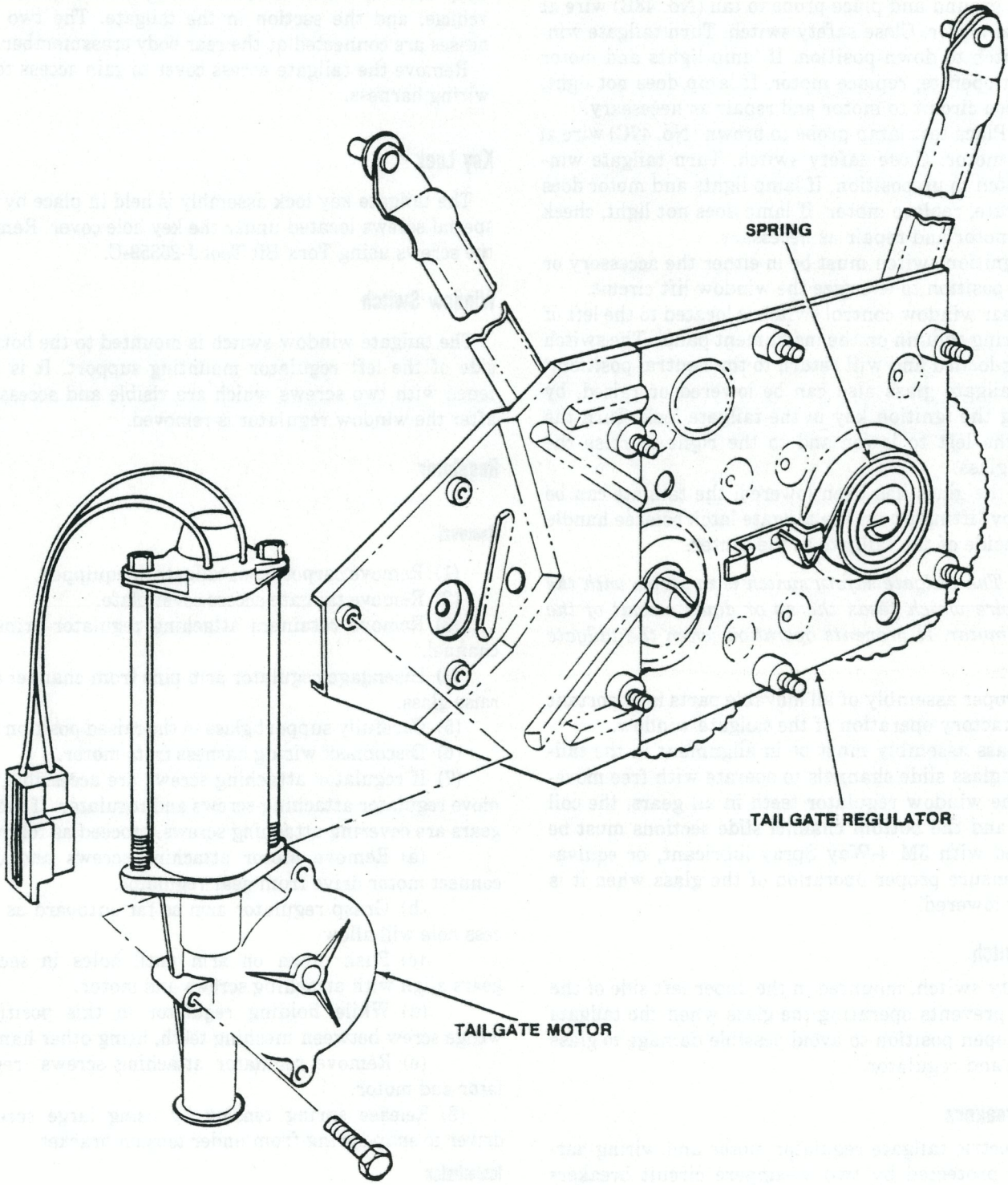

Fig. 3H-5 Power Tailgate Window Regulator and Motor

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Installation

(1) Position motor on regulator
(2) Install motor attaching screws.
(3) Install tailgate window regulator, as outlined above.
(4) Check motor operation.

TOWNSIDE TRUCK TAILGATE

GENERAL

The tailgate on the Townside pickup box is hinged at both sides. It is necessary to lower the tailgate for access to the cross-recessed countersunk attaching screws.

The tailgate on the pickup box is held in the up or closed position with spring-loaded latches at the top of the gate. A paddle handle, located in the center of the tailgate operates the latches at each side through connecting rods.

Pin type hinges are located on the sides of the pickup box. The hinge pin brackets are attached with cross-recessed countersunk attaching screws and cage nuts for easier adjusting.

The left side hinge pin is a solid round bar. The right side pin is similar but with two flat surfaces which correspond with a notch and the two flat surfaces allow the tailgate to be removed quickly from the tailgate opening.

To remove, open and lower the tailgate. Remove the side supports and then raise the tailgate to about 45-degrees from horizontal. Disengage the right side hinge and move the tailgate to the right to disengage the left side hinge.

SPORT TRUCK TAILGATE

GENERAL

The tailgate on the Sport Truck box is hinged at both sides. The hinges can be removed with the tailgate in either the closed or open position.

The tailgate is held in the open or closed position with a chain and hook assembly (fig. 3H-6).

Removal

(1) Disconnect chain assemblies (fig. 3H-6).
(2) Support tailgate assembly.
(3) Remove hinge attaching hardware.
(4) Remove hinge assemblies.
(5) Remove tailgate assembly.

Installation

(1) Position tailgate and support.
(2) Position hinge assemblies on tailgate and body.
(3) Install hinge attaching hardware.

NOTE: *Do not tighten attaching hardware until both hinges are positioned.*

(4) Align tailgate and tighten attaching hardware.
(5) Connect chain assemblies.

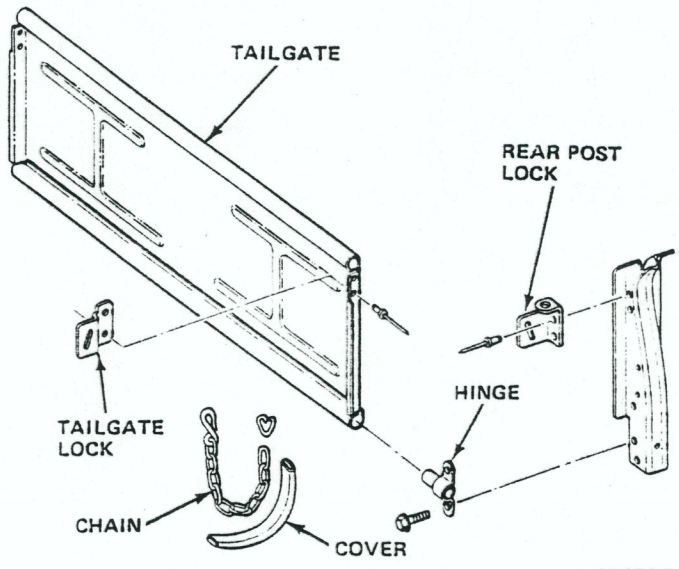
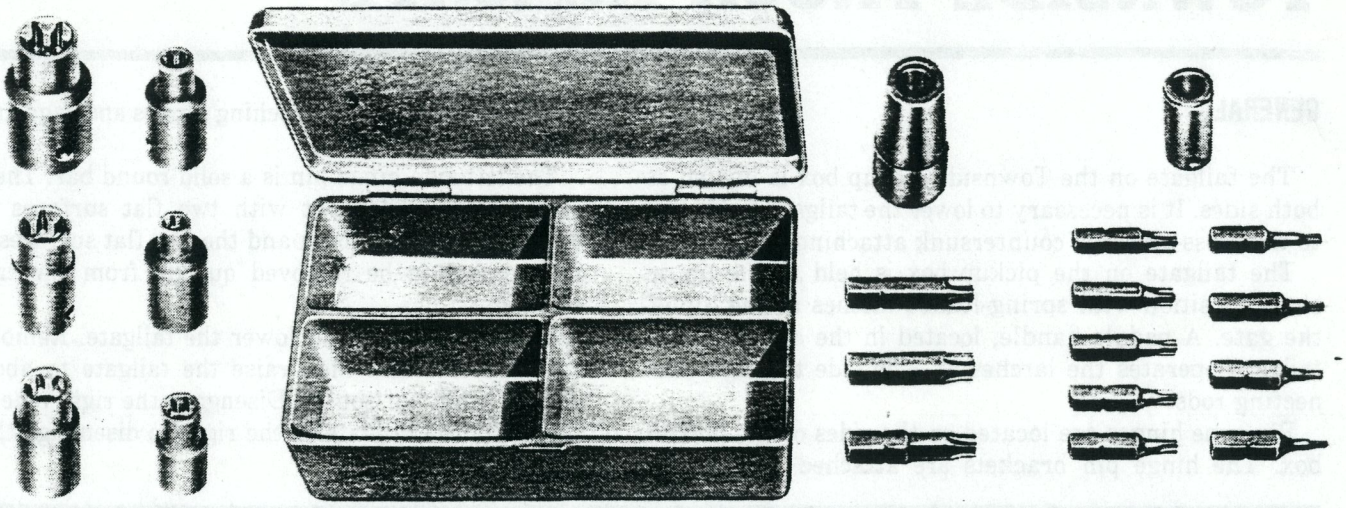


Fig. 3H-6 Tailgate Assembly—Sport Truck Model



J-25359-C
TORX BIT AND SOCKET SET

DOORS 3J

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CJ-7 WITH HARDTOP ENCLOSURE

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DOOR TRIM

Window Regulator Handle

Window regulator handles are attached to the splined shaft of the window regulator with a 5/32-inch Allen head screw. To remove the handle, remove the screw and pull the handle straight off the shaft.

Install the handle with the knob forward, the handle horizontal and the glass all the way up.

Door Assist Handle

Removal

(1) Remove screws attaching door assist handle using Torx Bit Tool J-25359-C.

(2) Remove handle from door.

Installation

(1) Position handle on door.

(2) Install attaching screws using Torx Bit Tool J-25359-C.

Trim Panel

Trim panels consist of fiber board composition covered with a vinyl material. They are fastened to the door with spring clips inserted into holes in the door inner panel.

Removal

(1) Remove door assist handle.

(2) Remove window regulator handle.

(3) Pry trim panel-to-door clips along sides loose with Trim Pad Depressor Tool J-2631-01 and remove panel.

Installation

(1) Position trim panel on door and install clips in holes in inner door panel.

NOTE: *To prevent creasing the trim panel cover, do not hammer or exert excessive force on the clips.*

(2) Install window regulator handle.

(3) Install door assist handle.

SEALING SYSTEM

Water Shield

The water shield is attached to the door inner panel with adhesive. To remove water shield, use a putty knife between shield and door inner panel to break adhesive bond.

When installing water shield, be sure the slit lower portion is tucked inside the door panel at the access opening and that the shield is bonded securely to the door inner panel.

Rubber Sealer

The door rubber sealer is made of molded latex foam with a smooth rubber skin on the outside.

Plastic retainers are used to retain the rubber sealer to the door below the belt line. Barbs on the retainer depress when inserted in the holes and spread when fully inserted. Above the belt line, the sealer is retained in a channel formed in the upper door frame.

Maintenance of Rubber Sealers

Cold weather may cause the rubber sealer to harden and lose resiliency. This may cause the door to loosen in its opening, resulting in noise. When servicing, use a dampened cloth to clean rubber sealer. Remove dirt from all points where the rubber sealer contacts the body. Apply AMC Silicone Lubricant, or equivalent, to sealer.

CAUTION: *Do not use graphite, brake fluid, or wax on rubber sealer.*

Replacement

Replacement rubber sealers are coated with powder to prevent stickiness in storage. Before installation, remove all powder with a cloth dampened in 3M General Purpose Adhesive Cleaner, or equivalent.

(1) Carefully remove rubber sealer from door using Weatherstrip Remover J-21104-01 to remove plastic retainers from panel holes. Remove upper portion from upper door frame with fingers or wooden wand.

(2) Remove dust and dirt from rubber sealer, door and body.

(3) Install upper front corner of sealer to door first using fingers or wooden wand to engage sealer into channel. Place inner shoulder of sealer in channel-to-window frame above belt line.

(4) Press retainers, starting at rear edge of door, into door panel holes.

WINDOW SYSTEM

Door Glass

Adjustment

One adjustment point is available which regulates the amount of effort required to raise and lower the door glass. The door glass division channel is adjustable fore and aft at the lower attachment point.

(1) Remove door trim panel and water shield.

(2) Loosen division channel lower adjusting screw and move division channel fore or aft to obtain desired door glass operation (fig. 3J-1).

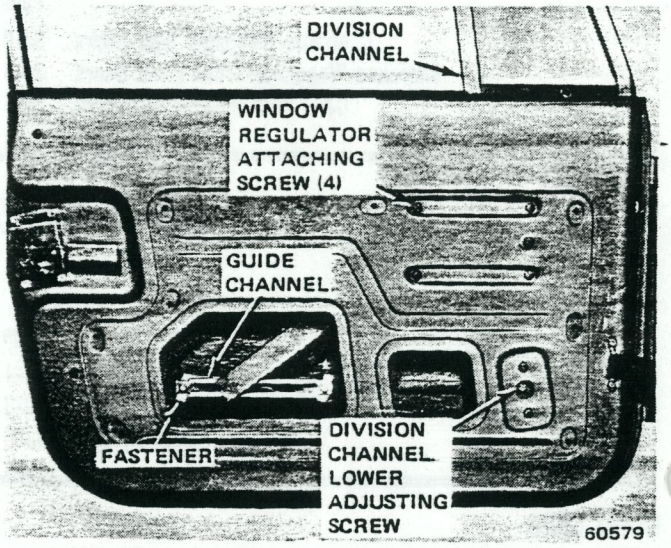

Fig. 3J-1 Door Glass Replacement—CJ Models

NOTE: *Movement of division channel fore and aft reduces or increases free play between channels.*

(3) Tighten division channel lower adjusting screw.

(4) Install water shield and door trim panel.

Removal

(1) Remove door trim panel and water shield.

(2) Remove glass down-stop.

(3) Remove screws attaching guide channel to plastic fasteners. Remove guide channel and plastic fasteners.

(4) Lower glass to bottom of door.

(5) Remove division channel upper attaching screw and lower adjusting screw. Disengage front three inches of glass weatherstrip from upper door frame. Remove division channel.

(6) Tilt glass toward hinge side of door and disengage from rear channel.

(7) Pull glass up and out of door panel.

Installation

(1) Lower glass into door with front of glass tilted down, while positioning glass into rear channel.
(2) Install plastic fasteners into glass.
(3) Slide glass down into bottom of door panel.
(4) Lower division channel into door and position glass in channel.
(5) Install upper attaching screw and lower adjusting screw. Engage weatherstrip in upper door frame.
(6) Slide guide channel onto regulator arm and position channel on glass. Install attaching screws.
(7) Install glass down-stop.
(8) Check operation and adjustment.
(9) Install water shield and door trim panel.

Stationary Vent Window

Removal

(1) Remove door trim panel and water shield.
(2) Lower glass to down-stop.
(3) Remove division channel upper attaching screw and lower adjusting screw.
(4) Disengage front three inches of weatherstrip from upper door frame. Lower division channel and tilt toward rear of door.
(5) Remove stationary vent glass from weatherseal.

Installation

(1) Install stationary vent glass into weatherseal.

NOTE: *It is necessary to seat front edge of weatherstrip into door frame. Then, seat vent glass into weatherstrip.*

(2) Install division channel into door and position channel on glass.
(3) Install upper attaching screw and lower adjusting screw.
(4) Engage weatherstrip in upper door frame.
(5) Water test and check for leaks.
(6) If water leakage is evident, apply 3M Windshield Sealer, or equivalent, or realign weatherseal.
(7) Check operation and adjustment of door glass.
(8) Install water shield and door trim panel.

Window Regulator

Removal

(1) Remove trim panel and water shield.
(2) Lower glass to expose guide channel fasteners. Remove fasteners and guide channel. Raise window to full up position and apply masking tape to glass and over top of window frame.
(3) Remove division channel lower adjusting screw.
(4) Remove regulator attaching screws. Push division channel outward and remove regulator through access hole in inner door panel.

Installation

(1) Position regulator in door and install attaching screws.
(2) Remove masking tape from glass and lower glass.
(3) Slide guide channel onto regulator arm and position channel on glass. Install attaching screws.
(4) Install division channel lower adjusting screw.
(5) Check operation.
(6) Install water shield and door trim panel.

LOCK SYSTEM

Outside Handle Replacement

NOTE: *The replacement outside handle is furnished without the lock cylinder. The lock cylinder is furnished uncoded without the keys.*

(1) Remove screws attaching outside door handle to door using Torx Bit Tool J-25359-C and remove handle.
(2) Code existing door lock key to replacement cylinder.
(a) Insert key in replacement cylinder.
(b) File tumblers until flush with cylinder body.
(c) Remove and install key, check that tumblers are flush with body.
(d) Install cylinder in replacement outside door handle.
(3) Install outside door handle on door and install attaching screws using Torx Bit Tool J-25359-C.

Latch Replacement

(1) Remove screws attaching door latch to door using Torx Bit Tool J-25359-C and remove latch.
(2) Lubricate door latch with 3M 4-Way Spray lubricant, or equivalent.
(3) Position door latch on door and install attaching screws using Torx Bit Tool J-25359-C.

HINGE SYSTEM

NOTE: *When removing door or hinge DO NOT lose the plastic shims on the hinge pin.*

Adjustments

The doors are adjusted at the hinge mounting points on the body or door.

Enlarged holes are provided in the body, lower hinge only, for fore, aft and tilt adjustments. Enlarged holes are also provided in the door, upper and lower hinges, for up, down, fore, aft and tilt adjustments.

Prior to any door adjustment or alignment, the door latch must be removed to allow the door to close freely in proper alignment.

The door latch striker should be adjusted in or out to allow the door latch to be fully engaged. The door should be flush with the adjacent body panels.

Replacement

NOTE: *When removing door or hinge DO NOT lose the plastic shims on the hinge pin.*

(1) Mark outline of existing hinge on body and door with wax pencil.

(2) Remove hinge-to-body screws and hinge-to-door screws using Torx Bit Tool J-25359-C and remove hinge.

NOTE: *Upper hinge is part of windshield hinge assembly. When replacing, adequately support the windshield frame prior to removal and check alignment after installation.*

(3) Clean replacement hinge in suitable solvent and blow dry with compressed air.

(4) Color-coat hinge to match body using Jeep exterior spray paint, or equivalent.

(5) Lubricate hinge with 3M 4-Way Spray lubricant, or equivalent.

(6) Position hinge on door, align carefully with wax pencil marks, and install screws using Torx Bit Tool J-25359-C.

(7) Position hinge on body, align carefully with pencil marks, and install screws using Torx Bit Tool J-25359-C.

(8) Check door alignment. Adjust if necessary. Refer to Door Adjustment.

CHEROKEE - WAGONEER - TRUCK FRONT DOORS

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DOOR TRIM

Window Regulator Handle

Window regulator handles are attached to the splined shaft of the window regulator with a 5/32-inch Allen head screw. To remove the handle, remove the screw and pull the handle straight off the shaft.

Install the handle with the knob forward, the handle horizontal and the glass all the way up.

Trim Panel

Trim panels consist of fiber board composition covered with a vinyl material. They are fastened to the door with spring clips inserted into holes in the door inner panel and screws along the bottom edge.

Removal

(1) Remove overlay on armrest, if equipped, and remove attaching screws and armrest.

(2) Remove window regulator handle, if equipped, and door latch remote control handle.

(3) Remove assist handle, if equipped.

(a) Remove woodgrain insert at both ends of assist handle.

(b) Remove attaching screws and assist handle.

(4) Remove power door lock/window bezel, if equipped.

(5) Remove trim panel attaching screws on bottom of trim panel.

(6) Pry trim panel-to-door clips along sides loose with tool J-2631-01 and remove panel.

(7) Loosen setscrew securing remote control mirror control cable to escutcheon, if equipped, and remove trim panel.

Installation

(1) Insert remote control mirror control cable in escutcheon and tighten setscrew, if equipped.

(2) Position trim panel on door and install clips in holes in inner door panel.

NOTE: *To prevent creasing the trim panel cover, do not hammer or exert excessive force on the clips.*

(3) Install screws along bottom of trim panel.
(4) Install window regulator handle, if equipped, and door latch remote control handle.
(5) Install armrest and overlay.
(6) Install assist handle, if equipped.
(a) Position assist handle and install attaching screws.
(b) Install woodgrain inserts.
(7) Install power door lock/window bezel, if equipped.

Replacement

(1) Remove door trim panel.
(2) If equipped with door mounted speaker, proceed as follows:
(a) Remove speaker grille and bezel from original panel.
(b) Cut speaker grille opening in replacement panel, following outline provided on backside of panel, with sharp knife.
(c) Install speaker grille and bezel on replacement panel.
(3) If equipped with manual window regulator or remote mirror, cut opening(s) in replacement trim panel, following outline provided on backside of panel, with sharp knife.
(4) If equipped with power window or power door locks, cut opening(s) in replacement trim panel following outline provided on backside of panel with sharp knife.
(5) Transfer door trim panel attaching clips to replacement panel.
(6) Install door trim panel.

SEALING SYSTEM

Water Shield

The water shield is attached to the door inner panel with adhesive. To remove water shield, use a putty knife between shield and door inner panel to break adhesive bond.

When installing water shield be sure the tab on the lower portion is tucked inside the door panel slit at the access opening and that the shield is bonded securely to the door inner panel.

Rubber Sealer

The door rubber sealer is made of molded latex foam with a smooth rubber skin on the outside.

The door rubber sealer is attached to the body opening around the door opening.

Maintenance of Rubber Sealers

Cold weather may cause the rubber sealer to harden and lose resiliency. When servicing, use a dampened cloth to clean rubber sealer. Remove dirt from all points where the rubber sealer contacts the door. Apply AMC/Jeep Silicone Lubricant, or equivalent, to a dampened cloth and apply to rubber sealer.

CAUTION: *Do not use graphite, brake fluid, or wax on rubber sealer.*

Replacement

Replacement rubber sealers are coated with powder to prevent stickiness in storage. Before installation, remove all powder with a cloth dampened with 3M General Purpose Adhesive Cleaner, or equivalent.

(1) Carefully remove rubber sealer from door opening.
(2) Remove dust and dirt from rubber sealer, door and body opening.
(3) Install upper front corner of sealer to body first.
(4) Work rubber sealer onto flange completely around door opening.

WINDOW SYSTEM

Door Glass

Removal

(1) Remove door trim panel and water shield.
(2) Remove glass stop bracket (fig. 3J-2).
(3) Remove lower division channel attaching bracket.
(4) Remove division channel upper bracket-to-door panel attaching screws.
(5) Remove lock rod guide bushing and push knob.

NOTE: *Move lock rod aside so glass may be lowered to bottom of door.*

(6) Remove screws attaching remote control assembly to door panel and lower to bottom of door.
(7) Lower door glass and remove retaining clip.
(8) Lower glass to bottom of door.
(9) Push lower end of division channel toward front of door to release glass from channel.
(10) Move glass toward front of door to release it from rear channel.
(11) Rotate glass vertically 90° and guide it between inner and outer door panels.

Installation

(1) Position door glass in lower section of door so bottom channel has recessed portion of guide groove toward outer door panel.

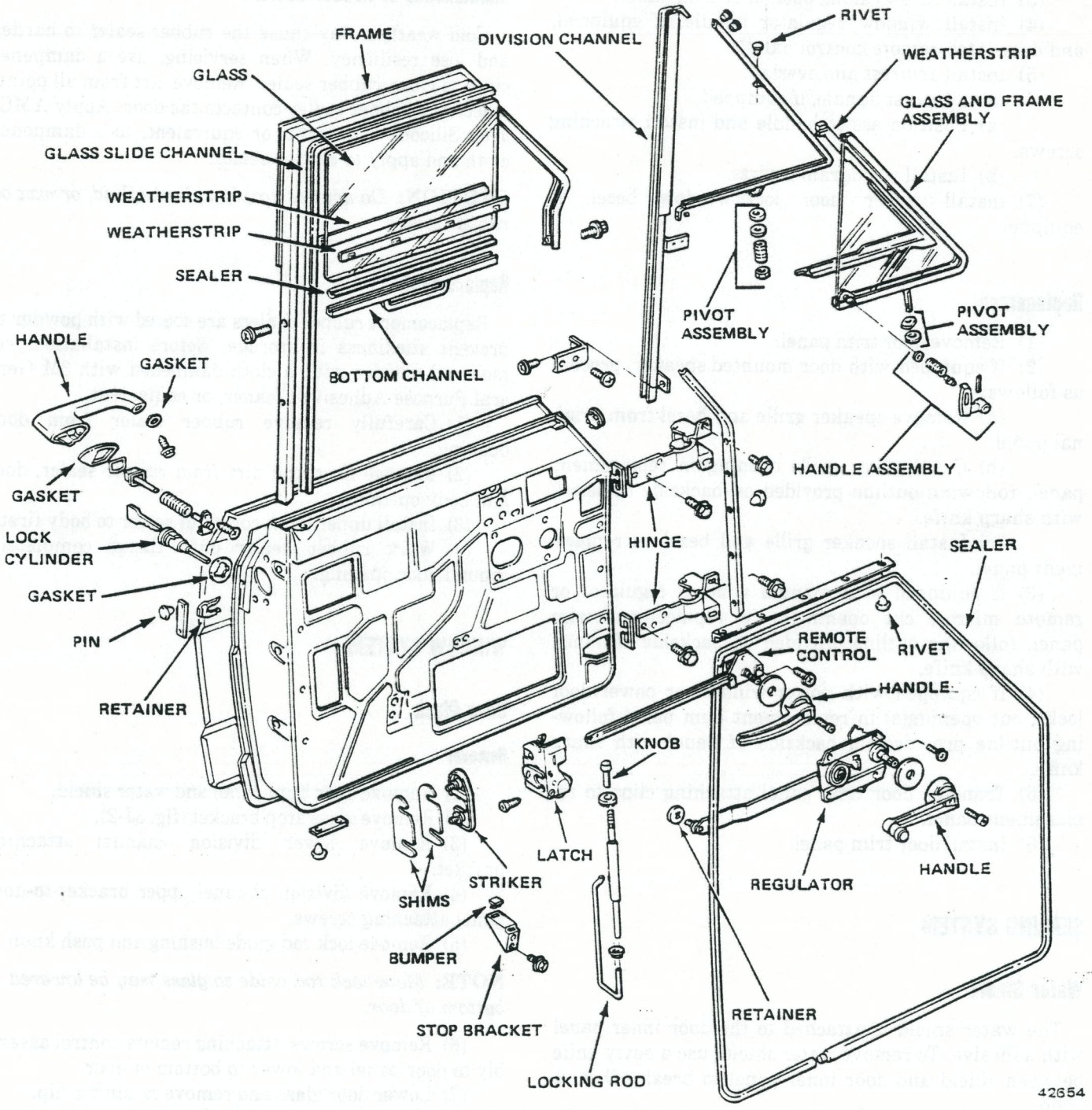

Fig. 3J-2 Front Door—Cherokee-Wagoneer-Truck Models

(2) Position glass in rear channel and position front channel so glass can be inserted.

(3) Slide glass up channels and crank regulator arm down to align pin at end of regulator arm with slot in bottom channel.

(4) Install retainer on regulator arm.

(5) Position remote control assembly and install attaching screws.

(6) Position lock rod and install lock rod guide bushing to door panel.

(7) Install door lock push knob.

(8) Install upper and lower division bar attaching brackets.

(9) Install glass stop bracket.

(10) Check glass operation and adjustment.

(11) Install water shield and trim panel.

Vent Window

Removal

(1) Remove door trim panel and water shield.
(2) Remove door window glass.
(3) Remove glass slide channel along top (fig. 3J-2).
(4) Remove vent assembly attaching screws on leading edge of door frame and under base of vent weatherseal.
(5) Move vent assembly toward rear of door, tipping it to clear upper door frame.
(6) Pull ventilator assembly straight out until upper attaching bracket is above opening between outer and inner door panels.
(7) Rotate vent assembly 90° to position lower attaching bracket on run channel to clear opening between door panels.
(8) Remove vent assembly.

Installation

(1) Position vent assembly in door.
(2) Install vent assembly attaching screws through door frame.
(3) Install upper glass slide channel.
(4) Install door window glass.
(5) Install water shield and door trim panel.

Window Regulator

Removal

(1) Remove door trim panel and water shield.
(2) Lower glass and remove retainer attaching regulator arm to glass bottom channel (fig. 3J-2).
(3) Raise and support glass.
(4) Lower regulator arm and remove attaching screws.
(5) Remove regulator through access hole in door.

Installation

(1) Install regulator in door and secure with attaching screws.
(2) Position regulator arm in glass bottom channel.
(3) Install retainer on regulator arm.
(4) Remove glass support.
(5) Install water shield and door trim panel.

LOCK SYSTEM

Outside Handle

Removal

(1) Remove door trim panel and water shield.
(2) Raise window to fully closed position.
(3) Through opening in inner door panel, remove handle attaching screws and remove handle and gaskets.

Installation

(1) Position gaskets and handle on door and secure with attaching screws.
(2) Install water shield and door trim panel.

Key Lock

Removal

(1) Remove rubber sealer along rear edge of door by prying out retaining pins to expose lock cylinder retainer (fig. 3J-2).
(2) Using flat-bladed screwdriver, remove retainer.
(3) Remove lock cylinder and extension rod from outside of door.

Installation

(1) Position lock cylinder in door, making sure extension rod is inserted in square hole in latch.
(2) Install lock cylinder retainer.
(3) Install rubber sealer with retaining pins.

Lock Cylinder Coding

A lock cylinder service kit is available which includes an uncoded cylinder, housing and a dust cover.

Whenever a lock cylinder replacement is required, the uncoded service cylinder can be coded to match the existing key.

(1) Remove lock cylinder from door.
(2) Remove dust cover from original lock housing and remove lock cylinder and discard.
(3) Insert original key into new uncoded service lock cylinder.
(4) Press cylinder into special Door Cylinder Lock Tumbler Filing Fixture, Tool J-22977, with notched side of key up and long tumbler in slot (fig. 3J-3).
(5) Hold filing fixture in vise and file tumblers flush with flat side of fixture. Use standard 5/8-inch, double-cut bastard file. Finish filing with smooth mill file.
(6) Remove lock cylinder from fixture and insert cylinder into opposite end of fixture with notched side of key down (fig. 3J-3).

NOTE: *This side of the fixture can be identified as the end without the double slot cut out (180° apart).*

(7) File tumblers flush with flat side of fixture.

NOTE: *Utilize the filing fixtures as a test gauge. Remove the fixture from the vise and if the tumblers are filed correctly, the lock cylinder will turn in the fixture.*

(8) Insert new lock cylinder into lock housing.
(9) Install new dust cap and crimp ends of cap over lock housing.
(10) Install lock cylinder in door.

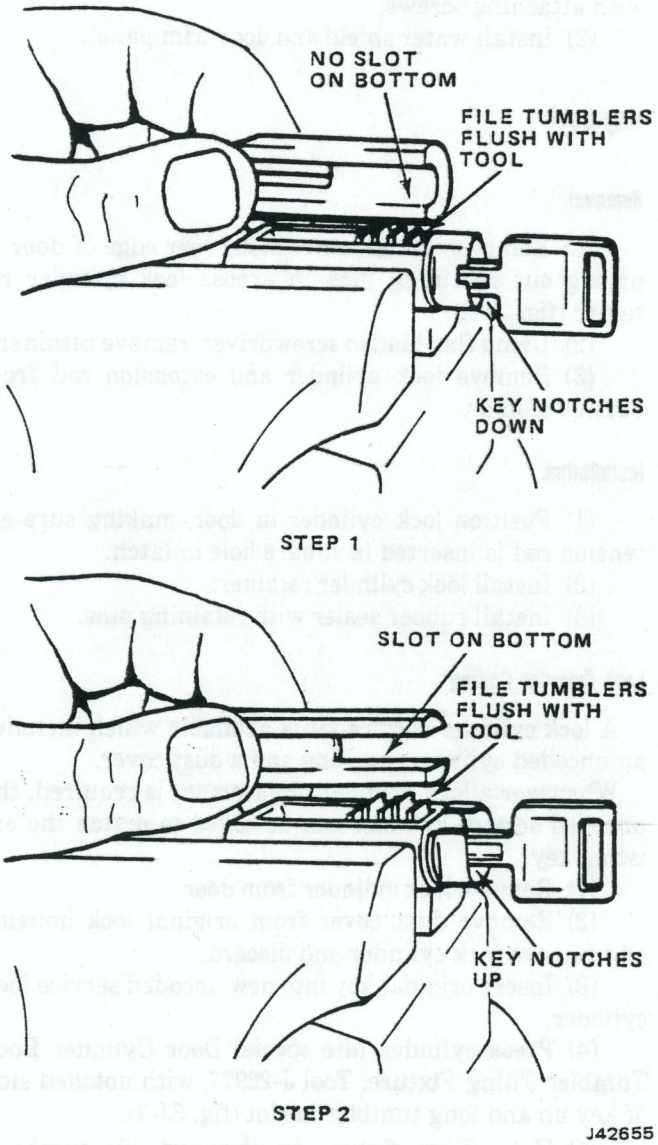

Fig. 3J-3 Filing Lock Tumblers

Latch and Remote Control

Removal

(1) Remove door trim panel and water shield.
(2) Remove lock cylinder.
(3) Remove screws from door lock remote control (fig. 3J-2). Push control in and lower to bottom of door.
(4) Disconnect remote control arm from door latch and remove remote control assembly through access hole at bottom of door.
(5) Remove screws attaching door latch to door panel using Torx Bit Tool J-25359-C.
(6) Push door latch in and turn it 90° to free it from lock lever rod and remove through lower access hole.

Installation

(1) Connect lock lever rod to door latch.
(2) Position door latch on door panel and install attaching screws using Torx Bit Tool J-25359-C.
(3) Connect remote control arm to door latch. Position remote control on door inner panel and install attaching screws.
(4) Install outside lock assembly.
(5) Install water shield and door trim panel.

Locking Rod

Removal

(1) Remove door trim panel and water shield.
(2) Remove door lock push knob.
(3) Push nylon bushing (on rod) off bracket.
(4) Loosen latch mounting screws using Torx Bit Tool J-25359-C and disengage locking rod.

Installation

(1) Engage locking rod to latch and tighten latch mounting screws using Torx Bit Tool J-25359-C.
(2) Install nylon bushing on bracket.
(3) Install door lock push knob.
(4) Install water shield and door trim panel.

HINGE SYSTEM

Replacement

(1) Remove trim panel and water shield.
(2) Disconnect electrical harnesses inside door and remove harnesses.
(3) Mark outline of existing hinges on body pillar and door for reference with wax pencil.
(4) Position door in holding fixture.
(5) Remove all hinge-to-body screws.
(6) Remove door from vehicle.
(7) Remove all hinge-to-door screws and remove hinges.
(8) Clean replacement hinges in suitable solvent and blow dry with compressed air.

CAUTION: *Do not immerse hinge in solvent.*

(9) Color coat hinges to match body.
(10) Lubricate hinges with 3M 4-Way Spray lubricant, or equivalent.
(11) Position hinges on door, being careful to align with scribe marks and install attaching screws. Tighten screws to 25 to 35 foot-pounds (34 to 47 N•m) torque.

(12) Position door in body opening and align hinges with scribe marks on body pillar. Install and tighten two outside screws, then install and tighten inner screw on each hinge. Tighten screws to 25 to 35 foot-pounds (34 to 47 N•m) torque.

(13) Remove door holding fixture.

(14) Position electrical harnesses inside door.

(15) Check door alignment. Adjust if necessary (refer to Door Adjustment).

(16) Connect electrical harnesses.

(17) Install water shield and trim panel.

Door Adjustments

The doors are adjusted at the hinge mounting points on the body or door.

The slotted center hole is provided in the hinge for in or out adjustment on the pillars. The upper and lower holes in the hinge set the door outboard slightly. To adjust the door inboard, loosen the center screw and push the door open against door stop. Tighten the center screw after correct alignment has been achieved.

To adjust up or down or fore and aft, loosen the hinge attaching screws in the door and move the door to the desired position and tighten the screws.

Prior to any door adjustment or alignment, the adjustable striker must be removed to allow the door to close freely in proper alignment without striker interference.

The door lock striker is adjustable up, down, in or out and can be shimmed forward or back to hold the door in the properly aligned position.

The door latch striker should be set so that the latch enters the striker without binding, yet provides secure retention for the lock and prevents up and down or in and out movement of the door.

The striker should also be adjusted in or out to allow the door latch to be fully engaged. The door should be flush with the adjacent body panels.

NOTE: *It is possible to set the striker in so far that the door is closed tight but only the safety catch is engaged. This prevents locking the door with the pushbutton lock rod.*

REMOTE CONTROL MIRRORS

Removal

(1) Remove door trim panel.

(2) Remove setscrew attaching mirror remote control assembly to trim panel escutcheon.

(3) Remove water shield paper.

(4) Remove screws attaching remote mirror-to-door panel using Torx Bit Tool J-25359-C.

NOTE: *Check and note routing of remote mirror control cables before removing assembly from door panel.*

(5) Remove remote mirror and gasket from door panel.

Installation

(1) Assemble remote mirror and gasket.

(2) Insert remote mirror control cables into door outer panel and duplicate routing of control cables into door inner panel as previously noted during removal.

(3) Install screws attaching remote mirror-to-door panel using Torx Bit Tool J-25359-C.

(4) Install setscrew attaching mirror remote control assembly to trim panel.

(5) Check mirror operation.

(6) Install water shield paper.

(7) Install door trim panels.

CHEROKEE - WAGONEER REAR DOORS

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Hinge System	3J-13	Window System	3J-10
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DOOR TRIM

Window Regulator Handle

Window Regulator handles are attached to the splined shaft of the window regulator with a 5/32-inch Allen head screw. To remove the handle, remove the screw and pull the handle straight off the shaft.

Install the handle with the knob forward, the handle horizontal and the glass all the way up.

Trim Panel

Trim panels consist of fiber board composition covered with a vinyl material. They are fastened to the door with spring clips inserted into holes in the door inner panel and screws along the bottom edge.

Removal

(1) Remove overlay on armrest, if equipped, and remove attaching screws and armrest.

(2) Remove window regulator handle, if equipped, and door latch remote control handle.

(3) Remove assist handle, if equipped.

(a) Remove woodgrain inserts at both ends of assist handle.

(b) Remove attaching screws and assist handle.

(4) Remove power window bezel, if equipped.

(5) Remove trim panel attaching screws on bottom of trim panel.

(6) Pry trim panel-to-door clips along sides loose with Tool J-2631-01 and remove panel.

Installation

(1) Position trim panel on door and install clips in holes in inner door panel.

NOTE: *To prevent creasing the trim panel cover, do not hammer or exert excessive force on the clips.*

(2) Install screws along bottom of trim panel.

(3) Install window regulator handle, if equipped, and door latch remote control handle.

(4) Install armrest and overlay.

(5) Install assist handle, if equipped.

(a) Position assist handle and install attaching screws.

(b) Install woodgrain inserts.

(6) Install power window bezel, if equipped.

Replacement

(1) Remove trim panel.

(2) If equipped with manual window regulator, assist handle, or ash receiver:

(a) Cut opening(s) in replacement trim panel, following outline(s) provided on backside of trim panel, with sharp knife.

(3) If equipped with power windows, it will be necessary to cut opening for switch in replacement trim panel following outline provided on backside of trim panel with sharp knife.

(4) Transfer door trim panel attaching clips to replacement panel.

(5) Install door trim panel.

SEALING SYSTEM

Water Shield

The water shield is attached to the door inner panel with adhesive. To remove water shield, use a putty knife between shield and door inner panel to break adhesive bond.

When installing water shield, be sure the tab on the lower portion is tucked inside the door panel slit at the access opening and that the shield is bonded securely to the door inner panel.

Rubber Sealer

The door rubber sealer is made of molded latex foam with a smooth rubber skin on the outside.

The rubber sealer is attached to the door body opening.

Maintenance of Rubber Sealers

Cold weather may cause the rubber sealer to harden and lose resiliency. This may cause the door to loosen in its opening, resulting in noise. When servicing, use a dampened cloth to clean rubber sealer. Clean dirt from all points where the rubber sealer contacts the body. Apply AMC Silicone Lubricant, or equivalent, to sealer.

CAUTION: *Do not use graphite, brake fluid or wax on rubber sealer.*

Replacement

Replacement rubber sealers are coated with powder to prevent stickiness in storage. Before installation, remove all powder with a cloth dampened with 3M General Purpose Adhesive Cleaner, or equivalent.

(1) Carefully remove rubber sealer from door opening.

(2) Remove dust and dirt from rubber sealer, door and body.

(3) Install upper front corner of sealer to door opening first.

(4) Complete installation of rubber sealer to remainder of door opening.

WINDOW SYSTEM

Door Glass

Removal

(1) Remove door trim panel and water shield.

(2) Remove glass stop bracket.

(3) Remove division channel lower attaching bracket.

(4) Lower door glass to obtain access to retainer.

(5) Remove retainer, disengage pin from slot in channel and lower glass to bottom of door (fig. 3J-4).

(6) Remove inner and outer belt weatherstrips.

(7) Remove upper glass slide channel.

(8) Remove stationary vent assembly attaching screws (fig. 3J-4).

(9) Tilt top of vent assembly forward approximately one inch.

(10) Push lower end of division channel toward rear of door to release glass.

(11) Move glass toward rear of door to release glass from front glass slide channel.

(12) Rotate glass 90° and guide glass between inner and outer door panels.

Installation

(1) Position door glass in lower section of door so bottom channel has recessed portion toward inner door panel.

(2) Position door glass in front glass slide channel and push division channel over glass.

(3) Slide glass up and crank regulator arm down until pin on regulator arm can be inserted in slot of bottom channel.

(4) Install retainer.

(5) Position stationary vent assembly and install attaching screws.

(6) Install upper glass slide channel.

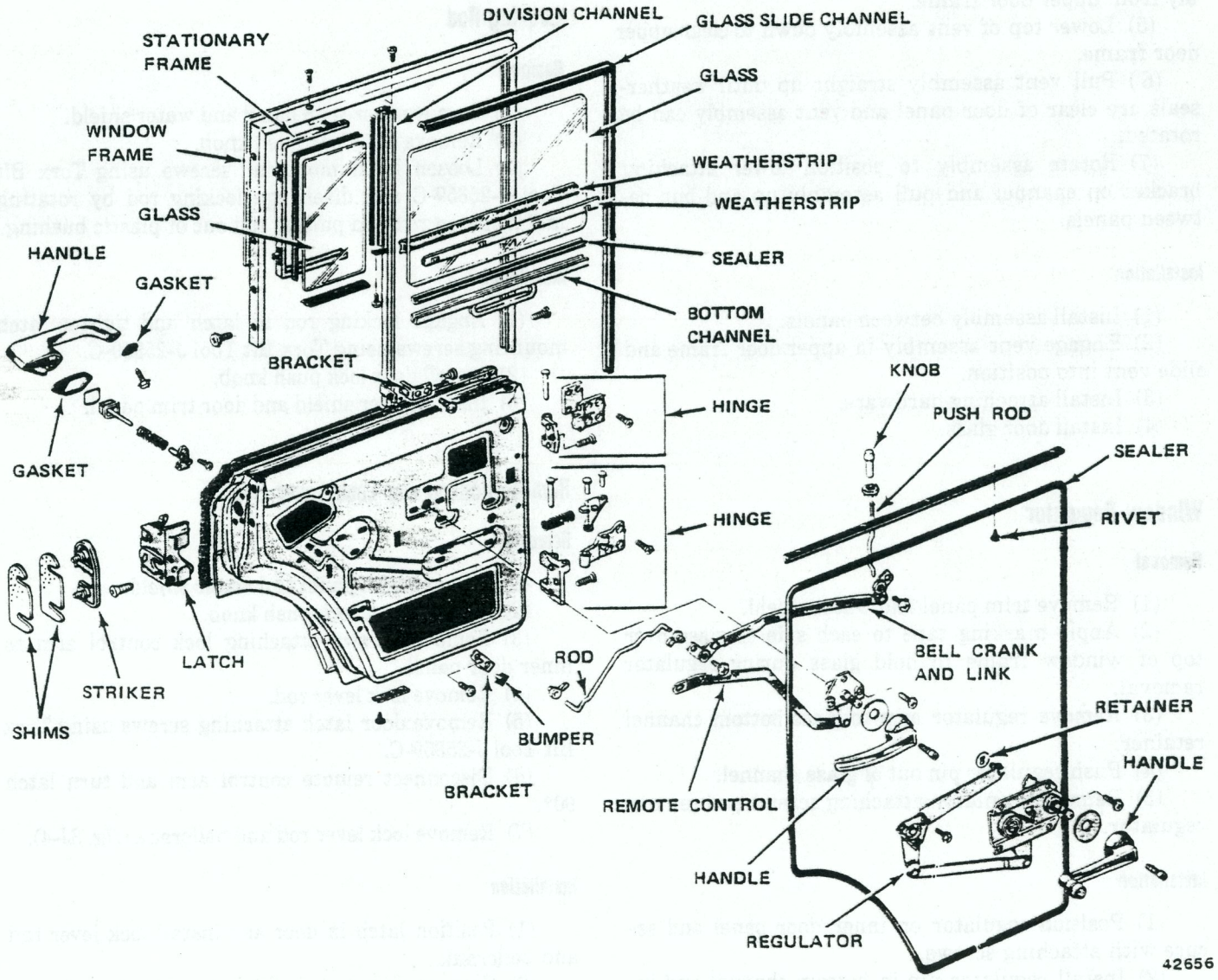

Fig. 3J-4 Rear Door—Cherokee-Wagoneer Models

(7) Install inner and outer belt weatherstrip.
(8) Install division channel lower attaching bracket.
(9) Install glass stop bracket.
(10) Check operation of glass.
(11) Install water shield and door trim panel.

Vent Window

Removal

(1) Remove door glass.
(2) Apply soap solution under vent weatherstrip and along inner and outer door panels.
(3) Slide vent assembly forward to center of door glass opening.
(4) Push vent assembly down through opening between inner and outer door panels to disengage assembly from upper door frame.
(5) Lower top of vent assembly down to clear upper door frame.
(6) Pull vent assembly straight up until weatherseals are clear of door panel and vent assembly can be rotated.
(7) Rotate assembly to position lower attaching bracket on channel and pull assembly up and out between panels.

Installation

(1) Install assembly between panels.
(2) Engage vent assembly in upper door frame and slide vent into position.
(3) Install attaching hardware.
(4) Install door glass.

Window Regulator

Removal

(1) Remove trim panel and water shield.
(2) Apply masking tape to each side of glass over top of window frame to hold glass during regulator removal.
(3) Remove regulator arm-to-glass bottom channel retainer.
(4) Push regulator pin out of glass channel.
(5) Remove regulator attaching screws and remove regulator.

Installation

(1) Position regulator on inner door panel and secure with attaching screws.
(2) Install regulator pin in bottom channel and install retainer.
(3) Remove tape from glass.
(4) Install water shield and door trim panel.

LOCK SYSTEM

Outside Handle

Removal

(1) Remove door trim panel and water shield.
(2) Raise window to fully closed position.
(3) Through opening in inner door panel, remove handle attaching screws and remove handle and gaskets.

Installation

(1) Position gaskets and handle on door and secure with attaching screws.
(2) Install water shield and door trim panel.

Locking Rod

Removal

(1) Remove door trim panel and water shield.
(2) Remove door lock push knob.
(3) Loosen latch mounting screws using Torx Bit Tool J-25359-C and disengage locking rod by rotating metal clip on rod and pulling rod out of plastic bushing.

Installation

(1) Engage locking rod to latch and tighten latch mounting screws using Torx Bit Tool J-25359-C.
(2) Install door lock push knob.
(3) Install water shield and door trim panel.

Remote Control and Lock Lever Rod

Removal

(1) Remove trim panel and water shield.
(2) Remove door lock push knob.
(3) Remove screws attaching lock control arm to inner door panel.
(4) Remove lock lever rod.
(5) Remove door latch attaching screws using Torx Bit Tool J-25359-C.
(6) Disconnect remote control arm and turn latch 90°.
(7) Remove lock lever rod and bellcrank (fig. 3J-4).

Installation

(1) Position latch in door and install lock lever rod and bellcrank.
(2) Connect remote control arm to latch and turn latch 90°. Secure latch to door panel with attaching screws using Torx Bit Tool J-25359-C.
(3) Install lock lever rod.

(4) Position lock control arm on inner door panel and install attaching screws.

(5) Install door lock push knob.

(6) Install water shield and trim panel.

HINGE SYSTEM

Replacement—One Hinge

(1) Scribe outline of hinge on body pillar and door for reference.

(2) Position door in holding fixture.

(3) Remove hinge screws using Torx Bit Tool J-25359-C and remove hinge. Retain shims.

(4) Clean replacement hinge in suitable solvent and blow dry with compressed air.

CAUTION: *Do not immerse hinge in solvent.*

(5) Color-coat hinge to match body.

(6) Lubricate hinge with 3M 4-Way Spray lubricant, or equivalent.

(7) Position hinge on door with original shims, being careful to align with wax pencil marks, and install screws using Torx Bit Tool J-25359-C. Tighten screws to 12 to 18 foot-pounds (16 to 24 N•m) torque.

(8) Remove door holding fixture.

(9) Check door alignment. Adjust if necessary. Refer to Door Adjustments.

Door Removal

(1) Remove trim panel and water shield.

(2) Raise door glass to closed position.

(3) Disconnect electrical harnesses inside door and remove harnesses.

(4) Position door in holding fixture and using wax pencil scribe outline of hinges on door for reference.

(5) Remove all hinge-to-door attaching screws using Torx Bit Tool J-25359-C.

(6) Remove door from vehicle.

Installation

(1) Position door in body opening, being careful to align with wax pencil marks, and install screws using Torx Bit Tool J-25359-C. Tighten screws to 12 to 18 foot-pounds (16 to 24 N•m) torque.

(2) Remove holding fixture.

(3) Position electrical harnesses inside door.

(4) Connect electrical harnesses.

(5) Check door adjustment. Adjust if necessary. Refer to door adjustments.

(6) Install water shield and trim panel.

Door Adjustments

The doors are adjusted at the hinge mounting points on the body or door.

Floating plates are located in the body pillars to permit adjustment up, down, in or out. To adjust forward or back, add or remove shims between the hinge and hinge pillar.

Prior to any door adjustment or alignment, the adjustable striker must be removed to allow the door to close freely in proper alignment without striker interference.

The door lock striker is adjustable up, down, in or out and can be shimmed forward or back to hold the door in the properly aligned position.

The door latch striker should be set so that the latch enters the striker without binding, yet provides secure retention for the lock and prevents up and down or in and out movement of the door.

The striker also should be adjusted in or out to allow the door latch to be fully engaged. The door should be flush with the adjacent body panels.

NOTE: *It is possible to set the striker in so far that the door is closed tight but only the safety catch is engaged. This will prevent locking the door with the pushbutton lock rod.*

ELECTRICALLY OPERATED WINDOWS

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GENERAL

The window regulator motors (fig. 3J-5) are of a two-wire design, using polarity of the circuit to change motor rotation.

An individual control switch is provided for each side window and is mounted in the door trim panel. A complete set of control switches on the driver's door enables remote control operation of all side windows. The igni-

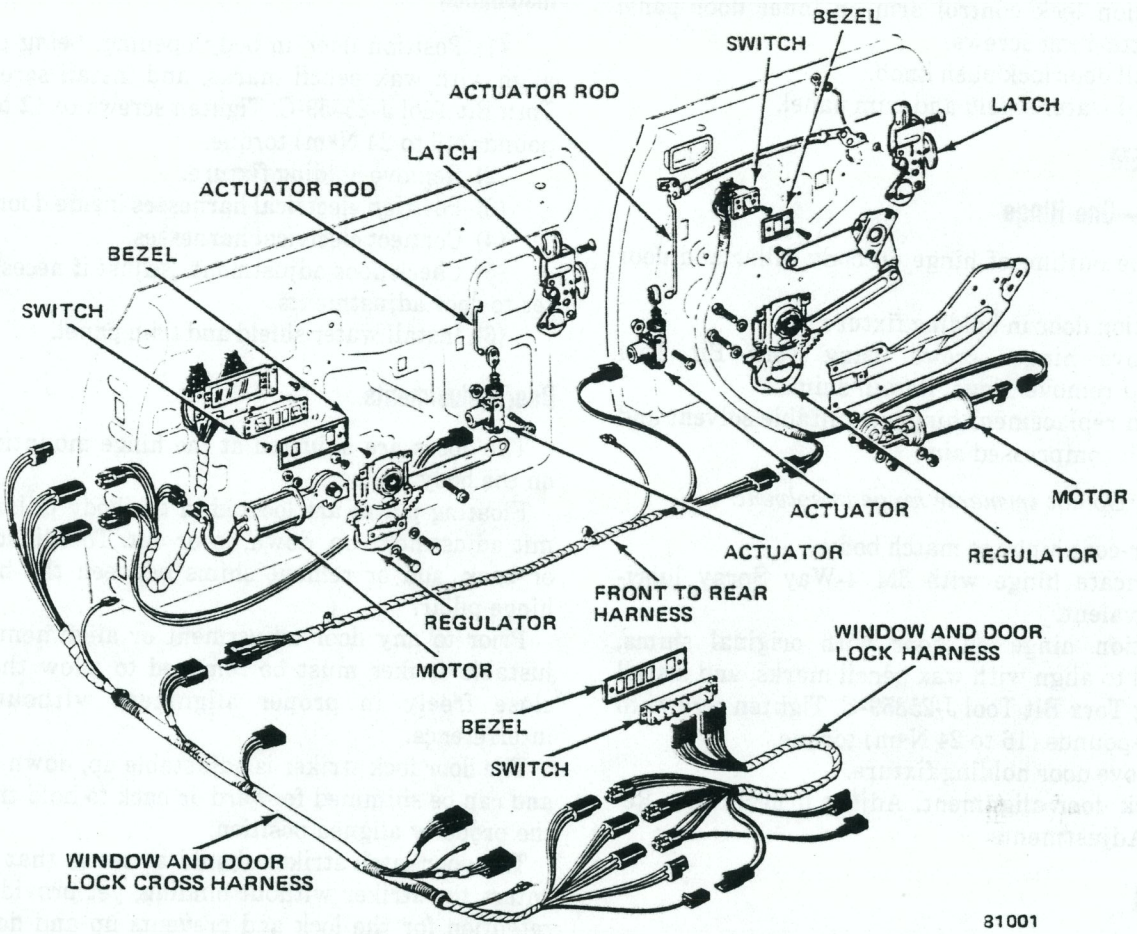

Fig. 3J-5 Electrically Operated Door Windows and Door Locks

tion switch must be in the On position to operate the windows.

CIRCUIT TESTS

A 30-amp circuit breaker, located in the fuse panel, is mounted at the far left side above the parking brake release handle (fig. 3J-6).

The circuit breaker (yellow and red wires) supplies power to the electric side windows when the ignition switch is in the On position. The black wires at the master control switch are the ground wires for the electric window circuits. They join in the harness and ground to the instrument panel harness ground circuit #9 at lower left corner of instrument panel.

NOTE: *The control switches, motors and wiring harness can be checked using a 12-volt test lamp.*

(1) Remove escutcheon and housing.

(2) Separate halves of terminal plate by releasing barbed retainer hooks to expose wire terminal ends.

(3) Turn ignition switch to On position.

(4) Connect one lead of test lamp to black wire and contact other lead to red terminal. Repeat this test procedure with second black wire in master switch.

(a) If lamp does not light, remove test lamp lead that was on black wire terminal and connect to chassis ground.

(b) If lamp lights at this point, an opening exists between master switch and ground.

(c) If lamp still does not light, check for defective circuit breaker or opening in red wire from circuit breaker to master switch.

Circuit Breaker Test

(1) Disconnect yellow wire from circuit breaker and connect test lamp between yellow wire and chassis ground.

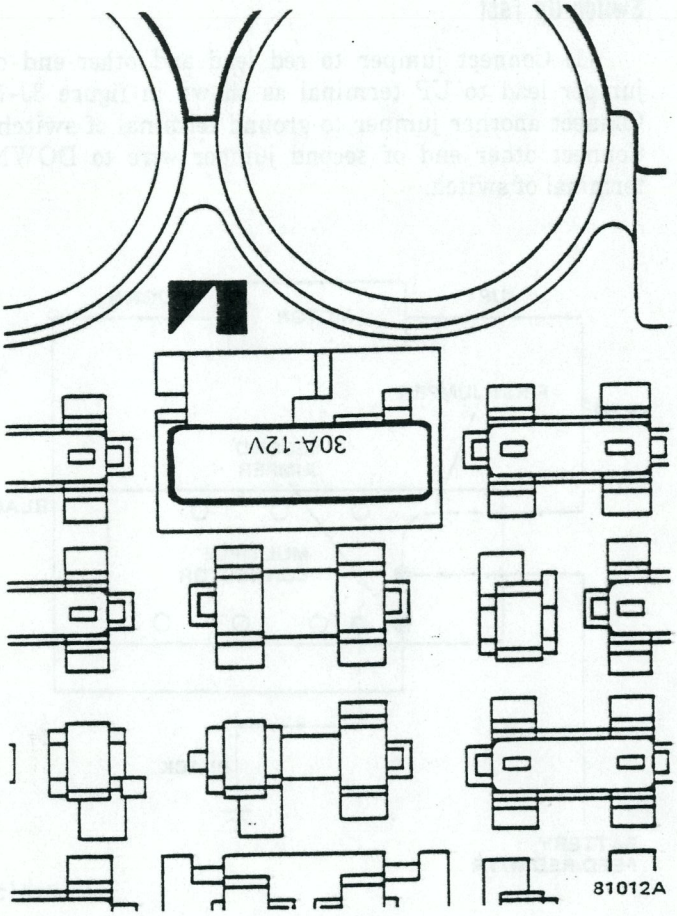

Fig. 3J-6 Circuit Breaker Location

(2) Turn ignition switch to On position. If lamp does not light, yellow wire has an open circuit or ignition switch is defective.

(3) Reconnect yellow wire to circuit breaker.

(4) Disconnect red wire from circuit breaker and connect test lamp to circuit breaker terminal and chassis ground. If lamp lights, circuit breaker is good. If lamp does not light, circuit breaker is defective.

Control Switch and Motor Test

(1) Connect test lamp between terminals of yellow and orange wire.

(2) Operate control switch up and down for respective window. If lamp lights in UP and DOWN position, test indicates that yellow and orange wires of wire harness to that window and back again to master switch are not defective. It also indicates that individual door switch on master control is not defective.

(3) Disconnect white and green motor leads at terminal plate and connect these leads to green and white leads respectively.

(4) Operate master switch. If window goes up and down, motor is not defective but switch is defective. If motor does not operate, remove door trim panel and check connections and leads to motor. If motor operates, switch is defective.

NOTE: *It may be possible that switch and motor both are defective.*

CONTROL SWITCH

Removal

CAUTION: *Be sure ignition switch is in Off position.*

(1) Disconnect battery negative cable.

(2) Remove retaining screws and escutcheon.

(3) Remove switch housing screws. Pull switch out to expose wires.

(4) Disconnect terminal plate from switch.

(5) Depress retainer clips through holes in switch housing and remove switch.

Installation

(1) Hold retainer clips in position on switch and slide switch into housing. Press retainer clips until they click into position.

(2) Install terminal plate to switch and install housing in door.

(3) Install escutcheon and retaining screws.

(4) Connect battery negative cable.

FRONT DOOR REGULATOR AND MOTOR

Removal

(1) Raise window half-way up.

(2) Disconnect battery negative cable.

(3) Remove door trim panel and water shield.

(4) Insert drift into hole in door inner panel or use masking tape to hold glass assembly in half-way position.

(5) Remove regulator arm retainer clip and remove arm from bottom window channel.

(6) Disconnect wires from motor.

(7) Remove nuts and bolts from inner door panel to regulator and remove regulator and motor assembly.

Installation

(1) Install replacement regulator in door.

(2) Connect wires to motor.

(3) Connect regulator arm to glass bottom channel and install clip.

(4) Position regulator in inner door panel and install nuts and bolts.

(5) Install screws attaching glass slide channel to inner door panel.

(6) Remove tape or drift holding window.

(7) Install water shield and trim panel. Connect negative battery cable.

REAR DOOR REGULATOR AND MOTOR

Removal

(1) Raise the window half way up.

(2) Disconnect battery negative cable.

(3) Remove door trim panel and water shield.

(4) Insert drift into hole in door inner panel or use masking tape to hold glass assembly in half-way position.

(5) Remove regulator arm retainer clip and remove arm from bottom window channel.

(6) Disconnect wires from motor.

(7) Remove nuts and bolts from inner door panel to regulator and remove regulator and motor assembly.

Installation

(1) Install replacement regulator in door.

(2) Connect wires to motor.

(3) Connect regulator arm to glass bottom channel and install clip.

(4) Position regulator in inner door panel and install nuts and bolts.

(5) Install screws attaching glass slide channel to inner door panel.

(6) Remove tape or drift holding window.

(7) Install water shield and trim panel. Connect negative battery cable.

SWITCH VOLTAGE TESTS

The following wiring test sequence determines whether or not voltage is continuous through the harness to switch.

Leave ignition switch in the On position. After removing the switch from the trim panel for testing purposes, carefully separate the multiple terminal block on the wiring harness from the switch body. Connect one lead of the test lamp lead to the red wire terminal and the other to ground. If the test lamp lights, the wiring circuit between the battery and switch is functional, proceed to check the continuity in the ground circuit (black wire). If the lamp does not light, check 30-amp main fuse (circuit breaker) or for a broken wire.

Switch Up Test

(1) Connect jumper to red lead and other end of jumper lead to UP terminal as shown in figure 3J-7. Connect another jumper to ground terminal of switch. Connect other end of second jumper wire to DOWN terminal of switch.

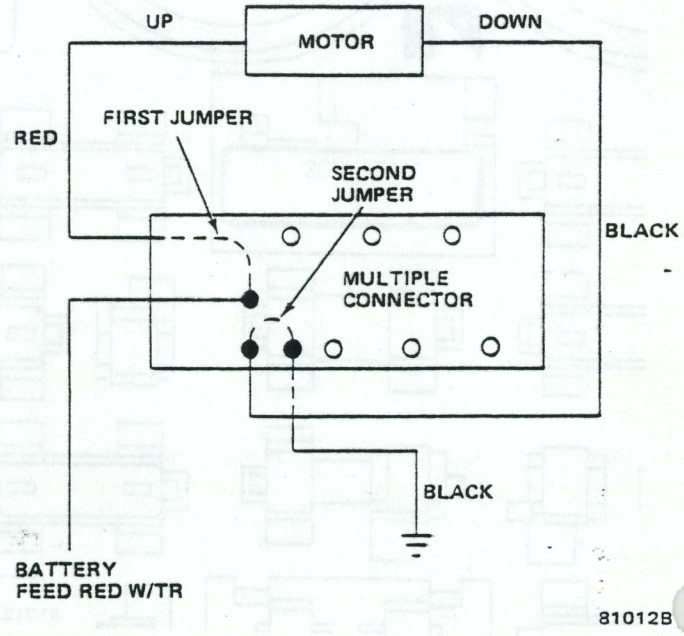

Fig. 3J-7 Motor Switch UP Test

(2) If motor runs, test verifies that voltage is available to motor. Switch must now be tested to make sure that voltage is passing through satisfactorily. Install switch body back on multiple connector and actuate switch. If motor fails to run, replace switch body. Each switch is tested in same manner.

(3) If motor does not run after installing new switch, perform Window Motor Test.

Switch Down Test

(1) Connect jumper lead to red terminal lead and other end of jumper to DOWN terminal as shown in figure 3J-8. Connect another jumper to ground terminal of switch and other end of jumper wire to UP terminal of switch.

(2) If motor runs, test verifies that voltage is available to motor. Install switch body back on multiple connector and actuate switch. If motor fails to run, replace switch body. Each switch is tested in same manner.

(3) If motor does not run, perform Window Motor Test.

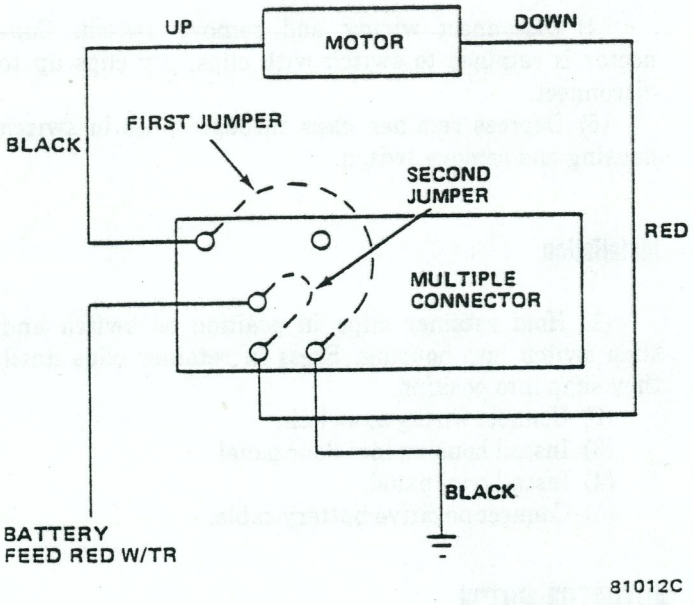

Fig. 3J-8 Motor Switch DOWN Test

MOTOR TEST

(1) Connect positive (+) lead (from a test battery) to either terminal.

(2) Connect negative (-) lead (from test battery) to remaining motor terminal.

(3) Motor should now rotate in one direction to either move window up or down.

(a) If window happens to already be in full up position and motor is connected so as to rotate in Up direction movement will be observed.

(b) Likewise, motor connected to Down direction rotation, no movement will be observed if window is already in full down position.

(4) Reverse battery leads (opposite to steps (1) and (2) and window should now move. If window does not move, remove motor. See below for motor removal from vehicle for bench test.

(5) If window moved completely up or down, motor should be reversed one more time (reverse leads to complete a full window travel inspection).

MOTOR

Removal

(1) Disconnect battery negative cable.
(2) Remove door trim panel.
(3) Remove motor attaching bolts and nuts.

WARNING: *The regulator assembly is spring loaded. The door glass must be supported in the up position with the regulator arm connected to the lower glass slide channel. This prevents the regulator spring from unloading.*

(4) Disconnect lead wires from motor and remove motor.

Installation

(1) Connect lead wires to motor.
(2) Install motor in door panel.
(3) Install door trim panel.
(4) Connect battery negative cable.

POWER DOOR LOCKS

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GENERAL

Door lock actuators are controlled by two rocker switches. To lock doors, push down on either switch. To unlock doors from inside the vehicle push upward on either switch.

The power door locks do not lock or unlock the doors from outside the vehicle. Insert the key into the lock cylinder to lock or unlock each individual door.

CIRCUITRY

The power door lock operates with battery power and, therefore, is independent of the ignition switch.

A 30-amp circuit breaker mounted in the fuse block protects the circuit. Refer to wiring diagrams in the back of this manual for complete circuits. The front door harness runs from door to door and is secured to the dash panel with harness retainers.

On four-door models, the right and left rear door harnesses are connected to the front door harness at the top of the side-cowl panels. They are routed along the side sill to the B-pillar, then through the bottom of the B-pillar to the rear doors.

If the vehicle is equipped with power windows, the door lock wires become part of the combined wire har-

nesses. The wire routing still follows the above description.

Circuit Breaker Test

Disconnect harness connector from fuse panel. Test fuse panel connection with test lamp. If lamp lights, battery voltage is present. If no battery voltage is present, remove circuit breaker and test with ohmmeter. If circuit breaker is OK then check for battery voltage at circuit breaker connection on fuse panel. If no battery voltage at fuse panel check for failure of fuse links in engine compartment.

Switch Test

Test door switches for continuity with a self-powered Test Lamp J-21008, or ohmmeter. Continuity should exist between terminals at various switch positions as shown in figure 3J-9.

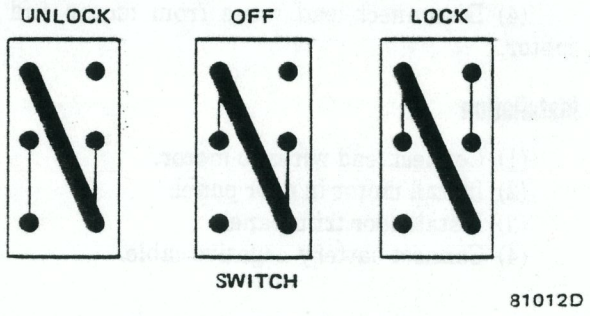


Fig. 3J-9 Continuity Test for Power Door Lock Switch

SWITCH

Removal

(1) Disconnect battery negative cable.
(2) Remove door trim panel.
(3) Remove switch housing from inner door panel.
(4) Disconnect wiring and remove switch. Connector is retained to switch with clips, pry clips up to disconnect.
(5) Depress retainer clips through holes in switch housing and remove switch.

Installation

(1) Hold retainer clips in position on switch and slide switch into housing. Press in retainer clips until they snap into position.
(2) Connect wiring to switch.
(3) Install housing into door panel.
(4) Install trim panel.
(5) Connect negative battery cable.

ACTUATOR MOTOR

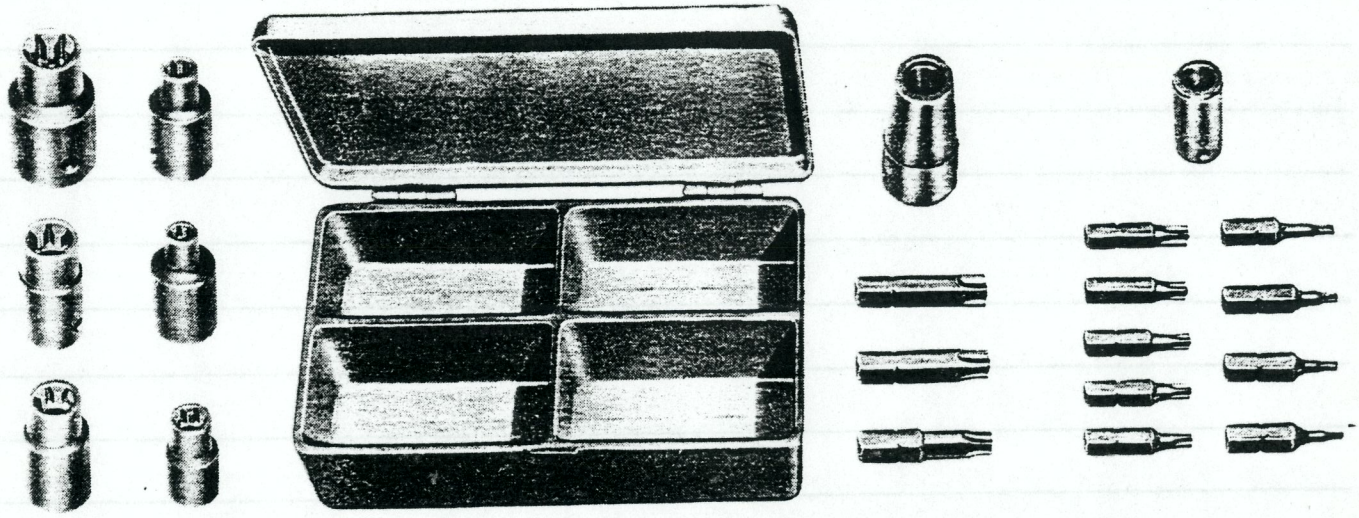
Test

To test the actuator motor, attach an ammeter to the motor terminals and operate the door switch. Replace the actuator motor if current draw exceeds 8 amps at room temperature or if the actuator does not complete its travel in less than one second.

Replacement

(1) Disconnect battery negative cable.
(2) Remove door trim panel.
(3) Remove actuator motor by drilling out rivets attaching motor to door panel with a 1/4-inch drill bit.
(4) Disconnect actuator rod from bellcrank.
(5) Disconnect wires from actuator motor and remove actuator motor.
(6) Connect wires to actuator motor and connect rod to actuator.
(7) Install actuator in door panel using two 1/4-20 x 1/2-inch screws and locknuts or rivets and connect bellcrank rod to bellcrank.
(8) Install door trim panel.
(9) Connect battery negative cable.

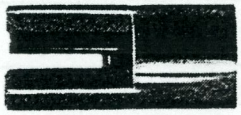
Tools



J-25359-C
TORX BIT AND
SOCKET SET

J-2631-01
TRIM PAD DEPRESSOR

J-21104-01
WEATHERSTRIP
REMOVER



J-22977
TUMBLER FILING
FIXTURE

70119

NOTES

REAR QUARTER 3K

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TRIM PANEL

NOTE: *The metal trim panels are held in place with sheet metal screws. Remove all attaching screws to remove panel.*

Removal

(1) Remove ash receiver, holder screws, and holder, if equipped.

(2) Remove armrest metal overlay strip, if equipped, and remove attaching screws and armrest.

(3) Remove trim panel screws at base of panel, if equipped.

(4) Pry loose trim panel attaching clips, using Trim Pad Depressor J-2631-01 and remove panel.

Installation

(1) Inspect all panel attaching clips; replace any that are bent. To prevent damage to trim panel, do not hammer or exert excessive force on clips.

(2) Install trim panel attaching screws, if equipped.

(3) Install armrest and armrest metal overlay strip, if equipped.

(4) Install ash receiver holder and ash receiver, if equipped.

PIVOT VENT WINDOW—CHEROKEE MODELS

Removal

(1) Remove handle-to-frame attaching screws (fig. 3K-1).

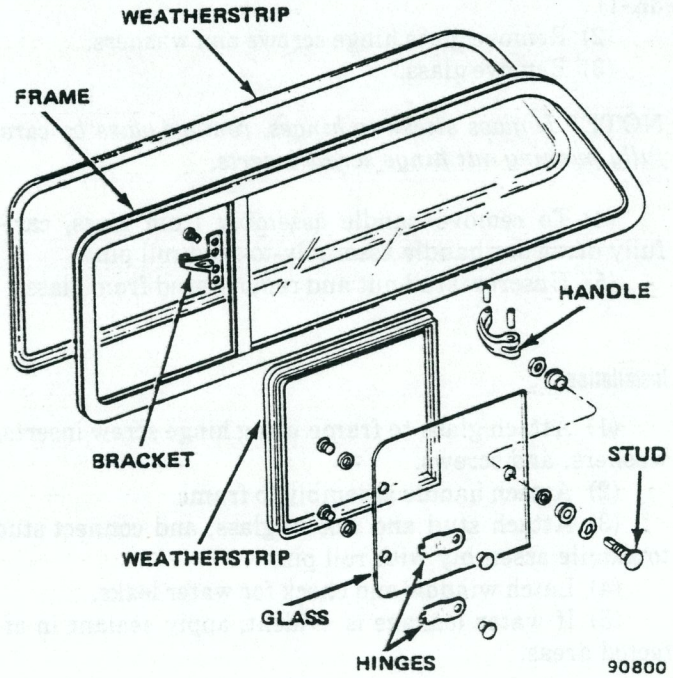


Fig. 3K-1 Rear Quarter Window—Cherokee Models

(2) Remove glass hinge screws and washers.

(3) Remove glass.

NOTE: *If glass sticks to hinges, remove glass by carefully pushing out hinge screw inserts.*

(4) To remove handle assembly from glass, carefully drive out handle assembly-to-stud roll pin.

(5) Unscrew stud nut and remove stud from glass.
(6) Remove vent window weatherstrip.

Installation

(1) Install vent window weatherstrip.
(2) Attach glass to frame using hinge screw inserts, washers, and screws.
(3) Attach handle assembly to frame.
(4) Attach stud and nut to glass, and connect stud to handle assembly with roll pin.
(5) Latch window and check for water leaks.
(6) If water leakage is evident, apply sealant in affected areas.

Vent Window Glass

Removal

(1) Remove handle-to-frame attaching screws (fig. 3K-1).
(2) Remove glass hinge screws and washers.
(3) Remove glass.

NOTE: *If glass sticks to hinges, remove glass by carefully pushing out hinge screw inserts.*

(4) To remove handle assembly from glass, carefully drive out handle assembly-to-stud roll pin.
(5) Unscrew stud nut and remove stud from glass.

Installation

(1) Attach glass to frame using hinge screw inserts, washers, and screws.
(2) Attach handle assembly to frame.
(3) Attach stud and nut to glass, and connect stud to handle assembly with roll pin.
(4) Latch window and check for water leaks.
(5) If water leakage is evident, apply sealant in affected areas.

STATIONARY WINDOW—2-DOOR CHEROKEE MODELS

Replacement

(1) Remove inside spare tire, if equipped.
(a) Remove inside spare tire mount using Torx Bit Tool J-25359-C for top shoulder screw.
(b) Remove remaining screws from wheelhouse and D-pillar post.
(2) Free weatherstrip-to-body flange (on inside of vehicles) as follows: starting at top corner, using fingers or a wooden wand, pull weatherstrip down to clear flange while exerting an outward pressure on glass.
(3) Push window and weatherstrip toward outside of vehicle.
(4) Remove weatherstrip from glass and clean sealer from glass cavity using 3M General Purpose Adhesive Cleaner, or equivalent.
(5) Before installing glass in weatherstrip, apply 3/16-inch bead of 3M Windshield Sealer, or equivalent, in weatherstrip glass cavity using pressure type applicator and position glass weatherstrip.
(6) Lubricate weatherstrip with soapy water.
(7) Place window frame and weatherstrip into position in window opening.
(8) With weatherstrip body flange in proper position at bottom of window opening, use wooden wand and walk weatherstrip-to-body flange into position.
(9) Clean excess sealer from window frame.
(10) Check for water leaks.
(11) If water leakage is evident between weatherstrip and flange, apply 3M Auto Bedding and Glazing Compound, or equivalent, to affected areas and realign weatherstrip.
(12) Install inside spare tire bracket and torque to 25 foot-pounds (33 N•m).
(13) Install spare tire.

STATIONARY WINDOW—CJ-7 MODELS WITH HARDTOP ENCLOSURE

Removal

(1) Unlock rubber weatherstrip using wood wand or fiber stick.
(2) Use fiber stick to break seal between glass and rubber weatherstrip.
(3) Push glass and weatherstrip toward outside of vehicle and remove glass.
(4) Remove weatherstrip from opening.

Installation

(1) Inspect weatherstrip and clean sealer from glass cavity and flange cavity using 3M General Purpose Adhesive Cleaner, or equivalent.

NOTE: *Inspect for uneven surfaces or irregularities in the opening flange that could cause stress damage to the glass.*

(2) Before installing weatherstrip on glass, apply 3/16-inch bead of 3M Auto Bedding and Glazing Compound, or equivalent, in weatherstrip glass cavity using pressure-type applicator.

(3) With glass installed in weatherstrip and before installing glass and weatherstrip into opening, insert 1/4-inch cord completely around weatherstrip in flange cavity.

NOTE: *The ends of the cord should hang out over the outside surface of the glass approximately in the center of the upper weatherstrip.*

(4) Place glass and weatherstrip into position in window opening with ends of cord hanging outside vehicle.

(5) Pull on ends of cord to pull lip of weatherstrip over body panel. With cord removed, weatherstrip should be positioned correctly.

(6) Use wooden wand to lock weatherstrip.

(7) Using pressure-type applicator, apply 3M Windshield Sealer, or equivalent, between weatherstrip and glass on outside of glass around entire perimeter.

(8) Clean excess sealer from glass and exterior body surface.

(9) Test window for water leaks.

STATIONARY WINDOW—4-DOOR CHEROKEE-WAGONEER MODELS

Removal

(1) Remove interior garnish mouldings from around window and break seal loose between weatherstrip and body panels (fig. 3K-2).

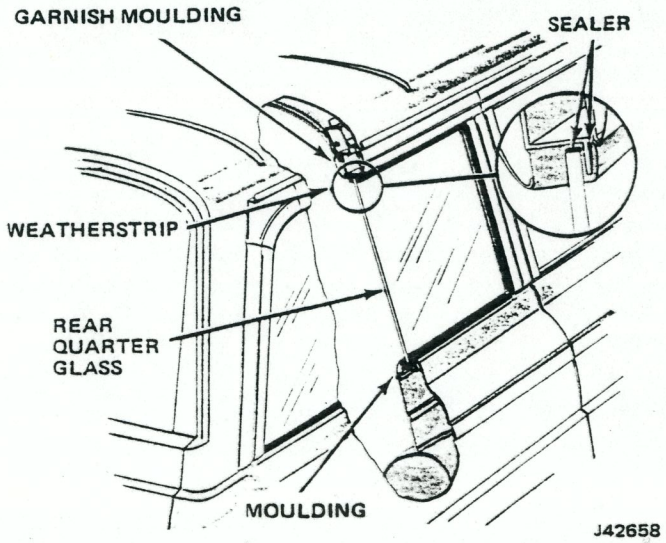


Fig. 3K-2 Rear Quarter Window—Cherokee-Wagoneer Models

(2) Push glass toward inside of vehicle.

(3) Remove weatherstrip from around glass and clean old sealer from glass cavity and flange cavity.

Installation

(1) Before installing glass in weatherstrip, apply 3/16-inch bead of 3M Windshield Sealer, or equivalent, in glass cavity completely around weatherstrip using pressure-type applicator (fig. 3K-2).

(2) With glass installed in weatherstrip and before installing glass and weatherstrip into opening, insert a 1/4-inch cord completely around weatherstrip in flange cavity.

NOTE: *The ends of the cord should hang out over the outside surface of the glass approximately in the center of the upper weatherstrip.*

(3) Place glass and weatherstrip into position in window opening with ends of cord hanging outside vehicle (fig. 3K-3).

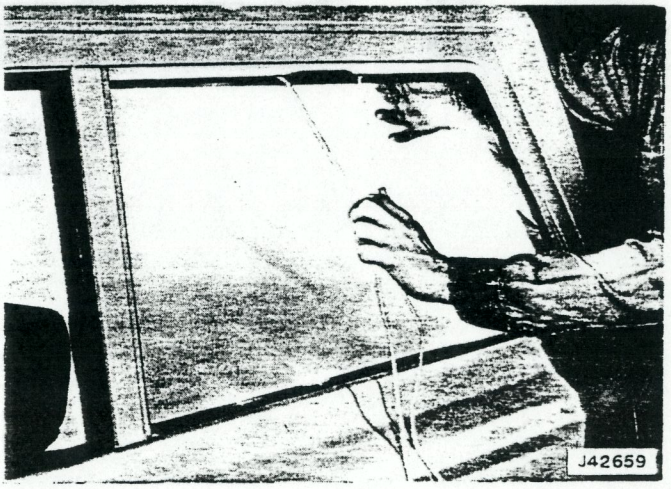


Fig. 3K-3 Rear Quarter Window Installation

(4) Pull on ends of cord to pull lip of weatherstrip over body panel. With cord removed, weatherstrip should be positioned correctly.

(5) Install interior garnish moulding.

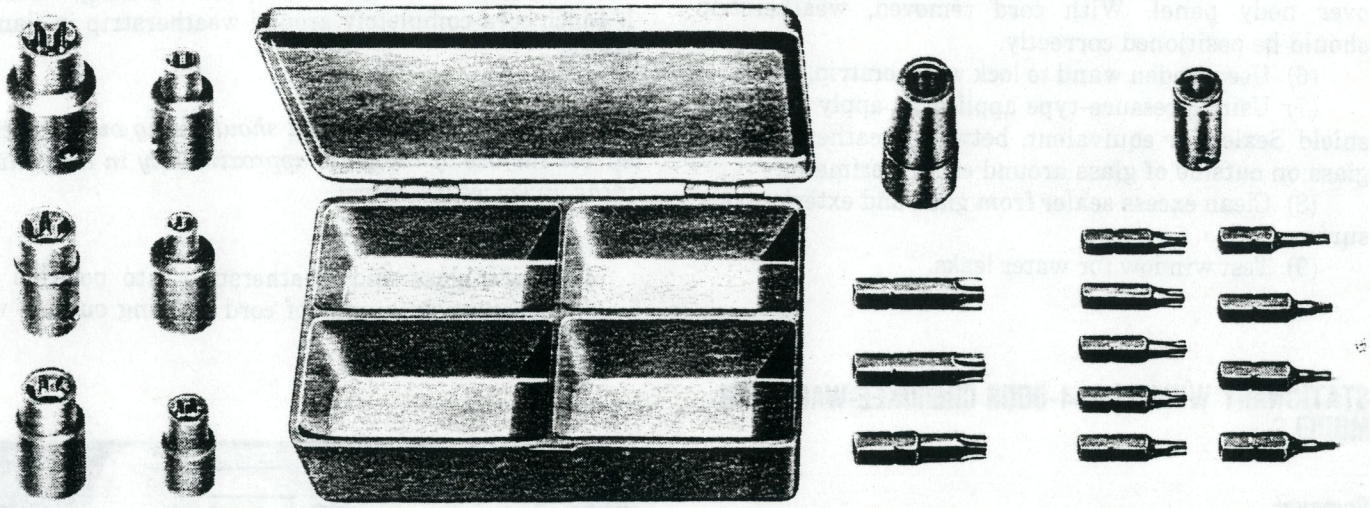
(6) Apply bead of 3M Auto Bedding and Glazing Compound, or equivalent, from outside of vehicle between weatherstrip and body panels.

(7) Clean excess sealer from glass and exterior body surface.

(8) Test window for water leaks.

Tools

J-2631-01
TRIM PAD
DEPRESSOR



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TORX BIT AND
SOCKET SET

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HARDTOP ENCLOSURE-SUN ROOF AND LUGGAGE RACKS 3L

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HARDTOP ENCLOSURE

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Removal	3L-1
Repair	3L-1

GENERAL

A lightweight, removable hardtop enclosure is available for CJ-7 models. The top is constructed of compression molded fiberglass. The hardtop enclosure and steel liftgate are painted with a special spatter finish.

REMOVAL

(1) Remove screws attaching hardtop enclosure to windshield frame (fig. 3L-1).

(2) Remove nuts, washers and screws attaching hardtop enclosure to rear quarter panels.

(3) Disconnect dome lamp, if equipped.

(4) Remove hardtop enclosure from vehicle.

CAUTION: *When removing hardtop enclosure, avoid damaging foam sealer installed between the hardtop enclosure and rear quarter panels.*

INSTALLATION

(1) Inspect tabular windshield seal, bonded to hardtop enclosure, for damage. Replace if necessary.

(2) Carefully position hardtop enclosure on vehicle.

CAUTION: *When installing the hardtop enclosure, avoid damaging foam sealer installed between the hardtop enclosure and rear quarter panels.*

(3) Install screws, washers and nuts attaching hardtop enclosure to rear quarter panels.

(4) Connect dome lamp, if equipped.

(5) Install screws attaching hardtop enclosure to windshield frame.

REPAIR

In the event of top damage, the following material will be required for use with these repair procedures:

- Paint Repair Kit (White)*
- Paint Repair Kit (Nutmeg)*
- Paint Repair Kit (Black)*
- Structural Adhesive (3M Brand or equivalent)

*The new paint repair kits are available from parts distribution centers. The paint repair kits consist of:

- Spatter Finish
- Base Coat
- Instruction Sheet

The following material will be required to repair the hardtop.

- Fiberglass mat or cloth
- Fiberglass resin and hardener
- Structural Adhesive (3M Brand or equivalent)
- Glazing Putty
- Aluminum Foil
- Plastic Spreader

Hole Repair

(1) Use grinder to remove paint and to outline damaged area.

(a) Use grade 24 disc for initial grinding.

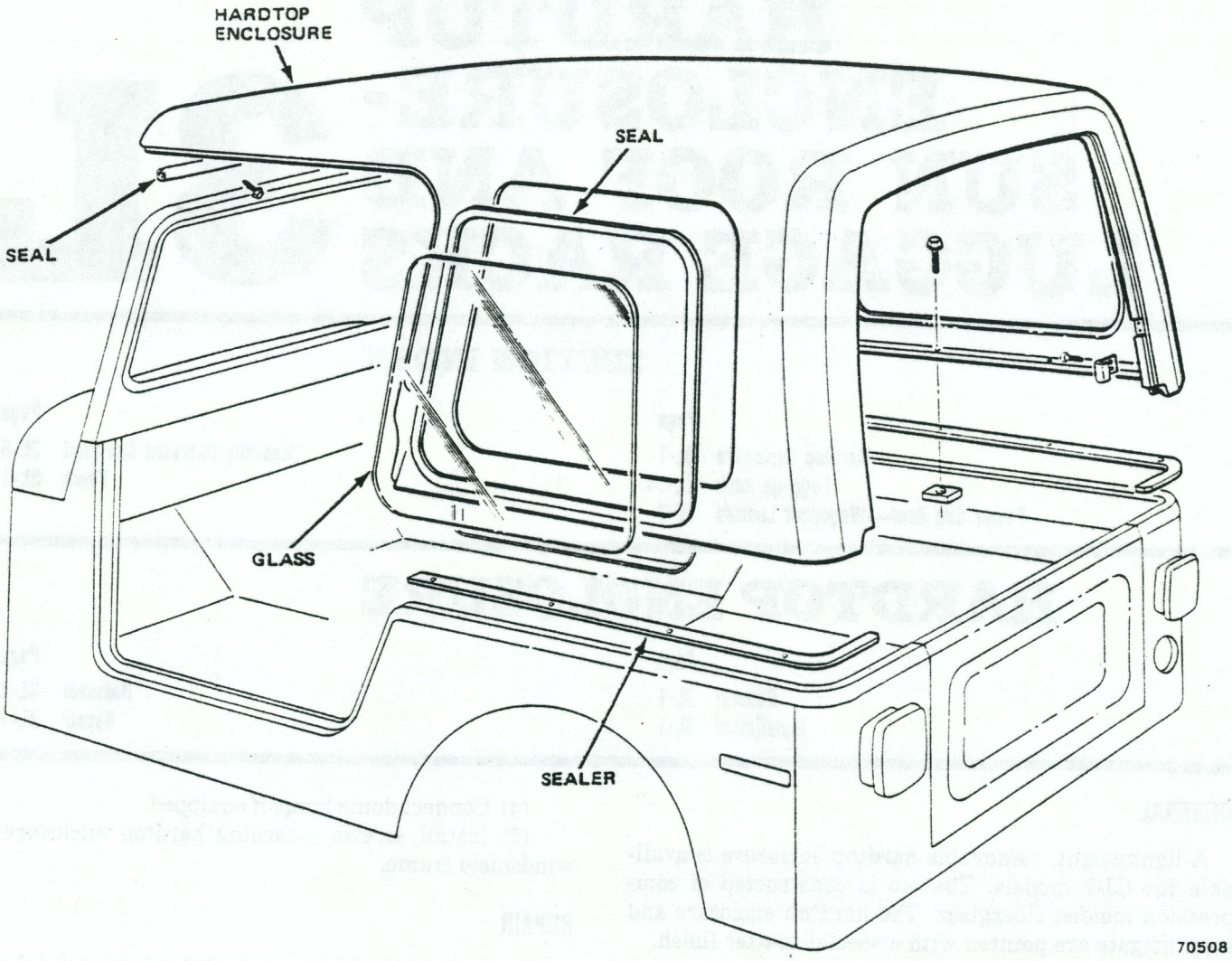

Fig. 3L-1 Hardtop Enclosure Removal

(b) Follow up with grade 50 disc to prevent coarse scratches from showing up in final finish.

NOTE: *If there are any cracks extending from hole it will be necessary to stop-drill crack(s) using 1/8-inch drill bit.*

(2) Position fiberglass mat or cloth on repair area, cut out piece, allow one inch extension beyond damaged area.

(3) Clean damaged area.

(4) Place fiberglass on piece of aluminum foil.

(5) Pour fiberglass resin into clean container.

(6) Mix appropriate amount of hardener with resin, according to manufacturer's instructions.

(7) Apply resin mixture to both sides of fiberglass.

(8) Lay fiberglass and aluminum foil over repair area, on outside. With plastic spreader, use firm pressure to remove air bubbles. Allow resin to cure.

(9) Remove aluminum foil from cured resin.

(10) Use air file or hand file board for shaping cured fiberglass resin.

(a) Use grade 24 paper for initial shaping.

(b) For shaping and sanding contour in fiberglass resin, use grade 180 paper.

(11) Repeat above step on inside of top.

(12) Mix Structural Adhesive, according to manufacturer's instructions, apply liberally to repair area on inside and outside of top.

(13) Use air file or hand file board for shaping hardened Structural Adhesive.

(a) For initial shaping, use grade 24 paper.

(b) For shaping and sanding contours in Structural Adhesive, use grade 220 paper.

(c) For finish sanding, use grade 320 paper.

(14) If necessary, apply glazing putty over repair area, according to manufacturer's instructions.

(15) Finish sanding repair area with grade 360 paper.

(16) Apply base coat and color coat (refer to Paint Repair Procedure).

Broken Section Repair

(1) Use grinder to remove paint, from both sides, and to outline damaged area.

(a) Use grade 24 disc for initial grinding.

(b) Follow up with grade 50 disc to prevent coarse scratches from showing up in final finish.

(2) Bevel edges of break on both sides, using rotary file as shown in figure 3L-2.

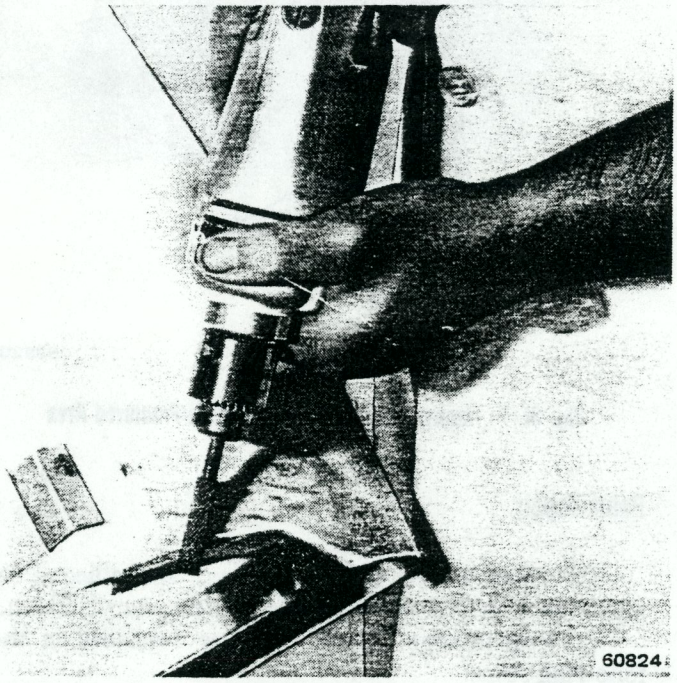

Fig. 3L-2 Beveling Edges of Broken Piece with Rotary File

NOTE: *Edges should be beveled on the inside and outside of the enclosure to ensure sufficient surface area for bonding.*

(3) Clamp broken piece into place leaving 1/16-inch gap along break line.

(4) Mix Structural Adhesive, according to manufacturer's instructions, apply liberally to break as shown in figure 3L-3.

(5) Use air file or hand file board for shaping of hardened Structural Adhesive.

(a) For initial shaping, use grade 24 paper.

(b) For shaping and sanding contours in Structural Adhesive, use grade 36 or 40 paper.

(c) For finish sanding, use grade 80 paper.

(6) Apply base coat and color coat (refer to Paint Repair Procedure).

Fracture Repair

(1) Use grinder to remove paint, from both sides, and to outline damaged area.

(2) Stop-drill crack(s) using 1/8-inch drill bit as shown in figure 3L-4.

(3) Bevel edges of crack(s) on both sides, using rotary file.

Fig. 3L-3 Applying Structural Adhesive to Broken Piece and Enclosure

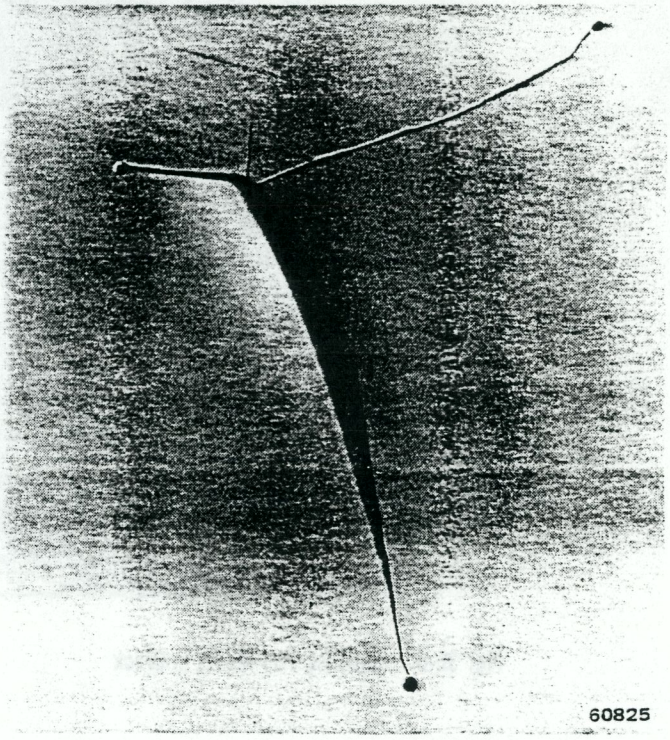

Fig. 3L-4 Stop-Drilling Cracks

NOTE: *Edges should be beveled on the inside and outside of the enclosure to ensure sufficient surface area for good bonding.*

(4) Cut along length of crack(s) using hacksaw blade as shown in figure 3L-5.

NOTE: *On crack(s) 6 inches or longer it is advisable to countersink pop rivets along length of crack(s) as shown in figure 3L-6.*

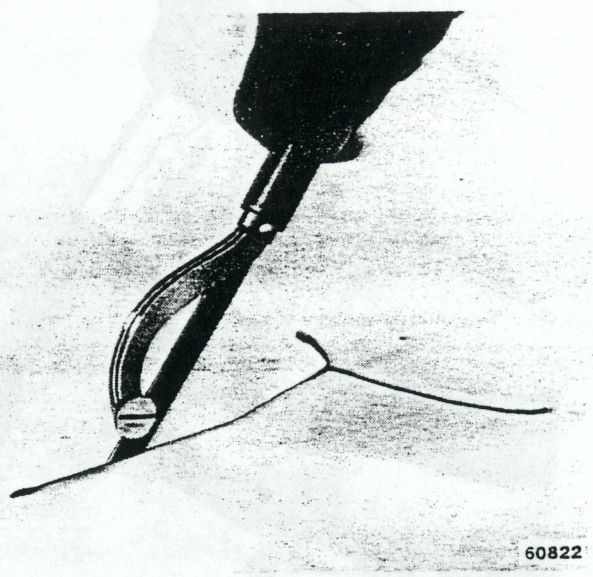

Fig. 3L-5 Cutting to Relieve Crack

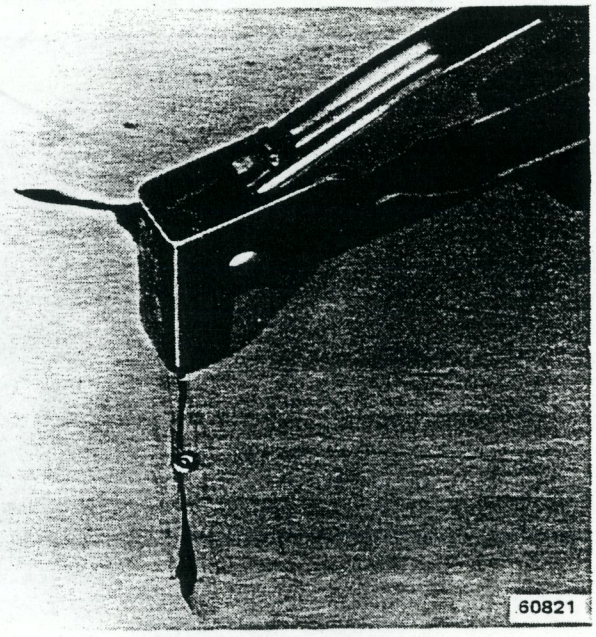

Fig. 3L-6 Installing Pop Rivets in Crack

(5) Mix Structural Adhesive, according to manufacturer's instructions, and apply liberally to crack(s) from inside and outside of enclosure as shown in figure 3L-7.

(6) Use air file or hand file board and sanding block for shaping of Structural Adhesive.

(a) For initial shaping, use grade 24 paper.

(b) For shaping and sanding contours in Structural Adhesive, use grade 220 paper on sanding block.

(c) For finish sanding, use grade 320 paper.

(7) Apply base coat and color coat (refer to Paint Repair Procedure).

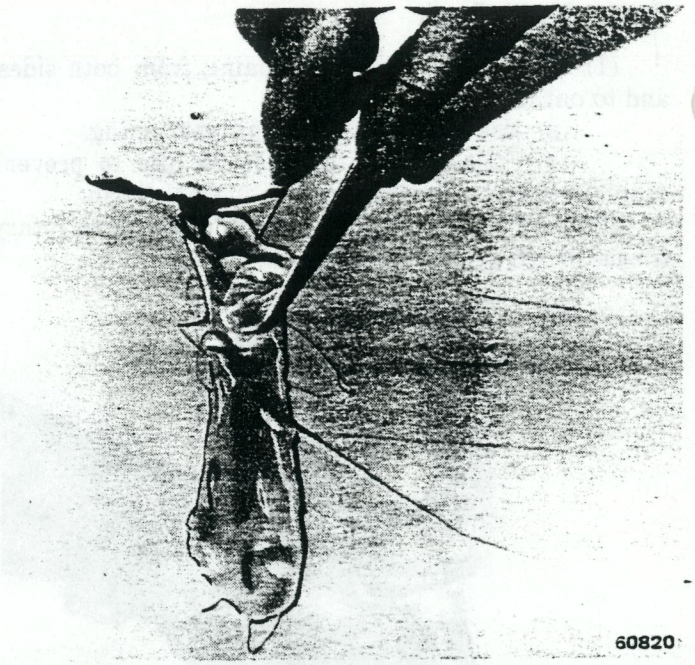

Fig. 3L-7 Applying Structural Adhesive to Fractured Area

Paint Repair

(1) Clean repair area using wax and silicone remover such as DuPont Prep-Sol or Ditzler Acryli-Clean.

(2) Featheredge affected area as described in the following steps:

(a) For rough featheredging, use grade 80 disc on random disc sander.

(b) For final featheredging, use grade 180 disc on random disc sander or 220 grade paper on hand sanding block.

(3) Mix base coat same as any acrylic enamel paint using enamel reducer or lacquer thinner.

NOTE: *One paint repair kit is sufficient to paint a complete top. Do not mix more paint than is necessary to cover the area being repaired. The spray equipment being used must be clean.*

CAUTION: *The solvents in this enamel will dissolve residual lacquers left in the cup or spray gun and may clog the gun or affect the finish surface.*

WARNING: *Vapor harmful—may cause lung irritation and allergic respiratory reaction. Use only with adequate fresh air ventilation.*

(4) Spray test panel and adjust spray gun as necessary.

(5) Apply base coat to affected area and allow to dry to touch.

(6) Empty spray gun.

NOTE: *In most cases, it is not necessary to reduce the texture coat. However, if you cannot achieve the desired texture finish it may be necessary to reduce slightly.*

(7) Stir texture paint thoroughly.
(8) Spray test panel and adjust spray gun to obtain desired texture finish.

NOTE: *Paint must be applied in the desired texture finish. This paint does not wrinkle or change texture during drying. In most cases, it is necessary to use a pressure-feed type spray gun to produce a coarse enough texture.*

(9) Spray affected area with texture color coat, starting in center and working to outside edges.
(10) Empty spray gun and fill cup with reducer.
(11) Spray reducer on edges of painted area to eliminate overspray and blend in repair.
(12) Bake for 30 minutes at temperature not to exceed 140°F or let air dry for 24 hours.
(13) Clean spray equipment thoroughly.

NOTE: *Equipment must be cleaned immediately after use.*

MANUALLY OPERATED SUN ROOF

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CJ Models	3L-5		

GENERAL

A manually operated sun roof as shown in figure 3L-8 is available on CJ models equipped with the hardtop option. The sun roof can be opened and locked in place or removed entirely. To remove the sun roof glass, pull the retaining rod and disconnect the latch handle assembly. Tilt the glass to an angle greater than 60 degrees, release bayonets from retainers, and remove glass. Safely stow the glass in storage compartment.

CJ MODELS

Sun Roof Glass

The bayonets and handle assembly are retained by screws with circular water seals, and retaining nuts with washers.

Frame

Removal

(1) Remove glass assembly.
(2) Remove frame screw cover.
(3) Remove attaching screws from clamp ring.
(4) Remove clamp ring.
(5) Push frame assembly outward and remove frame.

Installation

(1) Clean sun roof frame and roof panel contact surfaces using 3M General Purpose Adhesive Cleaner and Wax Remover, or equivalent.

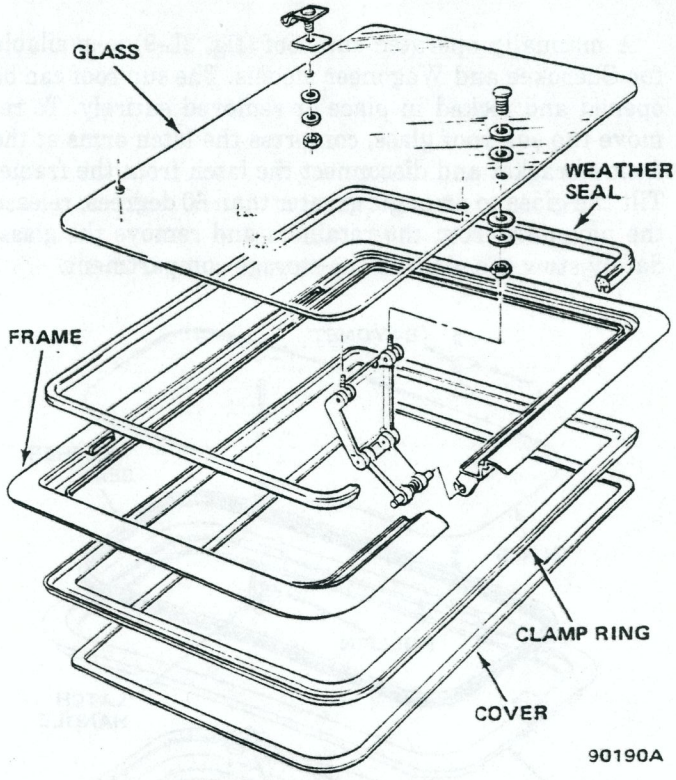

Fig. 3L-8 Sun Roof Component—CJ Models with Hardtop

(2) Apply bead of 3M Clear Super Silicone Sealer, or equivalent, on surface of outer roof panel, 1/8-inch from edge of opening.
(3) Install sun roof frame in roof panel.
(4) Position clamp ring over sun roof frame.
(5) Install attaching screws.

(6) Wipe excessive sealer from roof panel.
(7) Install screw cover.
(8) Install glass assembly.

Glass Frame Weatherseal

To remove the glass frame weatherseal use 3M Release Agent, or equivalent. Apply one application and allow several minutes for penetration. Apply a second application and allow several minutes for the adhesive bond to soften. Use a wooden wand or fiber stick to pry the weatherseal from sun roof glass frame. Clean weatherseal and adhesive residue from the frame channel with 3M General Purpose Adhesive Cleaner, or equivalent.

To install the replacement weatherseal, first apply a thin bead of 3M Super Weatherseal Adhesive, or equivalent, to the glass frame locating channel. Using wooden wand or fiber stick, install weatherseal in sun roof glass frame. Apply a thin film of petroleum jelly on seal-to-glass contact surfaces.

CHEROKEE-WAGONEER

A manually operated sun roof (fig. 3L-9) is available for Cherokee and Wagoneer models. The sun roof can be opened and locked in place or removed entirely. To remove the sun roof glass, compress the latch arms at the frame bracket and disconnect the latch from the frame. Tilt the glass to an angle greater than 60 degrees, release the bayonets from the retainers and remove the glass. Safely stow the glass in the storage compartment.

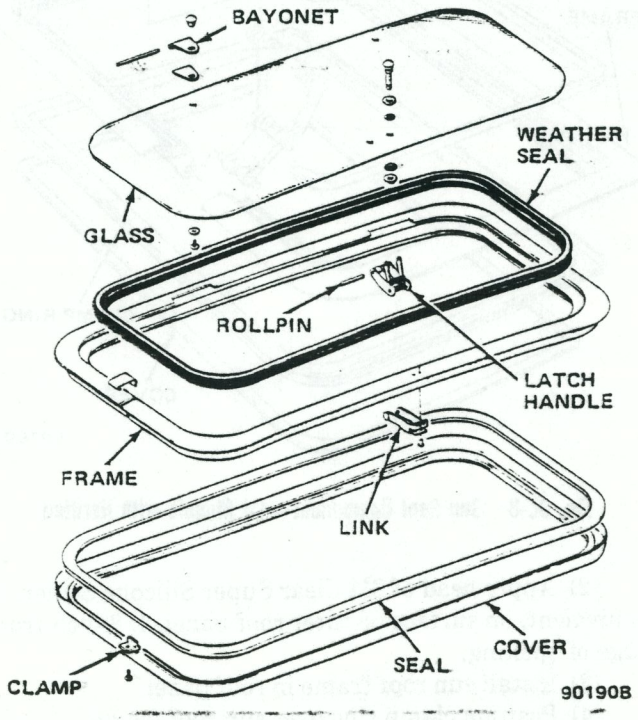

Fig. 3L-9 Sun Roof Components—Cherokee-Wagoneer Models

Glass Frame Weatherseal

Removal

(1) Remove glass assembly.
(2) Apply 3M Release Agent, or equivalent, to weatherseal and allow several minutes for penetration.
(3) Apply second application and allow several minutes for adhesive bond to soften.
(4) Remove seal from frame.
(5) Remove all residue from frame with 3M General Purpose Adhesive Remover, or equivalent.

Installation

(1) Apply thin bead of 3M Super Weatherstrip Adhesive, or equivalent, in channel.
(2) Install weatherseal in channel.
(3) Apply thin film of petroleum jelly to seal and glass contact surfaces.
(4) Install glass assembly.

Frame

Removal

(1) Remove frame cover (fig. 3L-9).
(2) Remove headliner as described in Chapter 3P.
(3) Remove sun roof glass.
(4) Remove frame attaching screws and clamps.
(5) Remove frame assembly.

Installation

(1) Clean sun roof frame and roof panel contact surfaces using 3M General Purpose Adhesive Cleaner and Wax Remover, or equivalent.
(2) Apply bead of 3M Clear Super Silicone Sealer, or equivalent, on surface of outer roof panel, 1/8-inch from edge of opening.
(3) Install sun roof frame in roof panel.

CAUTION: *Do not install retainers on roof panel indentations. Tighten attaching screws in a criss-cross pattern.*

(4) Install sun roof clamps and attaching screw. Tighten to 7 to 9 inch-pounds (0.79 to 1.02 N•m) torque.
(5) Wipe excessive sealer from roof panel.
(6) Install sun roof glass.

NOTE: *Check sun roof for waterleaks.*

(7) Install headliner as described in Chapter 3P.
(8) Install frame cover.

POWER SUN ROOF – WAGONEER LIMITED

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GENERAL

A power sun roof is available on Wagoneer Limited models (fig. 3L-10). The sun roof features a sliding glass panel operated by an electric motor and a manually operated sun screen. A nylon knit, one-piece headliner with bonded foam backing and a padded vinyl roof are standard with the optional sun roof.

The electric motor that operates the sliding glass panel is activated by a two-position switch mounted in the windshield header. The electric motor itself is mounted in the forward portion of the sun roof housing assembly. Electrical feed to the motor is through the A/C terminal of the fuse panel. Circuit protection is provided by the A/C terminal fuse and by a 20 amp, in-line fuse in a harness wire located just below the left A-pillar.

An additional feature of the sun roof is the ability to close the sliding glass panel manually if an electrical power failure should occur. A cranking tool is provided with the sun roof for this purpose.

A rubber drain hose is used at each corner of the sun roof housing. These hoses remove any water that may bypass the weatherstrip seal surrounding the roof opening. The forward hoses are routed downward through the A-pillars. The rearward hoses are routed downward through the D-pillars.

HALO ASSEMBLY

Removal

(1) Open glass panel partially and remove halo assembly attaching screws (fig. 3L-11).

(2) Grasp center of halo assembly and pull assembly downward to disengage front tabs from track.

(3) Close glass panel fully, slide halo assembly forward, and remove assembly from vehicle (fig. 3L-12).

Installation

(1) Close glass panel and position rear portion of halo assembly on glass panel.

(2) Open glass panel partially.

(3) Install halo assembly attaching screws.

GLASS PANEL

Removal

(1) Remove halo assembly. Refer to Halo Assembly Removal.

(2) Close glass panel and remove outboard screws from front guide shoe assemblies (fig. 3L-13). Then loosen inboard screws and rotate guide shoes to disengage slide portion from track.

(3) Release rear slide tension springs by rotating them to inboard position.

(4) Remove screws attaching rear guide shoes and retainers to tabs in glass panel and remove retainers.

(5) Working from outside of vehicle, raise front of glass panel and slide panel forward and out of vehicle.

Installation

(1) Position glass panel in vehicle.

(2) Install rear guide shoes and retainer brackets on glass panel and install guide shoe and retainer bracket attaching screws.

(3) Install rear slide tension springs (fig. 3L-13).

NOTE: *Be sure the spring is positioned under the spring lock roller.*

(4) Engage slide portion of front guide shoe assemblies in track and install guide shoe attaching screws.

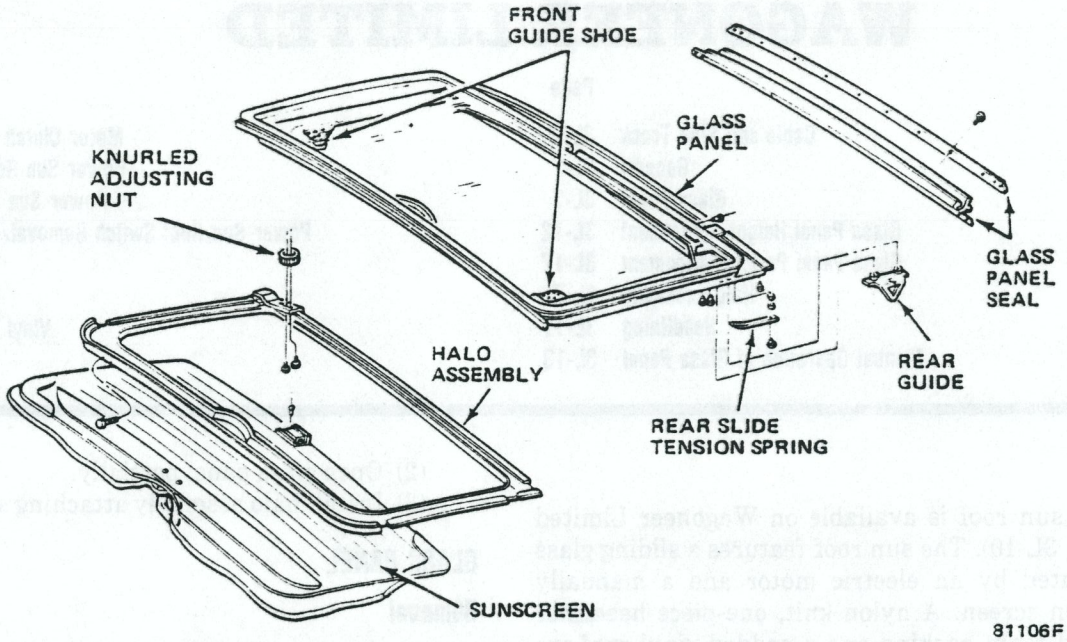
(5) Install halo assembly. Refer to Halo Assembly Installation.

SUNSCREEN

Removal

(1) Remove halo assembly and glass panel. Refer to Halo Assembly Removal and Glass Panel Removal procedures.

(2) Open sunscreen fully.



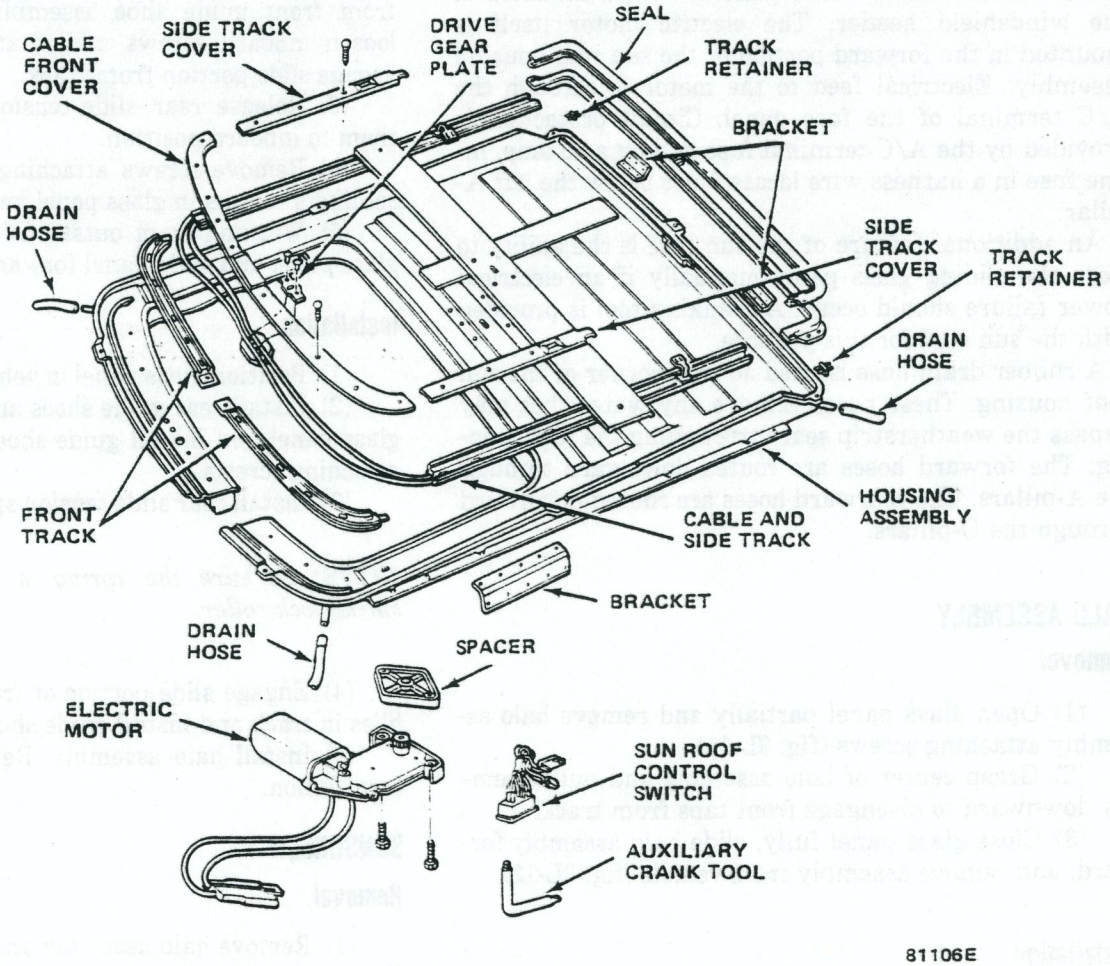


Fig. 3L-10 Power Sun Roof Assembly

(3) Working from outside of vehicle, push sunscreen upward at center of screen and slide screen forward and upward to remove it (fig. 3L-14).

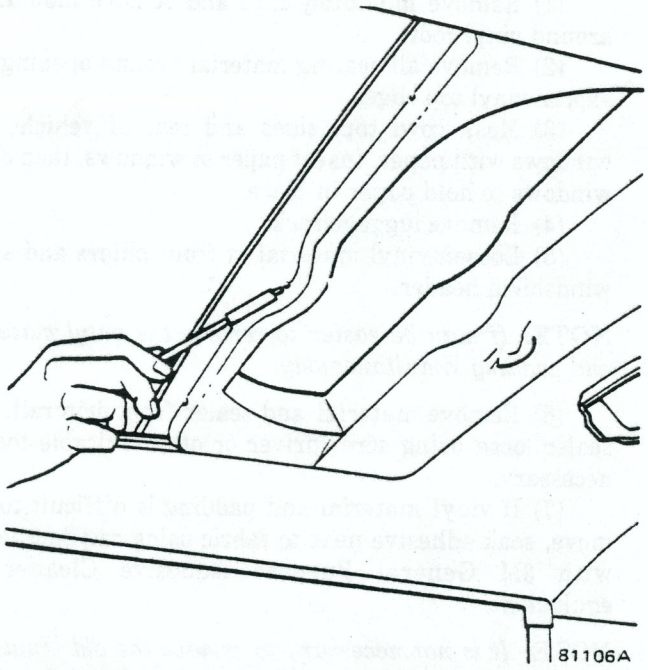


Fig. 3L-11 Removing/Installing Halo Assembly Attaching Screws

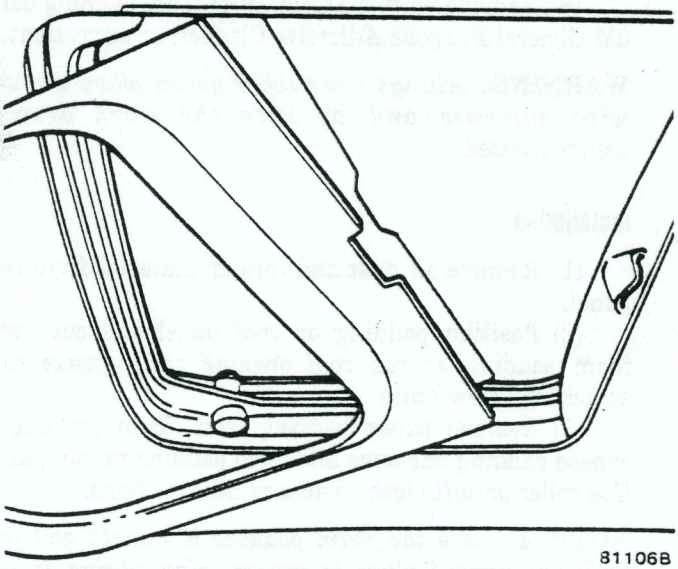


Fig. 3L-12 Removing/Installing Halo Assembly

Installation

(1) Working from outside of vehicle, curve sunscreen upward at center of screen and slide screen rearward and downward into sun roof opening (fig. 3L-14).

(2) Install glass panel and halo assembly. Refer to Glass Panel Installation and Halo Assembly Installation procedure.

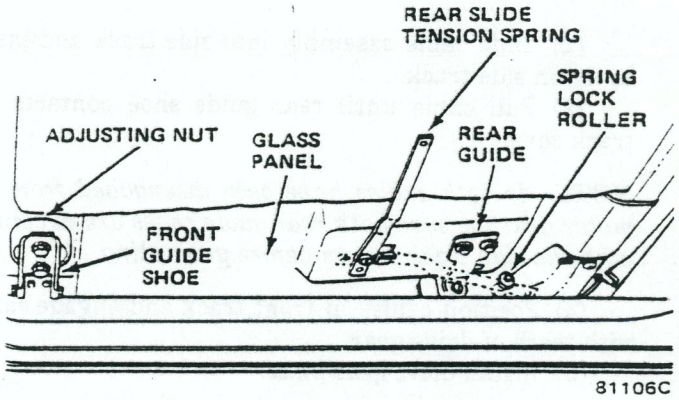


Fig. 3L-13 Front Guide Shoe and Rear Tension Spring

CABLE AND SIDE TRACK

Removal

(1) Remove halo assembly, glass panel and sunscreen. Refer to removal procedures.

(2) Remove screws that attach cable front cover and remove cover (fig. 3L-10).

(3) Remove drive gear plate.

(4) Remove side track cover screws and remove side track cover.

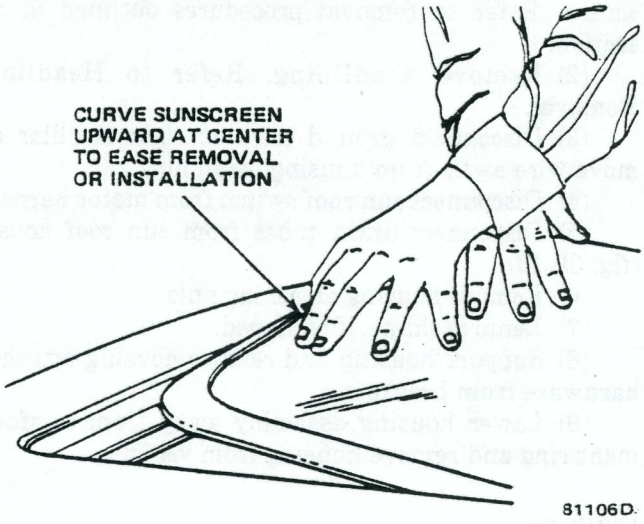


Fig. 3L-14 Sunscreen Removal/Installation

(5) Disengage cable from front track and motor gear and remove cable by pulling it upward and outward.

NOTE: *It may be necessary to reposition the front cable guide before the cable can be removed from the track.*

(6) Lift side track upward and remove side track.

Installation

(1) Position side track in sun roof housing. Be sure track retainer is seated in hole at rear of housing (fig. 3L-10).

(2) Slide cable assembly into side track and install cover on side track.

(3) Pull cable until rear guide shoe contacts side track cover.

NOTE: *If both cables have been disengaged from the motor gear, be sure both rear guide shoes are in contact with the side track covers before proceeding.*

(4) Position cables in front track and engage cables with teeth of drive gear.

(5) Install drive gear plate.

CAUTION: *Do not operate the motor at this time as the cables could be damaged.*

(6) Install cable front cover.

(7) Install sunscreen, glass panel and halo assembly. Refer to installation procedures outlined in this section.

POWER SUN ROOF HOUSING

Removal

(1) Remove halo assembly, glass panel and sunscreen. Refer to removal procedures outlined in this section.

(2) Remove headlining. Refer to Headlining Removal.

(3) Disconnect ground wire at right A-pillar and move wire away from housing assembly.

(4) Disconnect sun roof switch from motor harness.

(5) Disconnect drain tubes from sun roof housing (fig. 3L-10).

(6) Remove housing attaching nuts.

(7) Remove shims, if equipped.

(8) Support housing and remove housing attaching hardware from brackets.

(9) Lower housing assembly away from reinforcement ring and remove housing from vehicle.

Installation

(1) Position housing assembly in vehicle.

(2) Raise and support housing on reinforcement ring.

(3) Install shims, if equipped, and tighten housing attaching hardware.

(4) Connect drain tubes to housing assembly (fig. 3L-10).

(5) Connect sun roof switch to motor harness.

(6) Position ground wire on housing assembly and connect wire to right A-pillar.

(7) Install headlining. Refer to Headlining Installation.

(8) Install sunscreen, glass panel and halo assembly. Refer to Installation Procedures outlined in this section.

VINYL ROOF

Removal

(1) Remove moulding clips and remove mouldings around vinyl roof.

(2) Remove all sealing material around openings to expose vinyl top edges.

(3) Mask cowl top, sides and rear of vehicle, and windows with paper. Insert paper in windows, then close windows to hold paper in place.

(4) Remove luggage rack.

(5) Loosen vinyl material at front pillars and along windshield header.

NOTE: *If may be easier to remove the vinyl material and padding simultaneously.*

(6) Remove material and sealer from drip rail. Pry sealer loose using screwdriver or other suitable tool if necessary.

(7) If vinyl material and padding is difficult to remove, soak adhesive next to fabric using rag dampened with 3M General Purpose Adhesive Cleaner or equivalent.

NOTE: *It is not necessary to remove the old vinyl top adhesive. However, it is important that the roof surface be smooth and free of irregularities to prevent highlighting after a new cover is installed.*

(8) Remove vinyl material from foam padding using 3M General Purpose Adhesive Cleaner, or equivalent.

WARNING: *Always use rubber gloves when working with solvents and be sure the work area is wellventilated.*

Installation

(1) Remove all dust and foreign material from roof panel.

(2) Position padding on roof panel and cut away foam padding at sun roof opening and luggage rack attaching screw holes.

(3) Remove paper backing from foam padding to expose padding adhesive and bond padding to roof panel. Use roller or soft cloth to ensure positive bond.

NOTE: *Be sure the foam padding is smooth and free from any irregularities to prevent highlighting after a new cover is installed.*

(4) Mark centerline of roof panel above windshield and rear window openings.

(5) Align center of vinyl cover with centerline mark above windshield and rear window.

(6) Secure cover to pinch weld flange at centerline locations with tape.

(7) Check cover for alignment at both sides and at roof extension panels.

(8) Fold cover in half at centerline.

(9) Apply smooth, even coat of 3M Vinyl Trim Adhesive or equivalent to 15-inch wide strip of one side of foam padding and to vinyl cover. Start at center when applying adhesive and work from front to rear.

NOTE: *Allow the adhesive applied to the vinyl material and foam padding to dry until it is tacky to the touch.*

(10) Bond cover to foam padding using a roller or soft cloth to ensure positive bond and to eliminate air pockets. Bond cover by starting at centerline and working toward side.

NOTE: *To remove wrinkles caused by folding, keep the cover fabric taut while installing it.*

(11) Apply adhesive to remainder of cover and foam padding and in drip moulding at side of cover being installed. Allow adhesive to dry until tacky.

(12) Apply smooth, even coat of adhesive to 15-inch wide strip of foam padding and to vinyl cover on opposite side of vehicle. Start at center and work from front to rear when applying adhesive. Allow adhesive to dry until tacky.

NOTE: *When applying the cover to the foam padding, always work from the center to the outside to eliminate air pockets to ensure positive bonding.*

(13) Brush adhesive onto cover, ledge of windshield, and rear window opening. Allow adhesive to dry until tacky before bonding.

(14) Work vinyl cover into crease line areas around roof using smooth fiber stick.

(15) Trim excess cover material from around drip rails, windshield and rear window.

(16) Trim vinyl material around sun roof opening and luggage rack attaching screw holes.

(17) Brush adhesive onto cover and ledge of sun roof opening. Allow adhesive to dry until tacky before bonding.

(18) Position and work vinyl cover into sun roof opening using smooth fiber stick.

(19) Install luggage rack.

(20) Apply bead of 3M Super Silicone Sealer (black preferred) or equivalent along top of windshield rubber weather strip and vinyl cover.

NOTE: *It may be necessary to apply sealer to the drip rails also.*

(21) Remove excess sealer using 3M General Purpose Adhesive Cleaner or equivalent and remove all masking tape and paper.

(22) Install mouldings and clips.

HEADLINING

Removal

(1) Remove sun visors, escutcheons and center support.

(2) Remove windshield moulding and end caps.

(3) Remove sun roof switch and disconnect switch wires.

(4) Remove sun roof opening trim welt and remove motor cap.

(5) Spray 3M Release Agent or equivalent, across headlining at windshield and around sunroof opening. Allow several minutes for release agent penetration.

CAUTION: *When removing the headlining, use care to avoid separating the foam backing from the fabric. If the fabric begins to separate from the backing, make a second application of the release agent.*

(6) Remove headlining from roof panel and sun roof opening.

(7) Remove headlining from side retainers.

(8) Remove lens from dome lamp. Remove screws attaching lamp to sun roof housing and remove lamp.

(9) Remove coat hooks.

(10) Remove lens from cargo lamp, then remove screws attaching cargo lamp to roof bow and remove lamp and switch.

(11) Remove tailgate opening moulding and end caps.

(12) Spray 3M Release Agent, or equivalent, across headlining at tailgate opening moulding. Allow several minutes for release agent penetration.

CAUTION: *When removing the headlining, use care to avoid separating the foam backing from the fabric. If the fabric begins to separate from the backing, make a second application of release agent.*

(13) Remove headlining from tailgate opening.

(14) Remove headlining from side retainers and slide headliner rearward and out of headlining brackets.

(15) Remove headlining from vehicle through tailgate opening.

Installation

(1) Install headlining in vehicle through tailgate opening. Insert headlining in headlining brackets and slide headlining forward.

(2) Spray 3M General Trim Adhesive, or equivalent, across at roof panel at tailgate opening.

(3) Attach headlining to roof panel at tailgate opening and install tailgate opening moulding and end caps.

(4) Pull headlining forward. Install headlining up to coat hook locations along both sides using Installer Tool J-2772-C.

(5) Connect and install cargo lamp and lens.

(6) Connect and install cargo lamp switch.

(7) Spray 3M General Trim Adhesive, or equivalent, on sun roof opening flange.

(8) Install coat hooks.

(9) Pull headlining forward and attach it to sun roof opening flange.

(10) Install sun roof opening trim welt.

(11) Connect and install dome lamp and lens.

(12) Place strip of masking tape across top of windshield at roof panel.

(13) Spray 3M General Trim Adhesive, or equivalent, on roof panel along top of windshield.

(14) Using sun visor holes as guides, pull headlining forward and attach it along windshield.

(15) Install headlining along both sides using Installer Tool J-2772-C.

(16) Connect and install sun roof switch.

(17) Install windshield moulding and end caps, and motor cap.

(18) Install sun visors, escutcheons and center support.

(19) Remove masking tape.

POWER SUN ROOF SWITCH REMOVAL/INSTALLATION

(1) Pull switch downward and disconnect switch wires (fig. 3L-10).

(2) Connect switch wires and install switch in switch opening.

POWER SUN ROOF MOTOR

Removal

(1) Open sun roof glass panel; then disconnect battery negative cable.

(2) Remove sun visors, escutcheons, center support, and windshield moulding and end caps.

(3) Remove sun roof switch and motor cap.

(4) Spray 3M Release Agent, or equivalent, across headlining at windshield. Allow several minutes for release agent penetration.

CAUTION: *When removing the headlining, use care to avoid separating the foam backing from the fabric. If the fabric begins to separate from the backing, make a second application of the release agent.*

(5) Pull front edge of headlining downward.

(6) Remove motor mounting screws and remove motor.

Installation

(1) Position motor in housing and install motor mounting screws.

(2) Place strip of masking tape across top of windshield at roof panel.

(3) Spray 3M General Trim Adhesive, or equivalent, on roof panel along top of windshield.

(4) Pull headlining forward and attach it along windshield. Use sun visor holes as guides when attaching headlining.

(5) Connect wires to sun roof switch and install switch and motor cap.

(6) Install sun visors, escutcheons, windshield trim moulding and end caps, and center support.

(7) Connect battery negative cable, and check sun roof operation.

NOTE: *If the motor slips and does not open and close the glass panel, the motor clutch located in the gear portion of the motor may have to be adjusted. Refer to Motor Clutch Adjustment.*

MOTOR CLUTCH ADJUSTMENT

(1) Remove motor cap to gain access to adjusting screw. Cap is located in headlining just above, and at center of windshield.

(2) Loosen clutch plate adjusting screw jamnut using deep socket.

(3) Tighten adjusting screw to 50 inch-pounds (5.6 N•m) torque.

(4) Tighten jamnut and install motor cap.

GLASS PANEL PARALLEL ALIGNMENT

CAUTION: *Do not operate the electric motor while the glass panel or cables are removed from the track as cable damage could occur.*

(1) Open glass panel approximately 1/4 to 1/2 inch.

(2) Determine how much forward edge of glass panel is out of parallel with foreward edge of opening in roof panel and note variation.

(3) Open panel approximately 8 inches to gain access to cable and drive gear mechanism.

(4) Remove cable front cover and drive gear plate.

(5) Remove one cable from track.

(6) Move one side of glass panel slightly fore or aft as required to obtain parallel alignment with forward edge of roof panel opening (fig. 3L-15).

(7) Install cable in front track and insert cable in drive gear teeth.

(8) Install drive gear plate and cable front cover.

(9) Position glass panel approximately 1/4 inch from fully closed position.

(10) Check parallel alignment. Repeat steps (2) through (9) to obtain proper alignment if necessary.

GLASS PANEL HEIGHT ADJUSTMENT

Adjusting Front of Panel

(1) Remove halo assembly. Refer to Halo Assembly Removal.

(2) Loosen front guide shoe attaching screws (fig. 3L-16).

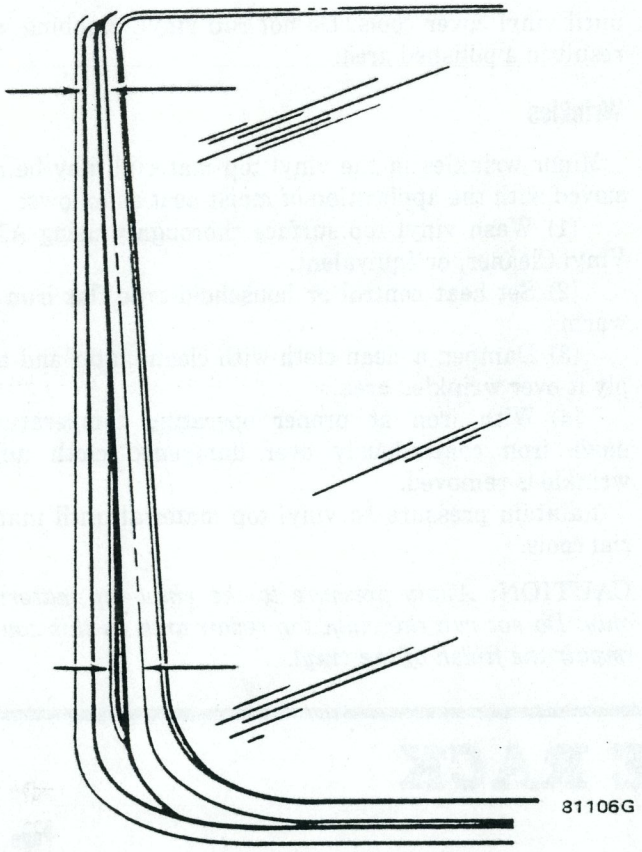


Fig. 3L-15 Glass Panel Parallel Alignment

(3) Turn knurled nut on each front guide shoe clockwise to lower glass panel or counterclockwise to raise panel and obtain desired height adjustment (fig. 3L-16).

(4) Tighten front guide shoe attaching screws to 20 inch-pounds (2.3 Nm) torque after adjusting panel height.

CAUTION: *Do not adjust the glass panel too high as it could be damaged when the panel is opened or closed.*

(5) Check glass panel alignment and operation in open and closed positions. Repeat steps (2) through (4) to obtain proper height if necessary.

(6) Install halo assembly. Refer to Halo Assembly Installation.

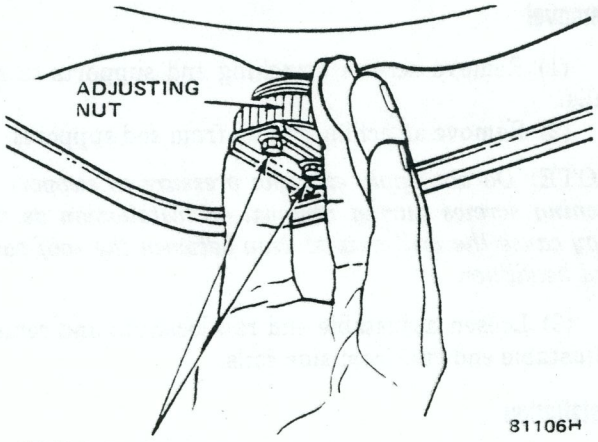


Fig. 3L-16 Glass Panel Front Height Adjustment

Adjusting Rear of Panel

(1) Remove halo assembly. Refer to Halo Assembly Removal.

(2) Release rear slide tension spring and rotate spring to inboard position (fig. 3L-13).

(3) Loosen rear slide adjuster nut (fig. 3L-17) and raise or lower panel as required to obtain desired adjustment.

(4) Tighten rear slide adjuster nut to 30 inch-pounds (3.3 Nm) torque after completing adjustment.

(5) Install halo assembly. Refer to Halo Assembly Installation.

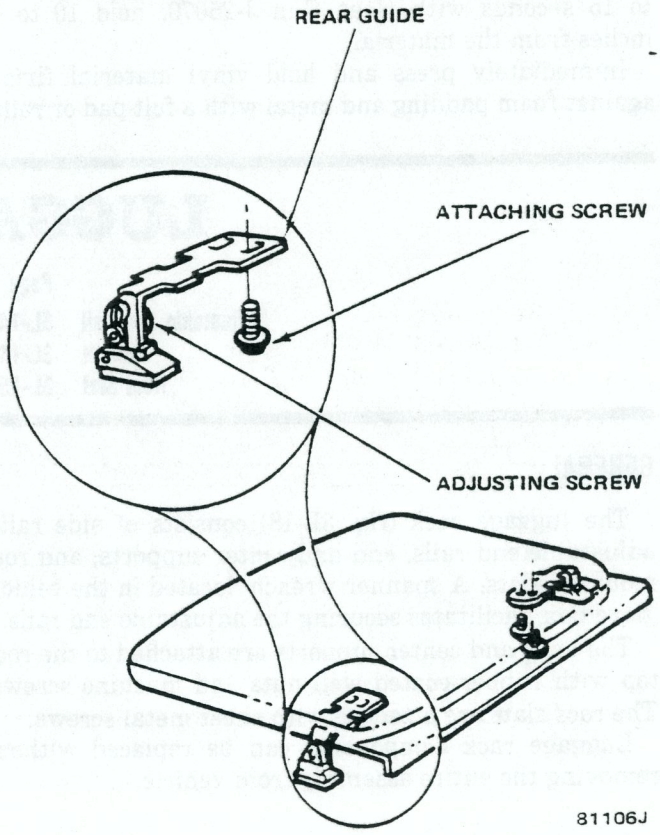


Fig. 3L-17 Glass Panel Rear Height Adjustment

MANUAL OPERATION OF GLASS PANEL

If an electrical malfunction should ever occur, the glass panel can be opened or closed manually as follows:

(1) Remove small round motor cap located in center of windshield header near front edge of sun roof opening. Cap removal will provide access to motor driveshaft.

(2) Remove screw in driveshaft using flat bladed screwdriver or cranking tool blade end (located in glovebox).

(3) Rotate motor driveshaft using cranking tool. Rotate driveshaft clockwise to close glass panel, or counterclockwise to open panel.

(4) Install screw in driveshaft and install access plug in windshield header after opening/closing glass panel.

VINYL TOP REPAIR

Bulges or Blisters

Bulges or blisters in the vinyl top indicate poor bonding or trapped air. They can be eliminated by piercing the bulge or blister to expel the air. Heat the area for 10 to 15 seconds with Heat Gun J-25070, held 10 to 15 inches from the material.

Immediately press and hold vinyl material firmly against foam padding and metal with a felt pad or roller until vinyl cover cools. Do not rub vinyl. Rubbing will result in a polished area.

Wrinkles

Minor wrinkles in the vinyl top material may be removed with the application of moist heat as follows:

(1) Wash vinyl top surface thoroughly using AMC Vinyl Cleaner, or equivalent.

(2) Set heat control or household-type flat iron to warm.

(3) Dampen a clean cloth with clean water and apply it over wrinkled area.

(4) With iron at proper operating temperature, move iron continuously over dampened cloth until wrinkle is removed.

Maintain pressure on vinyl top material until material cools.

CAUTION: *Apply pressure to the vinyl top material only. Do not rub the vinyl top repair area as this could impair the finish of the vinyl.*

LUGGAGE RACK

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Roof Slat	3L-15		

GENERAL

The luggage rack (fig. 3L-18) consists of side rails, adjustable end rails, end and center supports, and roof mounted slats. A spanner wrench, located in the vehicle glove box, facilitates securing the adjustable end rails.

The ends and center supports are attached to the roof top with rubber-coated well nuts and machine screws. The roof slats are attached with sheet metal screws.

Luggage rack components can be replaced without removing the entire assembly from vehicle.

SUPPORT

Removal

(1) Remove screw(s) attaching support to side rail.

(2) Remove attaching screws from support.

NOTE: *Do not apply extreme pressure to support attaching screws during removal or installation as this may cause the well nuts to drop between the roof panel and headliner.*

(3) Remove support and gasket from roof.

Installation

(1) Position support on side rail.

(2) Position support and gasket on roof.

(3) Coat screw threads with 3M Drip-Chek Sealer or equivalent, and install screws. Tighten screws to 28 inch-pounds (3 N•m) torque.

(4) Install screw(s) attaching support to side rail.

ADJUSTABLE END RAIL

Removal

(1) Remove screws attaching end supports to side rails.

(2) Remove attaching screws from end supports.

NOTE: *Do not apply extreme pressure to support attaching screws during removal or installation as this may cause the well nuts to drop between the roof panel and headliner.*

(3) Loosen adjustable end rail locknuts and remove adjustable end rail from side rails.

Installation

(1) Position adjustable end rail in side rails.

(2) Position end supports on side rails.

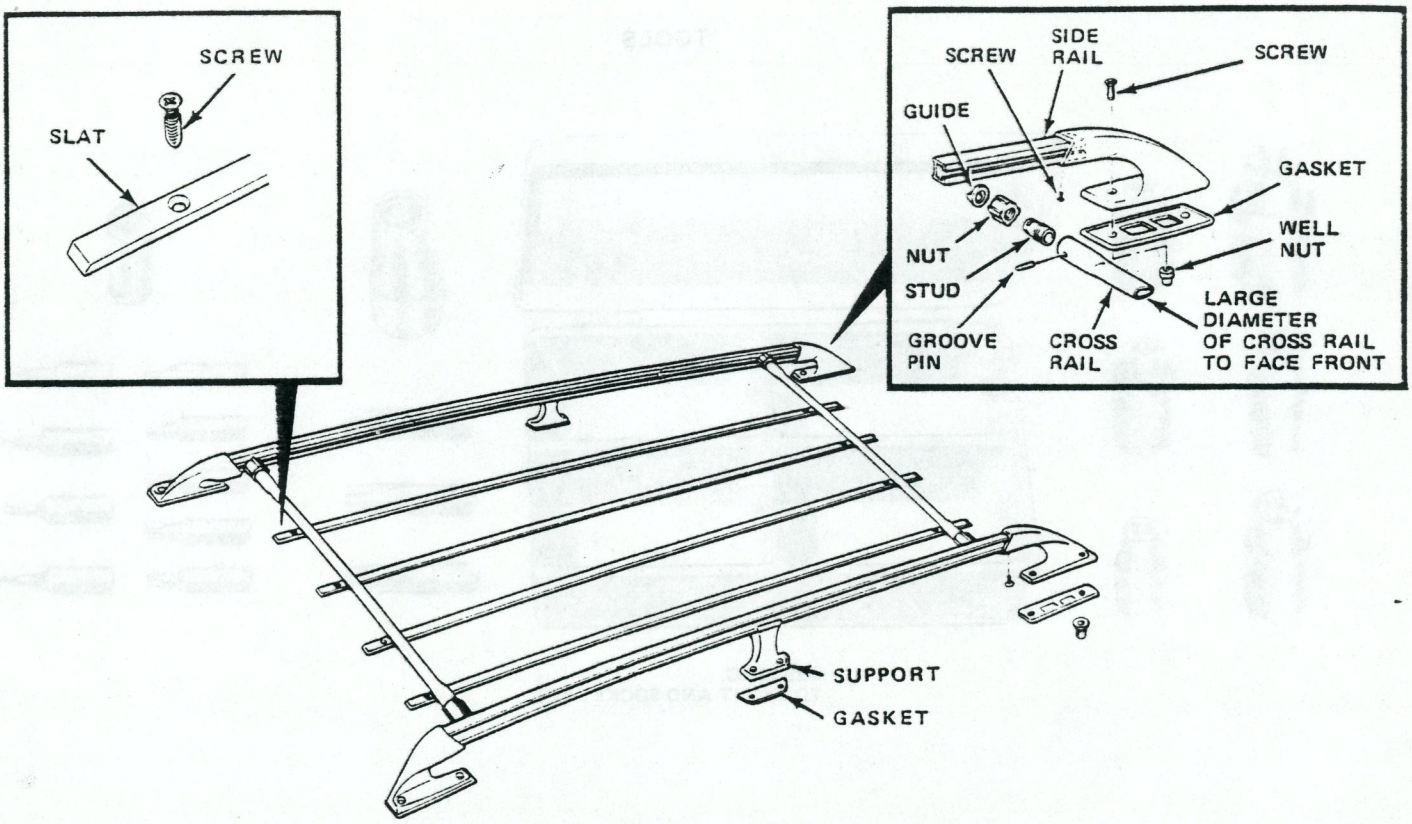


Fig. 3L-18 Luggage Rack—Cherokee-Wagoneer Models

(3) Position end supports and gaskets on roof.
(4) Coat screw threads with 3M Drip-Chek Sealer or equivalent, and install screws. Tighten screws to 28 inch-pounds (3 N•m) torque.
(5) Install screws attaching end supports to side rails.
(6) Tighten adjustable end rail locknuts.

SIDE RAIL

Removal

(1) Remove screws attaching side rail to supports.
(2) Remove screws attaching end support to roof.

NOTE: *Do not apply extreme pressure to support attaching screws during removal or installation as this may cause the well nuts to drop between the roof panel and headliner.*

(3) Remove end support and side rail.

Installation

(1) Position side rail on supports.
(2) Position end support and gasket on roof.
(3) Coat screw threads with 3M Drip-Chek Sealer or equivalent, and install screws. Tighten screws to 28 inch-pounds (3 N•m) torque.
(4) Install screws attaching side rail to supports.

ROOF SLAT

Removal

(1) Remove screws attaching roof slat to roof.
(2) Remove roof slat.

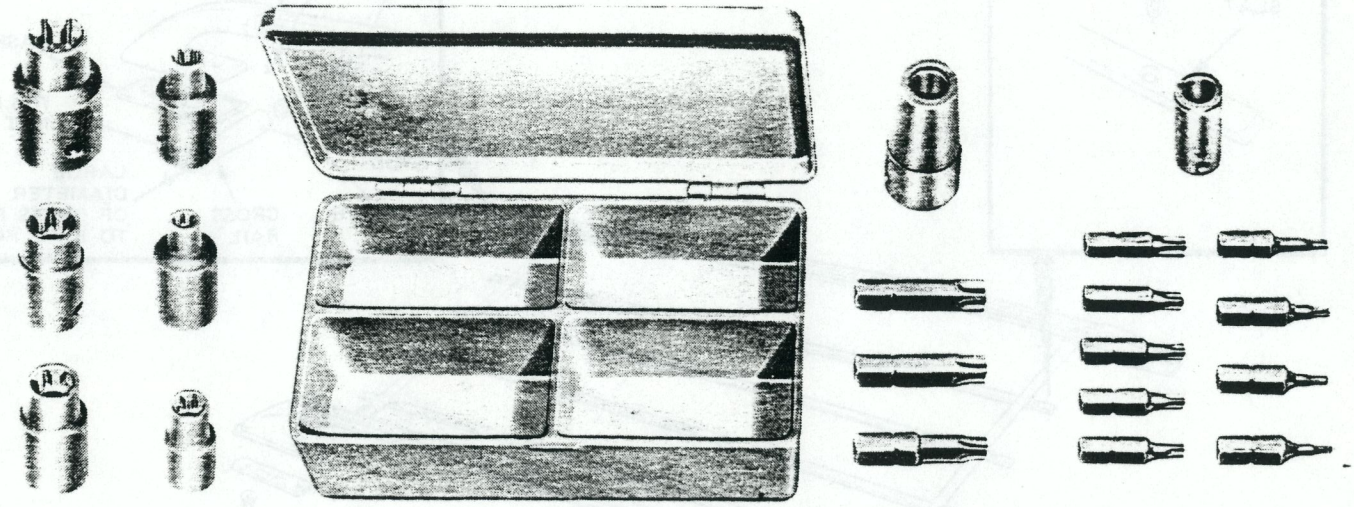
Installation

CAUTION: *Excerise care not to damage painted or vinyl surfaces.*

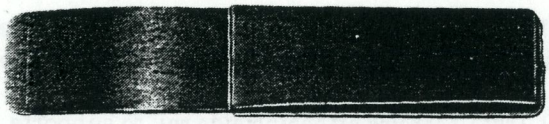
NOTE: *Surface must be clean and dry for roof slat to adhere.*

(1) Position roof slat on roof panel.
(2) Install screws attaching roof slat to roof.

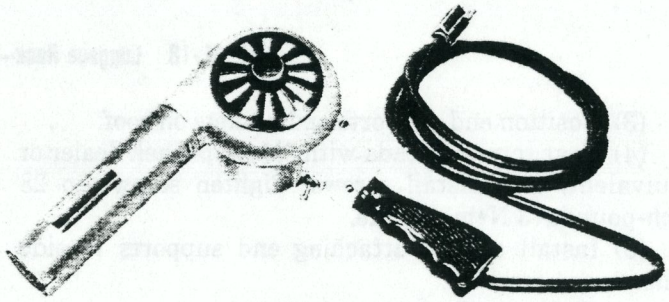
TOOLS



J-25359-C
TORX BIT AND SOCKET SET



J-2772-C
HEADLINING INSTALLER



J-25070
HEAT GUN

70119

SEAT ASSEMBLIES 3M

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FRONT SEATS

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GENERAL

Bucket seats are standard on 2-door Cherokee and CJ models (fig. 3M-1) and optional on the Wagoneer, 4-door Cherokee, and Truck models. The passenger side bucket seat, except CJ, is adjustable fore and aft. On Cherokee 2-door and Truck models, the passenger side bucket seat has a forward tilting seat back for access to rear seat or tool storage area. A folding support for passenger side bucket seat on CJ models allows the whole seat to move forward for easier entry to the rear area.

On all Truck models, the bench seat back swings forward for access to the seat back storage area. The seat back locks automatically in the fully upright position to prevent it from tilting forward in the event of sudden stops. To release the seat back lock, pull up on the seat back release.

The fore-and-aft seat adjuster mechanism for Cherokee-Wagoneer-Truck models and left front CJ seats has a turnbuckle to allow for slight dimensional variances during production assembly of seats and seat support components. The turnbuckle permits the seat sliding and latching components to be adjusted for trouble-free operation. Adjustment of the turnbuckle is covered in this chapter.

All seat belts utilize quick-release buckle latches. Cherokee and Wagoneer models are equipped with three sets of rear seat belts; the two outboard seat belt retractors are anchored on the wheelhousings.

CJ BUCKET SEATS

The seats are removed by unfastening the supports and braces from the floorpan.

The left front seat frame attaches to the seat slides and the seat slides, in turn, attach to braces or supports which are fastened to the floorpan. The seat may be locked in the full forward position, or every half inch toward the full rear position, for a distance of approximately 2-1/2 inches on CJ-5 models and five inches on other models.

Removal

(1) Remove screws (fig. 3M-1) attaching supports and braces to floorpan.

(2) Remove seat assembly from vehicle.

Installation

(1) Position seat assembly in vehicle.

(2) Install screws attaching supports and braces to floorpan. Tighten screws to 15 foot-pounds (20 N•m) torque.

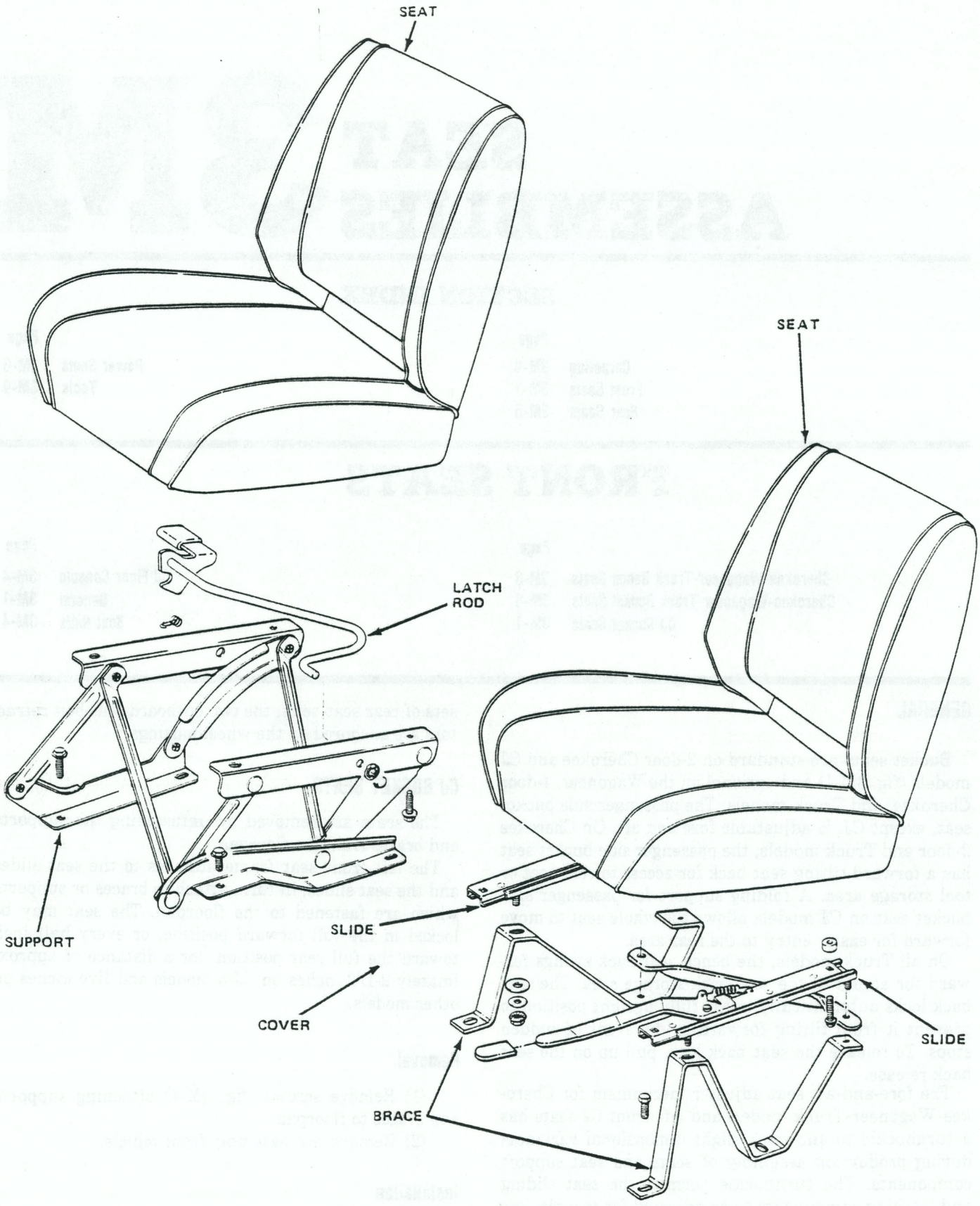

Fig. 3M-1 Bucket Seats—CJ Models

CHEROKEE-WAGONEER-TRUCK BUCKET SEATS

The seats are removed by unfastening the supports and/or braces from the floorpan.

The front seat frame attaches to the seat slides and the seat slides, in turn, attach to braces or supports which are fastened to the floorpan. The seat may be locked in the full forward position, or every half inch toward the full rear position, for a distance of approximately five inches.

Removal

(1) Remove screws attaching supports to floorpan.
(2) Remove seat assembly from vehicle.

Installation

(1) Position seat assembly in vehicle.
(2) Install screws attaching supports to floorpan. Tighten screws to 20 foot-pounds (27 N•m) torque.

Forward Tilting Seat Back Replacement—Cherokee and Truck Models

(1) If equipped with center armrest, remove bucket seat from vehicle.
(2) Remove screw attaching side wing panel-to-hockey stick using Torx Bit Tool J-25359-C.
(3) Remove screws attaching hockey sticks to bottom frame using Torx Bit Tool J-25359-C.
(4) Remove seat back.
(5) Position seat back on bottom frame and install screws attaching hockey sticks to bottom frame using Torx Bit Tool J-25359-C.
(6) Position side wing panel on outboard hockey stick and install attaching screw using Torx Bit Tool J-25359-C.
(7) Install bucket seat in vehicle, if removed.

Tilt Lock Pawl Assembly

Removal

(1) Remove forward tilting seat back.
(2) Remove screw attaching release handle-to-latching rod using Torx Bit Tool J-25359-C and remove handle.
(3) Remove screws attaching plastic bumpers using Torx Bit Tool J-25359-C and remove bumpers.
(4) Unzip upholstery and pull back.
(5) Remove spring retainers attaching latching rod (fig. 3M-2).
(6) Remove rod, pawl, and spring from seat.

Installation

(1) Position pawl and spring in seat and install latching rod.
(2) Install spring retainers attaching latching rod to seat.

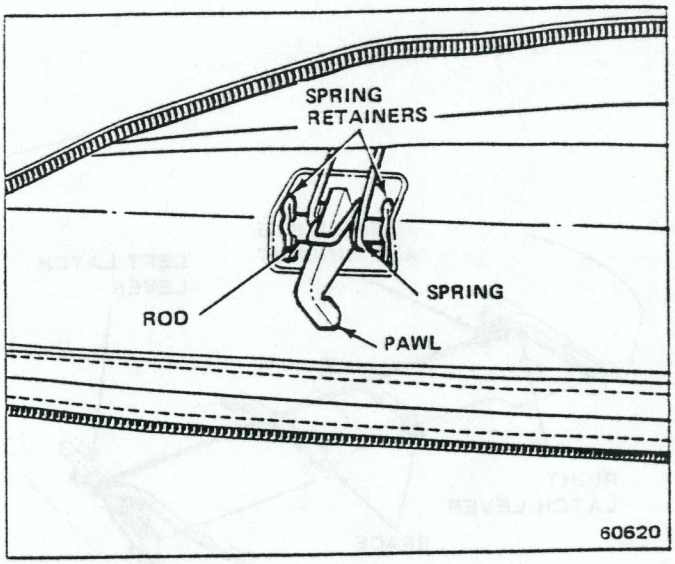

Fig. 3M-2 Tilt Lock Pawl Assembly

(3) Pull upholstery over pad, zip up and tuck end of zipper under upholstery.
(4) Position plastic bumpers on seat and install attaching screws using Torx Bit Tool J-25359-C.
(5) Position release handle on latching rod and install attaching screw using Torx Bit Tool J-25359-C.
(6) Install forward tilting seat back.

CHEROKEE-WAGONEER-TRUCK BENCH SEATS

The seats are removed by unfastening the supports and/or braces from the floorpan.

The front seat frame attaches to the seat slides and the seat slides, in turn, attach to supports which are fastened to the floorpan. The seat may be locked in the full forward position, or every half inch toward the full rear position, for a distance of approximately five inches.

On bench seats and bucket seats, a latch wire connects the right and left spring-loaded locking levers, facilitating the simultaneous unlocking or locking of both seat adjusting slides.

Removal

(1) Remove screws attaching supports to floorpan.
(2) Remove seat assembly from vehicle.

Installation

(1) Position seat assembly in vehicle.
(2) Install screws attaching supports to floorpan. Tighten screws to 20 foot-pounds (27 N•m) torque.

Adjustment

(1) Locate turnbuckle under bench seat (fig. 3M-3). Loosen turnbuckle wingnut.

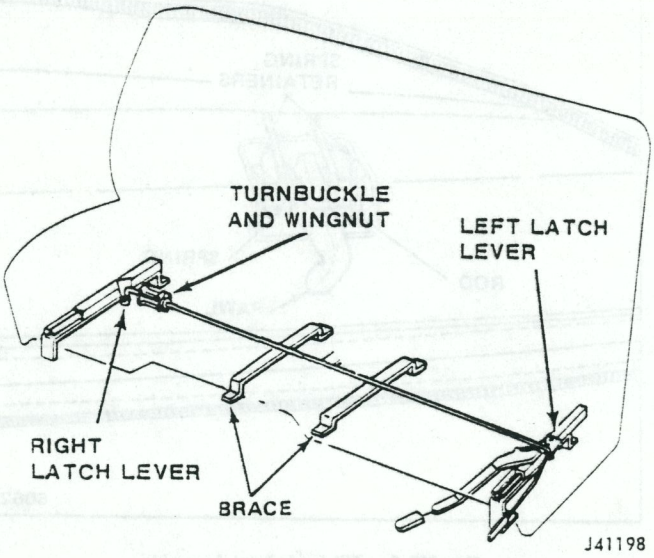

Fig. 3M-3 Front Seat Adjustment

(2) Tighten turnbuckle until slack is removed from wire.

(3) Back off turnbuckle three turns.

(4) Secure wingnut up against turnbuckle.

(5) Check for proper seat adjustment operation. If right side of seat will not release, increase tension by tightening turnbuckle. If right side of seat will not lock in place, decrease tension by loosening turnbuckle.

CJ FLOOR CONSOLE

The beverage container type floor console (fig. 3M-4), available only with bucket seat equipped models, is fabricated from molded plastic material. The floor console cover is provided with a lock and two depressions designed to hold beverage containers. The bottom of the floor console is equipped with a hole, in the rear, allowing ice water to drain onto the ground.

The oval head key is utilized to lock and unlock the cover.

Removal

(1) Open console cover.

(2) Remove screws attaching console to floorpan.

(3) Remove console assembly from vehicle.

Installation

(1) Position console assembly in vehicle.

(2) Align drain hole with hole in floorpan and install attaching screws.

(3) Close and latch console cover.

Console Cover Seal

The console cover seal is attached to the console. The foam seal may be replaced after opening the cover.

Console Cover Lock

Lock Cylinder Removal

(1) Open console cover.

(2) Remove screw attaching retainer to lock. Remove retainer from lock.

(3) Remove lock, cylinder and key as unit from cover.

(4) Manually set latch to simulate closed cover position, turn key and cylinder counterclockwise and lift out of lock.

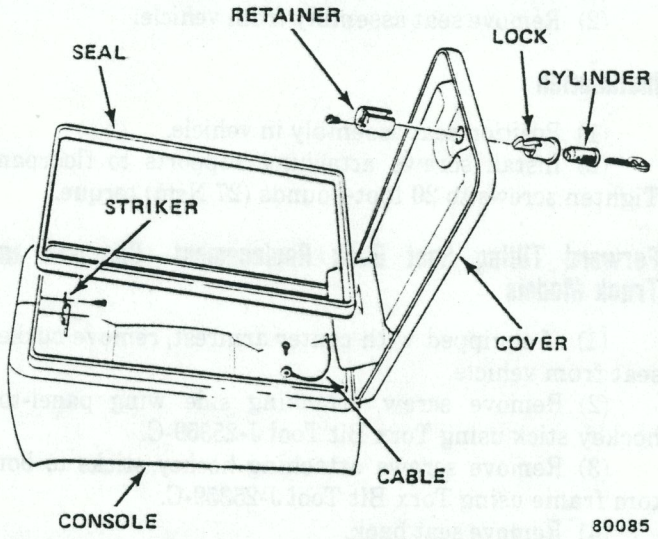

Fig. 3M-4 Floor Console Components

Lock Cylinder Installation

(1) Manually set latch to simulate closed cover position.

(2) Insert key and cylinder into lock and turn clockwise. Release latch and remove key.

(3) Position assembled lock in cover and install retainer and attaching screw.

SEAT BELTS

Removal

(1) Remove seat belt anchor bolt with Torx Bit Tool J-25359-C.

(2) Remove seat belt.

(3) Remove shoulder belt guide cover from guide, if equipped.

(4) Remove guide bolt with Torx Bit Tool J-25359-C.

(5) Obtain access to seat belt retractors by removing trim covers.

(6) Remove seat belt retractors anchor bolts with Torx Bit Tool J-25359-C.

(7) Remove seat belt retractor.

(8) Inspect seat belt material for evidence of wear, cuts, or fraying. Replace as required.

Installation

(1) Install seat belt and seat belt retractor anchor bolts. Tighten to 25 to 35 foot-pounds (34 to 47 N•m) torque.

(2) Position shoulder belt guide on B-pillar and install bolt with Torx Bit Tool J-25359-C.

(3) Install shoulder belt guide cover.

(4) Install seat belt retractor trim cover.

REAR SEATS

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CJ SEATS

The rear seat assembly (fig. 3M-5) is mounted by bolts to supports which, in turn, are secured to the floorpan of the vehicle by bolts.

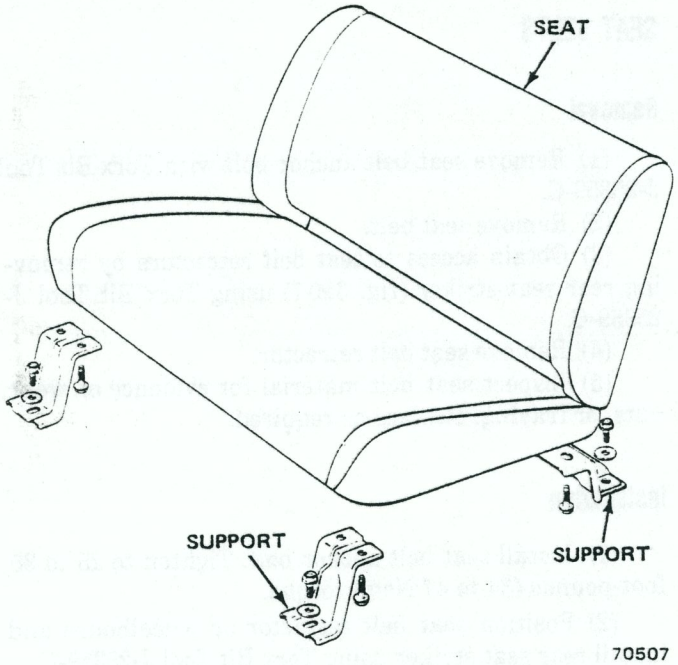

Fig. 3M-5 Rear Seat Assembly—CJ Models

All seats are of spring design and utilize padding and foam rubber in their construction.

Removal

(1) Remove bolts attaching rear seat assembly to floorpan.

(2) Remove rear seat assembly from vehicle.

Installation

(1) Position rear seat assembly in vehicle.

(2) Install bolts attaching rear seat assembly to floorpan.

CHEROKEE-WAGONEER SEATS

The full width rear seat is attached to the floorpan by two hinges to allow the seat to be folded forward or removed to provide an enlarged rear cargo area (fig. 3M-6).

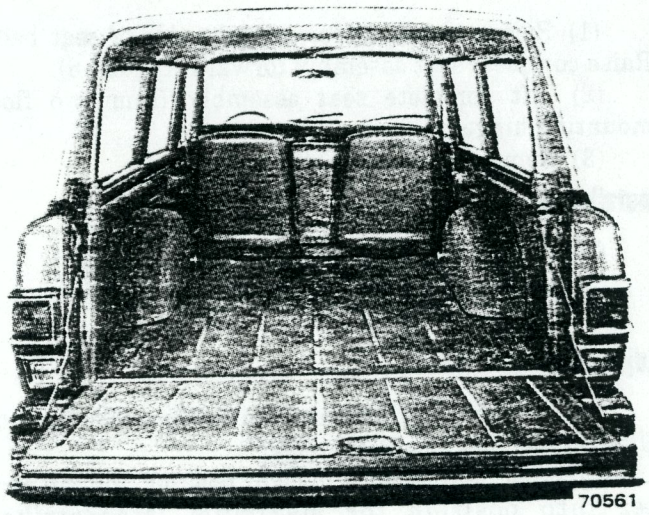

Fig. 3M-6 Rear Cargo Area with Rear Seat Removed

A latch on each side of the rear seat back engages a striker bolted into cage nuts on the rear wheelhouse panels. The cage nuts allow movement for striker adjustment.

To tilt the seat back forward, release the latch on the right side by raising the latch lever (fig. 3M-7) and simultaneously pulling the seat back forward.

A rear seat holding strap, attached to the right door pillar, prevents the seat from falling backward when the seat is in the folded position. An eye on the strap is engaged with the chrome plated stud to prevent the seat from falling backward. The strap should always be connected to the stud whenever the seat is in the folded position.

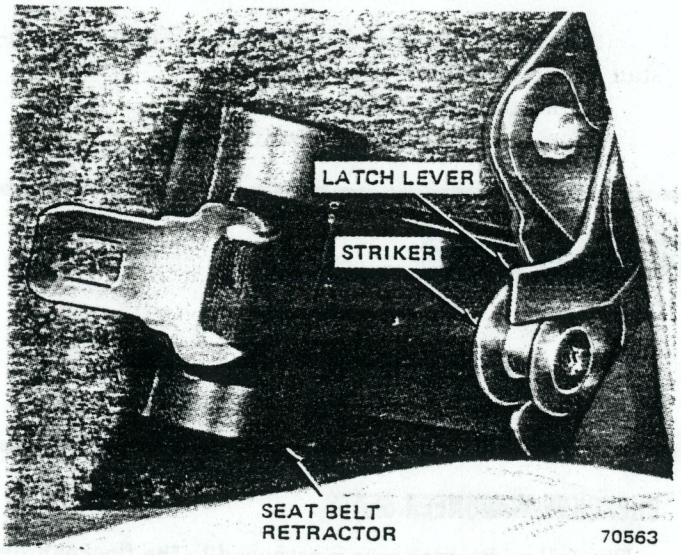

Fig. 3M-7 Rear Folding Seat—Latched Position

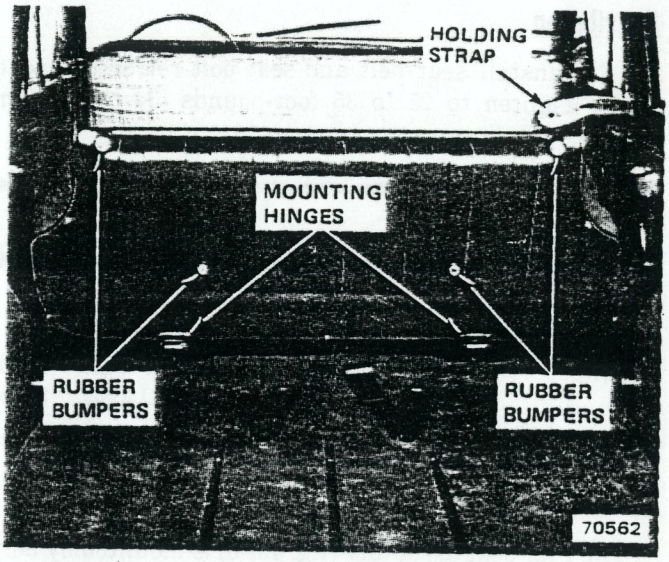

Fig. 3M-8 Rear Seat Assembly

Removal

(1) Release latch at lower right side of seat back. Raise complete seat assembly forward (fig. 3M-8).

(2) Lift complete seat assembly from two floor mounting hinges.

(3) Remove seat assembly from vehicle.

Installation

(1) Install seat assembly onto hinges.

(2) Position seat back in proper location.

(3) Secure seat back latch.

Adjustment

(1) Tilt seat back forward and loosen striker bolt to allow forced movement of striker.

(2) Raise seat back to upright position and tap striker into position for maximum latch/striker engagement.

(3) Unlatch seat back carefully so as not to change striker position and tighten striker securely.

(4) Check striker/latch operation.

SEAT BELTS

Removal

(1) Remove seat belt anchor bolt with Torx Bit Tool J-25359-C.

(2) Remove seat belt.

(3) Obtain access to seat belt retractors by removing rear seat striker (fig. 3M-7) using Torx Bit Tool J-25359-C.

(4) Remove seat belt retractor.

(5) Inspect seat belt material for evidence of wear, cuts, or fraying. Replace as required.

Installation

(1) Install seat belt anchor bolt. Tighten to 25 to 35 foot-pounds (34 to 47 N•m) torque.

(2) Position seat belt retractor on wheelhouse and install rear seat striker using Torx Bit Tool J-25359-C.

(3) Check striker/latch operation.

POWER SEATS

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GENERAL

The power seats can be adjusted in six different directions up, down, forward, back, tilt forward, or tilt rearward.

The control switch is located on the lower outboard side of the seat. The front lever on the switch (fig. 3M-9) raises or lowers (tilts) the front of the seat, the center lever raises or lowers the complete seat by moving the

switch up or down. It also moves it forward or rearward by moving the switch forward or rearward. The rear lever raises or lowers (tilts) the back of the seat.

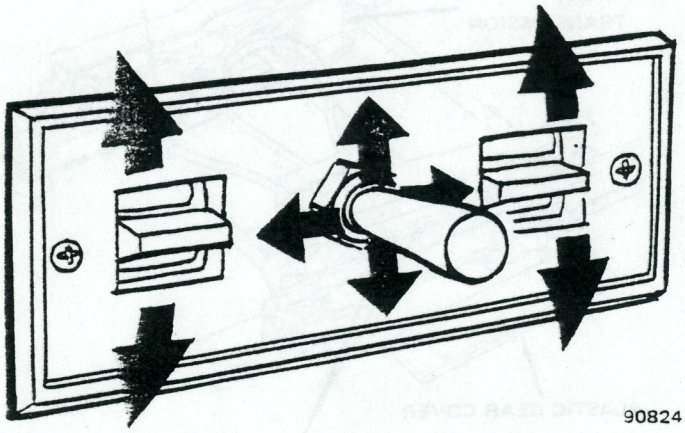

Fig. 3M-9 Power Seat Controls

A three armature permanent magnet reversible motor is coupled through cables to the rack and pinion assemblies located in the seat tracks, providing the various seat movements.

The electrical circuit is protected by a 30 amp circuit breaker located on the fuse panel on the inside of the cowl panel to the left of the steering column.

SERVICING PROCEDURES

Test

Before any testing is attempted, the battery should be fully charged and all connections and terminals cleaned and tightened to insure proper continuity and grounds.

With the dome light on, apply the switch in the direction of failure. If the dome light dims, the seat may be jamming. Check for binding. If the dome light does not dim, then proceed with the following electrical tests.

(1) Disconnect wiring harness at connector under seat. Connect 12 volt test lamp between red and black wire in female connector on harness. If test lamp lights, harness to seat is good. If test lamp does not light, check as follows:

(a) Current at fuse panel circuit breaker.

(b) Continuity in red wire between fuse panel and harness connector under seat.

(c) Continuity in black wire and proper connection to ground.

(2) Remove test lamp and connect harness.

(3) Remove switch from seat harness.

(4) To check rear motor, connect covered jumper wire between red terminal in center section (fig. 3M-10) and either light blue or orange connection in front section. Connect second covered jumper wire between black terminal in center section and open connection in front section. If motor does not operate, reverse jumpers in front section. If motor still does not operate, either harness or complete three motor assembly may be defective.

(5) To check center motor, connect covered jumper wire between red terminal of center section and either white or tan connection in center section. Connect second covered jumper wire between black terminal in center section and open connection in center section. If motor does not operate, reverse white and tan jumpers. If motor still does not operate, either harness or complete three motor assembly should be replaced.

(6) To check front motor, connect covered jumper wire between red terminal in center section and either green or yellow connection in rear section. Connect second covered jumper wire between black terminal in center section and open connection in rear section. If motor does not operate, reverse jumpers in the section. If motor still does not operate, either harness or complete three motor assembly should be replaced.

(7) If all motors and seat operate properly this indicates that switch is bad and should be replaced.

For specific continuity checks, see Power Seat Wiring Diagram at back of this manual.

WIRE COLOR	FUNCTION
ORANGE	POWER SEAT - FRONT UP
LIGHT BLUE	POWER SEAT - FRONT DOWN
TAN	POWER SEAT - FORWARD
WHITE	POWER SEAT - REARWARD
LIGHT GREEN	POWER SEAT - REAR DOWN
YELLOW	POWER SEAT - REAR UP
BLACK	POWER SEAT - GROUND
RED W/O TR.	POWER SEAT - IGNITION FEED

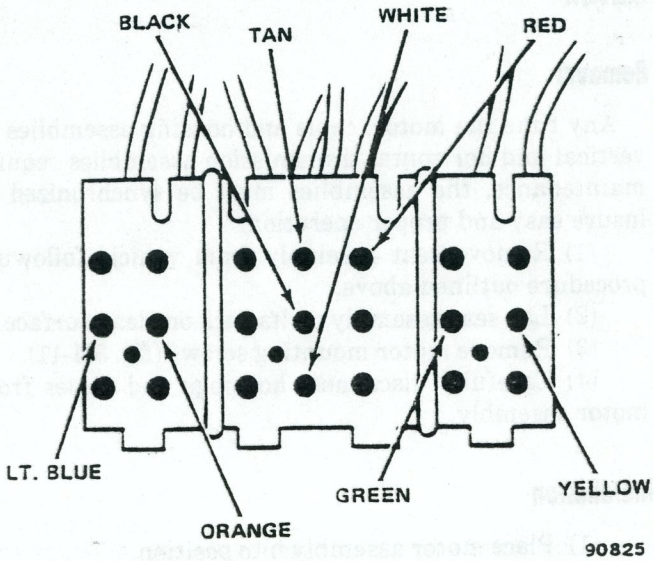

Fig. 3M-10 Electrical Test Locations—Driver's Side

SEAT ASSEMBLY

Removal

(1) Disconnect battery negative cable.
(2) Remove attaching nuts holding seat assembly to floorpan.
(3) Tilt seat and disconnect wiring harness.
(4) Remove seat assembly from vehicle.

Installation

(1) Position seat assembly in vehicle.
(2) Connect wiring harness.
(3) Install and tighten attaching nuts.
(4) Connect battery negative cable and check seat operation.

ADJUSTER

Removal

(1) Remove seat assembly from vehicle following procedure outlined above.
(2) Lay seat on its back on clean surface.
(3) Remove bolts attaching adjuster to seat assembly.

Installation

(1) Lay seat on its back on clean surface.
(2) Position adjuster to seat assembly and install attaching bolts.
(3) Install seat assembly following procedure outlined above.

MOTOR

Removal

Any time the motor, cable and housing assemblies or vertical and horizontal transmission assemblies require maintenance, the assemblies must be synchronized to insure easy and proper operation.

(1) Remove seat assembly from vehicle following procedure outlined above.
(2) Lay seat assembly on its back on clean surface.
(3) Remove motor mounting screws (fig. 3M-11).
(4) Carefully disconnect housings and cables from motor assembly.

Installation

(1) Place motor assembly into position.
(2) Carefully connect cables and housings to motor assembly.

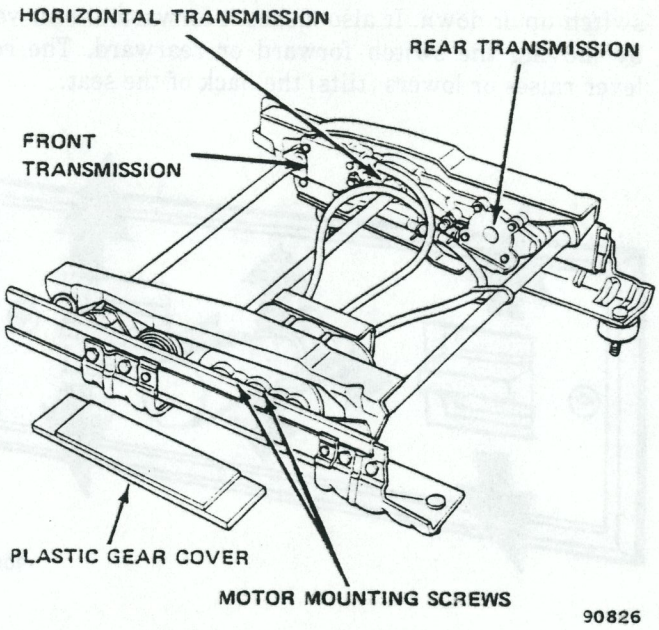

Fig. 3M-11 Seat Track Assembly

(3) Install mounting screws.
(4) Install bolt holding motor assembly to adjuster.
(5) Install seat assembly following procedure outlined above.

CABLE AND HOUSING

Removal

Any time the motor, cable and housing assemblies or vertical and horizontal transmission assemblies require maintenance, the assemblies must be synchronized to insure easy and proper operation.

It is recommended that any time a cable is to be replaced that the motor assembly be removed also for ease of replacement.

(1) After motor has been disconnected, remove corbin clamp from cable housing then slide cable and housing out of connector.

Installation

(1) Insert cable and housing into connector and install corbin clamp.
(2) Install motor assembly.

HORIZONTAL AND VERTICAL TRANSMISSIONS

Transmissions are not removable and no maintenance is required. If transmission fails, replace entire seat adjuster assembly.

CARPETING

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FLOOR CARPET

The rear floor carpet is held in position by the seats, center console, seat belts, sill plates and other components.

When removing and installing the rear floor carpet it may be necessary to remove and install the above items.

FRONT FLOOR CARPET

The front floor carpet is held in position by the seats, seat belts, sill plates and other components.

When removing and installing the carpet, it will also be necessary to remove and install the above items also.

When replacing the front floor carpet, position the carpet in the vehicle and cut the openings in the carpet using a sharp knife or razor blade for such things as the floor shifter, if equipped.

REAR COMPARTMENT CARPET

The rear compartment carpet is fitted to the rear compartment and is held in position by the skid strip screws and rear seat.

The replacement carpet may require some modifications to accommodate these items.

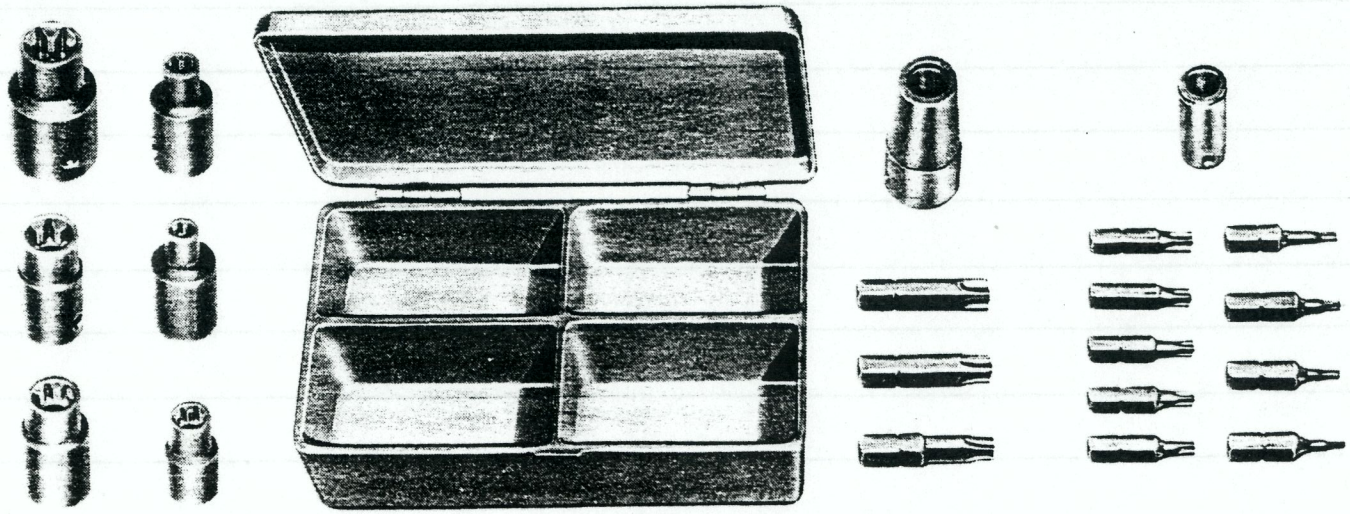
WHEELHOUSE CARPET

The wheelhouse carpet is held in place by a combination of the trim panel and adhesive on the senior line vehicles.

When installing the wheelhouse carpet on the senior line vehicles apply 3M General Trim Adhesive, or equivalent to the backside of carpet before installing.

On CJ models the wheelhouse carpet is held in position by velcro strips.

Tools



J-25359-C TORX BIT AND SOCKET SET

NOTES

WINDSHIELD - REAR WINDOW 3N

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WINDSHIELD

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CJ Folding Windshield	3N-1	Tools	3N-7
CJ Windshield Glass	3N-2	Specifications	3N-6
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GENERAL

The windshields on all models consist of two sheets of plate glass laminated together to form a one-piece safety glass.

All CJ windshields are retained in their openings by rubber weatherstrips (channels).

Cherokee-Wagoneer-Truck model windshields are bonded to the rubber weatherstrip and the rubber weatherstrip is bonded to the body opening to improve glass retention and sealing.

The safety type glass is designed with adequate clearance to prevent stress and strains. When replacing cracked glass resulting from causes other than a direct blow or a known instance of temporary misalignment, it is very important that the cause of the breakage be determined and the condition corrected.

The inside rear view mirror bracket for all models is bonded directly to the windshield glass with a polyvinyl-butyral compound through a heat-induction process.

Service replacement windshield glass may have the rear view mirror bracket bonded to the windshield glass. In this case, the mirror is simply transferred from the damaged windshield to the bracket on the replacement windshield.

If the replacement windshield does not have a bonded mirror bracket or if the bonded bracket has been lost, a service kit is available for bracket installation. The kit is available from your local parts distribution center and consists of a replacement bracket and a firm-setting, two-component adhesive. Installation instructions are included in the kit, and also in this section.

NOTE: *Do not attempt to remount the original bracket. Use a new bracket kit.*

CJ FOLDING WINDSHIELD

The windshield and frame assembly may be lowered to the hood by removing the knobs at each side of the windshield. When in the lowered position, always secure the windshield by passing the strap at the top of the windshield through the footman loop on the hood and drawing the strap up firmly.

Removal

(1) Remove necessary top components from windshield frame.

(2) Disconnect wiper motor wiring harness from switch.

(3) Remove windshield hinge-to-frame attaching screws using Torx Bit Tool J-25359-C.

(4) Remove windshield holddown knobs and remove windshield frame.

Installation

(1) Position windshield frame on vehicle and install windshield hinge-to-frame attaching screws using Torx Bit Tool J-25359-C.

(2) Install windshield holddown knobs.

(3) Connect wiper motor wiring harness to switch.

(4) Install necessary top components to windshield frame.

CJ WINDSHIELD GLASS

Removal

(1) Cover adjoining painted surfaces to protect finish.

(2) Remove windshield wiper arms using wide blade screwdriver.

(3) Remove inside rear view mirror from bracket.

(4) Remove sun visors and defroster ducts.

(5) Starting at top of windshield frame, pull glass weatherstrip away from flange while gently pushing out on glass.

(6) Work entire weatherstrip from pinch weld flange and remove glass.

Installation

(1) Using 3M Auto Bedding and Glazing Compound or equivalent, apply a 1/16-inch bead of sealer completely around weatherstrip in flange cavity.

(2) Install weatherstrip on glass. Split in weatherstrip should be centered on bottom edge of glass.

(3) Beginnning at bottom of glass, work weatherstrip over flange using fiber or wooden wand.

(4) Apply 3M Windshield Sealer or equivalent, between weatherstrip and outside of glass around entire perimeter.

(5) Clean off excess sealer.

(6) Install inside rear view mirror on bracket.

(7) Install defroster ducts and sun visors.

(8) Install windshield wiper arms.

(9) Test windshield installation for water leaks.

CHEROKEE-WAGONEER-TRUCK WINDSHIELD GLASS

A self-curing urethane adhesive is used to bond the windshield glass to the rubber weatherstrip and the rubber weatherstrip to the body opening. This material provides the strength necessary to meet the FMVSS regulation covering windshield retention.

NOTE: *FMVSS regulations require compliance to the standards throughout the life of the vehicle. Therefore, all windshields must be replaced with Windshield Glass Installation Kit (Urethane), Part Number 8128954, or equivalent, to assure compliance.*

Tools and Materials

The following tools and materials are necessary for a windshield replacement:

(1) Windshield glass installation kit consisting of the following components:

(a) Instruction sheets

(b) One six-ounce cartridge of urethane adhesive

(c) One pointed dispensing nozzle

(d) Five daubers for applying glass and rubber cleaners and primers

(e) Glass blackout primer

(f) Rubber primer

(g) Paint finish primer

(h) Glass cleaner

(i) Rubber cleaner

(2) One six-ounce, hand-operated Adhesive Gun J-24811, or equivalent.

(3) Electric Hot Knife J-24709-01, or equivalent.

(4) Razor-blade type knife.

(5) Masking tape.

(6) Isopropyl alcohol (rubbing alcohol).

(7) Clean wiping rags or paper towels.

(8) Methyl-ethyl-ketone (MEK) or toluene.

(9) Grow Chemical Solvent GS-35, or equivalent.

NOTE: *Methyl-ethyl-ketone (MEK), tuloul (toluene), and Grow Chemical Solvent GS-35 are usually available from chemical houses listed under SOLVENTS in the Yellow Pages of the telephone directory. If not available locally in small quantities, these solvents may be obtained from mail order chemical houses such as E. H. Sargent & Co. and Fisher Scientfic, which have sales-service centers throughout the country. This is neither a complete list, nor a recommendation for the exclusive use of the chemical houses listed.*

Water Leaks

Water leaks around windshields installed with urethane adhesive can be corrected without removing the windshield glass.

NOTE: *If the windshield is structurally sound in the body opening, without large breaks in the bond, water leaks may be corrected by using a liquid butyl sealer such as 3M Windo-Weld Resealant or equivalent. When the windshield is not structurally sound in the body opening, the following procedure will apply and will require one Windshield Glass Installation Kit.*

(1) Remove windshield reveal moulding, if equipped.

(2) Water test around the entire sealing area of windshield.

(a) Always begin water spray at lowest point and allow sufficient saturation before moving water spray upward.

(b) To best simulate normal conditions that cause water leaks, i.e., rain or washing, water test with a spray pattern rather than a heavy, solid stream of water which can create misleading symptoms.

NOTE: *If leak is between windshield glass and rubber weatherstrip, or between rubber weatherstrip and body, carefully push outward on glass in area of leak to determine extent of leak. This operation should be performed while water is being applied to leak area. Mark extent of leak area.*

(3) From outside body, clean dirt or foreign material from leak area with water; then completely dry area with compressed air.

(4) If leak is between glass and rubber weatherstrip, proceed as follows:

(a) Clean glass area to be resealed with windshield cleaner included in windshield installation kit.

(b) Using dauber, apply glass blackout primer to edge of glass, in leak area.

(c) Using a clean dauber, apply rubber primer to rubber weatherstrip, in leak area.

(d) Apply urethane adhesive, using pointed nozzle supplied with kit, in leak area.

(5) If leak is between rubber weatherstrip and body, proceed as follows:

(a) Using dauber as supplied in windshield installation kit, apply rubber primer to rubber weatherstrip, in leak area.

(b) Using clean dauber, apply paint finish primer, in leak area.

(c) Apply urethane adhesive in leak area using pointed nozzle supplied with kit.

(6) Water test windshield immediately using cold water spray. Allow water to spill over edge of glass and rubber weatherstrip. Do not direct hard stream of water on fresh urethane adhesive.

(7) Install all previously removed parts.

Removal

(1) Cover adjoining painted surfaces to protect finish.

(2) Remove windshield wiper arms using wide blade screwdriver.

(3) On vehicles with stainless steel mouldings, perform the following steps.

(a) Remove moulding screws on top and bottom of side mouldings.

(b) Remove top corner moulding by lifting bottom and pulling outboard.

(c) Tip side mouldings toward center of vehicle and lift off.

(d) Remove top moulding.

(4) Slide center moulding clip to left or right and remove bottom mouldings. This will expose the locking type weatherstrip.

(5) Use wedge-shaped fiber or hardwood stick or wand as shown in figure 3N-1 to unlock weatherstrip as shown in figure 3N-2.

(6) Unlock rubber weatherstrip starting at bottom with fiber stick or wand as shown in figure 3N-3.

(7) Remove inside rear view mirror from bracket.

(8) Use razor-blade knife to cut rubber weatherstrip, in locking lip groove, between glass and body flange.

(9) Remove windshield glass from body opening.

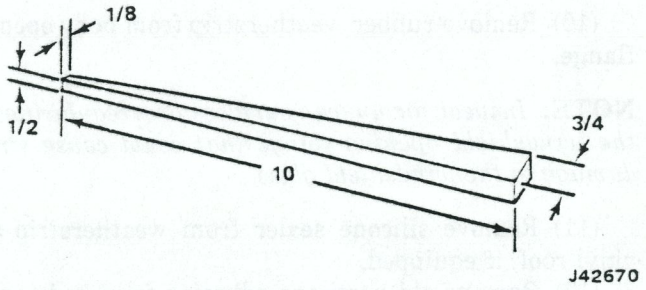

Fig. 3N-1 Wooden Wand Dimensions (Inches)

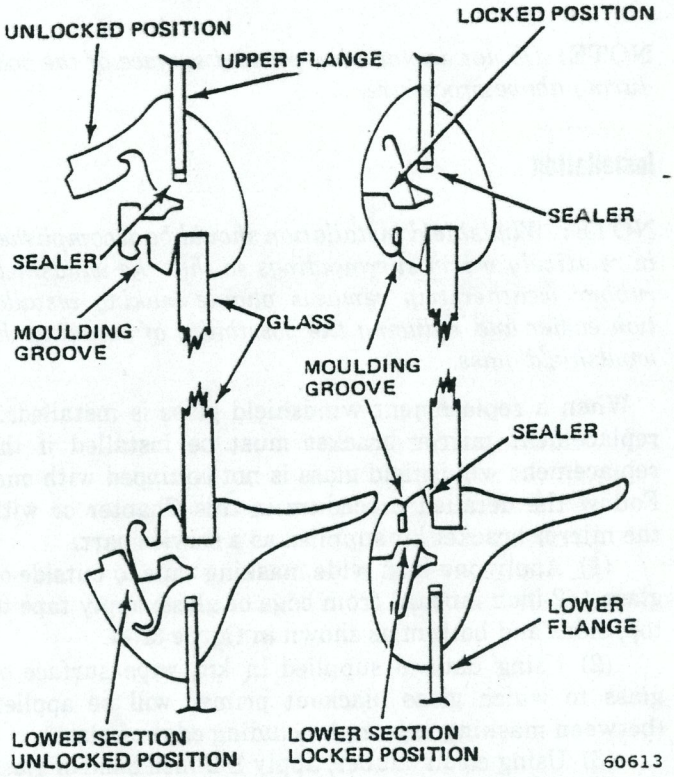

Fig. 3N-2 Windshield Weatherstrip Cross Section—Moulding Removed

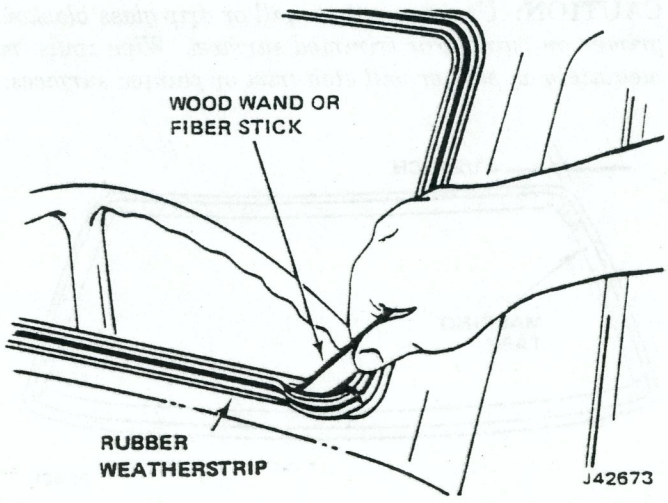

Fig. 3N-3 Unlocking Rubber Weatherstrip

(10) Remove rubber weatherstrip from body opening flange.

NOTE: *Inspect for uneven surfaces or irregularities in the windshield opening flange that could cause stress damage to the windshield glass.*

(11) Remove silicone sealer from weatherstrip and vinyl roof, if equipped.

(12) Remove old urethane adhesive from body opening flange using razor-blade type knife or Electric Hot Knife J-24709-01 equipped with the Plow-Type Blade J-24851.

NOTE: *Do not damage the painted surface of the body during above procedure.*

Installation

NOTE: *Windshield installation should be accomplished in relatively warm surroundings so that the windshield rubber weatherstrip remains pliable making installation easier and reducing the possibility of breaking the windshield glass.*

When a replacement windshield glass is installed, a replacement mirror bracket must be installed if the replacement windshield glass is not equipped with one. Follow the detailed procedure in this Chapter or with the mirror bracket kit supplied as a service part.

(1) Apply one-inch wide masking tape to outside of glass 1/2-inch inboard from edge of glass; apply tape to top, sides and bottom as shown in figure 3N-4.

(2) Using dauber supplied in kit, wipe surface of glass to which glass blackout primer will be applied (between masking tape and including edge of glass).

(3) Using clean dauber, apply 1/2-inch band of glass blackout primer around entire outside of glass and outer edge. Allow primer to dry for 10 minutes.

CAUTION: *Use care not to spill or drip glass blackout primer on painted or trimmed surfaces. Wipe spills immediately as primer will etch trim or painted surfaces.*

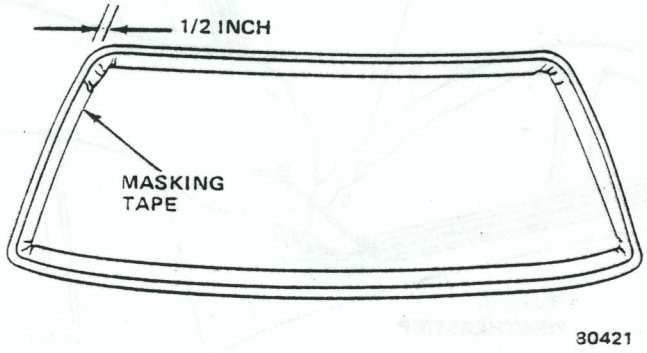

Fig. 3N-4 Installation of Windshield Glass Masking Tape

(4) Obtain replacement rubber weatherstrip. Using clean dauber, wipe glass cavity and body flange cavity clean.

(5) Using another dauber, apply rubber primer around inside of glass cavity and body flange cavity. Allow primer to dry for 30 minutes.

(6) Using isopropyl alcohol dampened rag, wipe body opening flange clean and allow to dry.

(7) Apply 2-inch wide masking tape on outside of windshield opening at roof, A-pillars and cowl top to prevent damaging body paint.

(8) Using clean dauber or brush, apply paint finish primer to body opening flange as shown in figure 3N-5. Allow primer to dry for 25 minutes.

NOTE: Do not use glass blackout primer on body opening flange.

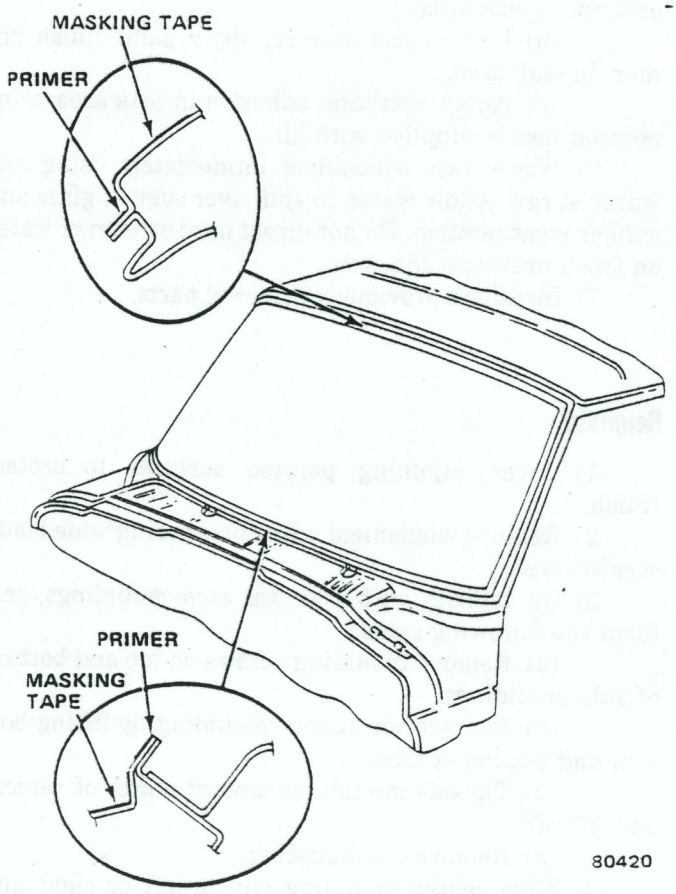

Fig.3N-5 Installing Body Opening Masking Tape and Primer

(9) Apply smooth, continuous bead of urethane adhesive material inside of rubber weatherstrip body flange cavity. Bead should be 1/8-inch in diameter.

(10) Install rubber weatherstrip on windshield opening flange.

(11) Apply liberal amount of soap and water solution to edge of windshield glass.

(12) Place 1/8-inch diameter cord in bottom glass cavity of rubber weatherstrip.

(13) Remove masking tape from windshield glass.

(14) With two men working on outside of vehicle, work windshield into upper glass cavity and into each side.

(15) Position wooden wand (fig. 3N-1) under bottom of glass and lift windshield up and into lower glass cavity.

(16) Check for equal side clearances.

(17) Wipe soap and water solution from windshield glass and rubber weatherstrip.

(18) Apply smooth, continuous bead of urethane adhesive material around entire outside edge of windshield glass and rubber weatherstrip. Bead should be 1/8-inch in diameter.

(19) Use wooden wand to lock weatherstrip as shown in locked position (fig. 3N-2).

NOTE: *Urethane adhesive material begins to cure after 15-minute exposure to air and moisture.*

(20) Remove masking tape from body and apply 3M Super Silicone Sealer, or equivalent, along weatherstrip and vinyl roof, if equipped.

(21) Water test windshield immediately using cold water spray. Do not direct hard stream of water on fresh urethane adhesive material. If leaks are encountered, apply extra urethane adhesive material with pointed nozzle.

(22) Bottom mouldings are installed one at a time. To facilitate installation, place 1/8-inch diameter cord in weatherstrip moulding retaining groove along entire length of weatherstrip, leaving enough cord hanging out at each end to permit good grip on cord.

(23) Working first with either left or right bottom moulding, place moulding in groove.

(24) Starting at outside corner of weatherstrip, pull up on cord while lightly tapping top of moulding with rubber mallet. This will lock moulding in weatherstrip retaining groove. Continue process until moulding is installed in weatherstrip. Repeat process with other bottom moulding, again starting at outside corner.

(25) Install center moulding clip to cover gap between left and right bottom moulding.

(26) The one-piece top moulding is installed in same manner, except that moulding is tapped upward into retaining groove.

(27) Side and upper corner mouldings can then be inserted in retaining groove and secured by installing upper and lower screws.

(28) Clean excess urethane adhesive material from windshield, body and mouldings with cloth dampened with Grow Chemical Solvent GS-35, or equivalent.

(29) Install side moulding screws.

(30) Install windshield wiper arms.

(31) Install inside rear view mirror on bracket.

REAR VIEW MIRROR BRACKET

Installation

(1) Locating windshield mounted rear view mirror bracket can be accomplished as shown in figures 3N-6 and 3N-7. Use wax pencil on outside of glass to locate mounting bracket.

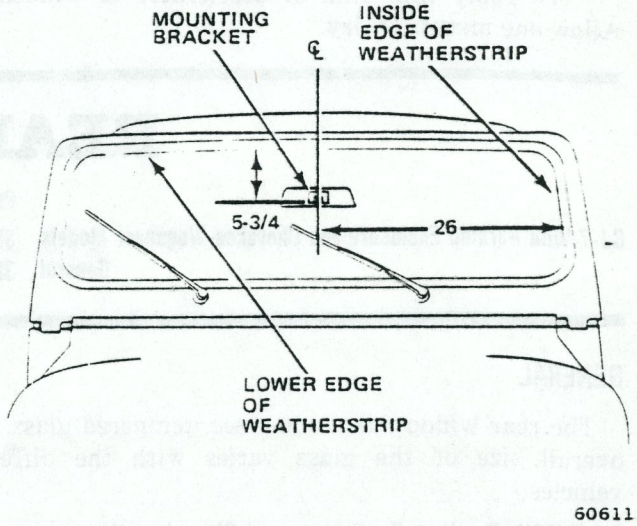

Fig. 3N-6 Windshield Mounted Rear View Mirror Bracket Location (Inches)—CJ Models

(2) If vinyl pad has remained on windshield glass, apply low heat with an Electric Heat Gun J-25070 until vinyl softens. Then, peel pad from glass using care not to scratch or mar glass surface.

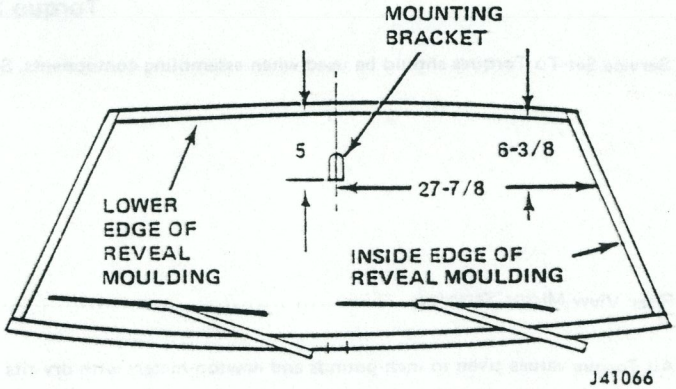

Fig. 3N-7 Windshield Mounted Rear View Mirror Bracket Location (Inches)—Cherokee-Wagoneer-Truck Models

(3) Clean bracket mounting area of windshield glass thoroughly. Use mildly abrasive cleaning powder (Ajax, Comet, or equivalent) applied to clean cloth saturated with alcohol.

(4) Remove all traces of cleanser by wiping area with paper towel moistened with alcohol.

(5) Scuff bonding surface (the side without the 3/8-inch circular depression) of mirror bracket with clean piece of fine grit sandpaper. Apply alcohol to clean towel and wipe surface clean.

(6) Apply generous amount of accelerator (supplied with kit) to mirror bracket mounting surface. Allow five minutes to dry.

(7) Apply thin film of accelerator to windshield. Allow one minute to dry.

CAUTION: *Do not touch surfaces to which accelerator has been applied or an imperfect bond could result.*

(8) Apply one drop of adhesive at center of mirror bracket bonding surface. Use bottom of adhesive tube to distribute adhesive evenly over entire surface.

(9) Position bottom straightedge of bracket on horizontal line (fig. 3N-6 and 3N-7). Press bracket to glass and hold firmly for one minute. Be sure bracket is properly located as adhesive sets quickly.

REAR WINDOW

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Truck Models	3N-6

GENERAL

The rear window is a one-piece, tempered glass. The overall size of the glass varies with the different vehicles.

CJ-7 With Hardtop Enclosure and Cherokee-Wagoneer Models

For service replacement and adjustment of tailgate window glass, refer to Chapter 3H—Liftgates-Tailgates.

Truck Models

For service replacement of solid rear glass, refer to CJ Glass Removal or Installation.

The sliding rear window on J-10 and J-20 cabs which provides cab ventilation and ease of communication between passengers in the truck cab and camper body, is replaced as an assembly.

SPECIFICATIONS

Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft-lbs)		Metric (N·m)	
	Service Set-To Torque	In-Use Recheck Torque	Service Set-To Torque	In-Use Recheck Torque
Rear View Mirror Setscrew	15	12-20	2	1-2

All Torque values given in inch-pounds and newton-meters with dry fits unless otherwise specified.

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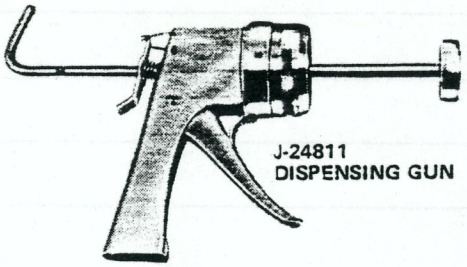
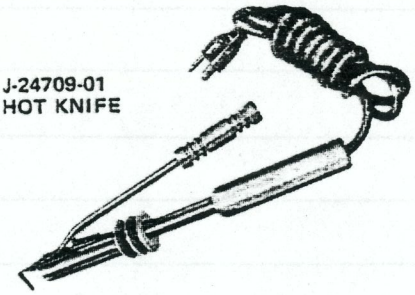
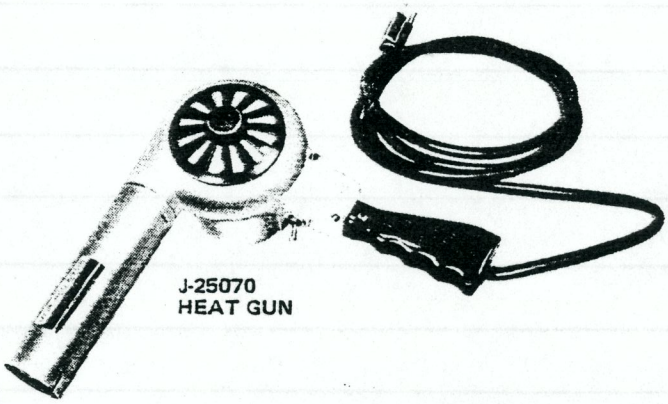
Tools



J-24811
DISPENSING GUN

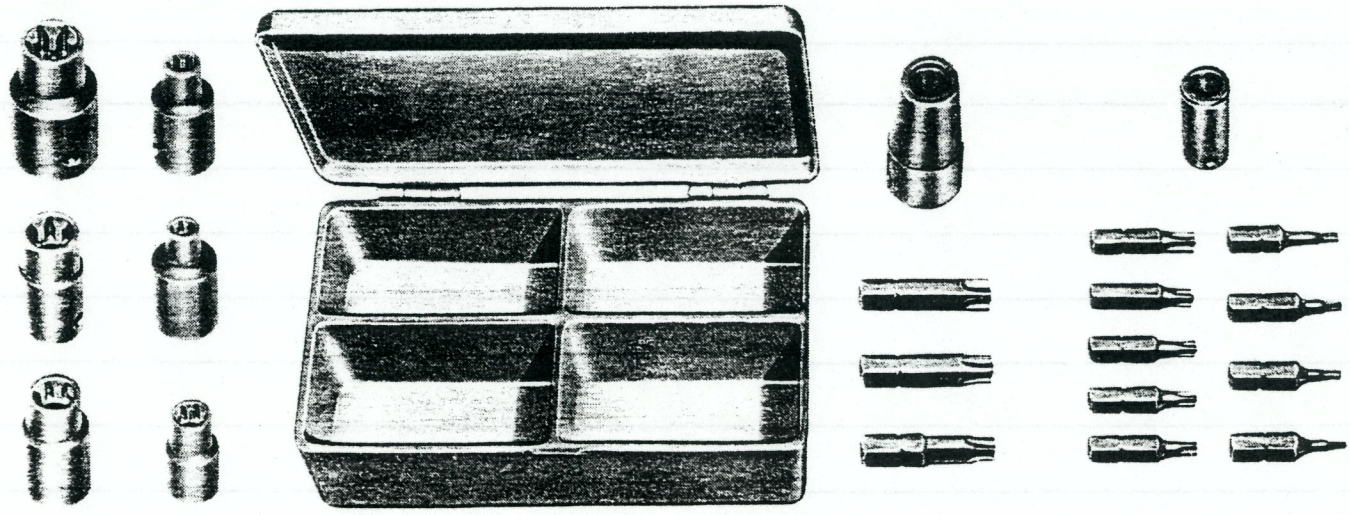


J-24709-01
HOT KNIFE



J-25070
HEAT GUN

J-24851
PLOW-TYPE
BLADE



J-25359-C
TORX BIT AND SOCKET SET

NOTES

HEADLINING-EXTERIOR DECALS AND OVERLAYS 3P

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Exterior Woodgrain Overlays	3P-5
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HEADLINING

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General	3P-1
Truck Models	3P-2

GENERAL

The headlining used in Cherokee, Wagoneer and Truck models is made of laminated polystyrene backing board which is finished, depending on the model, with either a plastic coating, a soft vinyl covering or a close knit fabric. Lines scored into the backing board allow the headlining to be shaped to fit the contour of the roof while providing added strength for self-support.

NOTE: *Information regarding the headliner used with the Wagoneer Limited power sun roof can be found in Chapter 3L.*

CHEROKEE-WAGONEER MODELS

Removal

(1) Remove sun visors, escutcheons and center support.

(2) Remove windshield moulding and end caps.

(3) Remove rear opening moulding and end caps.

(4) Remove plastic trim center moulding and end cap retainers.

(5) Remove lens from dome lamp and cargo lamp. Remove screws attaching lamp to roof bows. Remove and disconnect cargo lamp switch.

(6) Remove coat hooks.

(7) If equipped with inside spare tire, proceed as follows:

(a) Remove inside spare tire.

(b) Remove upper bracket shoulder screw, using Torx Bit Tool J-25359-C.

(8) Free rear headlining from J-moulding by pulling down carefully at center, while pushing up on either outside edge.

(9) Push cargo lamp through die-cut opening in headlining.

(10) Remove rear headlining through tailgate opening.

(11) Free front headlining from J-moulding by pulling down carefully at center, while pushing up on outside edges.

(12) Remove front headlining through tailgate opening.

Installation

(1) Position front headlining in vehicle and insert left side into J-moulding.

(2) Pull dome lamp through die-cut opening in headlining and align front headlining to vehicle roof.

(3) Pull down carefully at center of front headlining and insert right side of headlining into J-moulding.

(4) Position rear headlining in vehicle and insert left front headlining using sun visor and dome lamp holes and leading edge of headlining as guide. Adjust fore or aft as required.

(5) Check alignment of rear headlining using trailing edge as guide. Adjust fore or aft as required.

(6) Secure dome lamp and cargo lamp to roof bows and install lamp lenses. Connect and install cargo lamp switch.

(7) Install plastic center mouldings and end cap retainers.

(8) If equipped with inside spare tire, proceed as follows:

(a) Position upper bracket on headlining and install shoulder screw, using Torx Bit Tool J-25359-C.

(b) Install spare tire.

(9) Install sun visors, escutcheons and center support.

(10) Install windshield moulding and end caps.

(11) Install rear opening moulding and end caps.

Roof Bow Adjustment

Noise from the headlining may be caused by improperly adjusted roof bows.

(1) Remove headlining.

(2) Loosen roof bow attaching screws, using Torx Bit J-25359-C.

(3) Insert screwdriver through hole in roof bow and raise roof bow against roof panel.

(4) Tighten roof bow attaching screws using Torx Bit J-25359-C.

(5) Install headliner.

TRUCK MODELS

Removal

(1) Remove sun visors and center support.

(2) Remove lens from dome lamp. Remove screws attaching dome lamp to rear window panel.

(3) Remove windshield moulding and end caps.

(4) Pull down carefully at center of headlining while pushing up on outside edges to disengage headlining from J-moulding.

(5) Push dome lamp through die-cut opening in headlining.

(6) Remove headlining from vehicle.

Installation

(1) Position headlining in vehicle and insert left side into J-mouldings.

(2) Pull dome lamp through die-cut opening and align headlining to vehicle roof.

(3) Pull down carefully at center of headlining while pushing up on right edge, and insert right side of headlining into J-moulding.

(4) Check alignment of headlining using sun visor and dome lamp holes and headlining leading edge as guides. Adjust fore and aft as necessary.

(5) Secure dome lamp to rear window panel and install dome lamp lens.

(6) Install windshield moulding and end cap.

(7) Install sun visors and center support.

EXTERIOR DECALS

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GENERAL

Exterior decals and stripes are made of tough, durable, weather-resistant solid vinyl and have a pressure-sensitive back. The pressure-sensitive back is protected by a paper backing which is removed at installation. The front (or face) of stripes and decals may be covered with an easy-release paper for protection at installation and during shipment or storage. The paper should be removed after installation.

REPAIRS

Small nicks or scratches can be touched up with paint in much the same manner as painted surfaces. Proper color match can be obtained by mixing small amounts of appropriate paint colors, then applying it to the affected area of the decal.

To repair blisters or air bubbles, pierce them with a sharp needle or pin. Work the trapped air out through the pin hole and press the decal firmly against the panel. It may be necessary to preheat the panel slightly, with Heat Gun J-25070, to soften the adhesive. Heat also may be used to remove small wrinkles or irregularities.

REPLACEMENT

Preparation

The temperature of the workroom should be between 65°F and 90°F. Decals should not be replaced in temperatures below 65°F.

The following equipment and materials are necessary for a quality installation:

- Woodgrain and Stripe Remover (3M, or equivalent)
- Adhesive Remover (3M, or equivalent)
- Liquid detergent (Joy, Vel, or equivalent)
- Wax and silicone remover (3M General Purpose Adhesive Cleaner, xylol, or equivalent)
- Isopropyl alcohol (rubbing alcohol)
- Squeegee (4 to 5 inches wide, plastic or hard rubber)
- Water bucket and sponge
- Sandpaper (No. 220, 360 or 400 wet or dry type)
- Heat Gun J-25070 or infrared heat bulb with extension cord
- Clean wiping rags or paper towels
- Sharp knife, single-edge razor blade or X-acto knife
- Scissors
- Sharp needle or pin
- Grease pencil

Removal

(1) Clean repair surfaces, adjacent panels and openings as required.

(2) Remove decal overlapping parts from affected panel.

(3) Mask off area surrounding panel.

(4) Scuff sand decal with 220 grade wet or dry sandpaper. Avoid cutting through and reclean decal.

(5) Spray 3M Woodgrain and Stripe Remover, or equivalent, on flange area first. Then spray entire decal to be removed (fig. 3P-1). Move spray back and forth across entire decal in a smooth steady motion. Make sure entire decal is coated with remover.

CAUTION: *Woodgrain and Stripe Remover from 3M is designed for use on acrylic enamel surfaces only.*

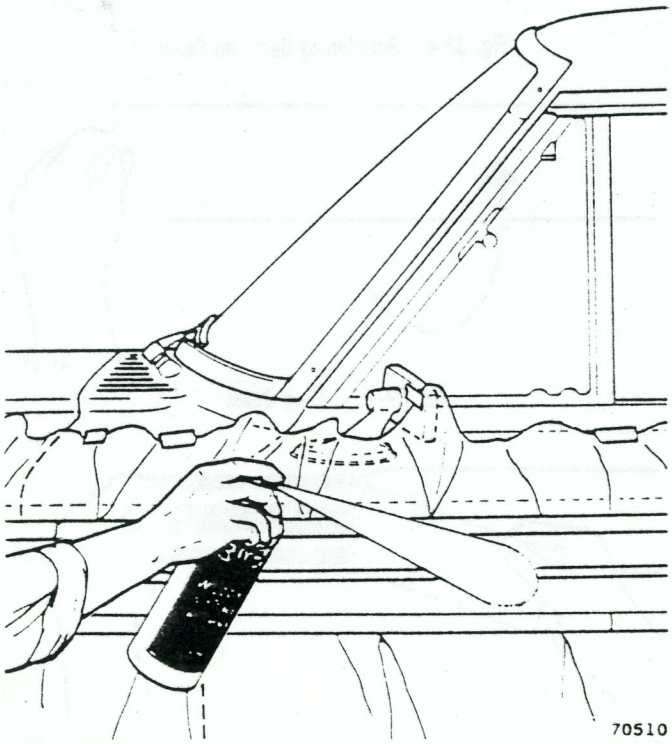

Fig. 3P-1 Spraying Remover on Decal

WARNING: *Use 3M Woodgrain and Stripe Remover, or equivalent, only in a well-ventilated area. Observe manufacturer's warnings printed on label.*

(6) Spray entire panel again, this time moving the spray up and down the decal.

(7) Allow remover to stay on decal for 20 minutes.

(8) After 20 minutes, peel decal away from flange areas. Then, start in one corner and peel decal away from panel (fig. 3P-2). If there is any difficulty in peeling decal/overlay away from panel, use squeegee to assist in removal (fig. 3P-3).

(9) Scrape all 3M Woodgrain and Stripe Remover from surface before proceeding.

(10) After decal is removed, spray panel again with 3M Adhesive Remover, or equivalent, to remove any

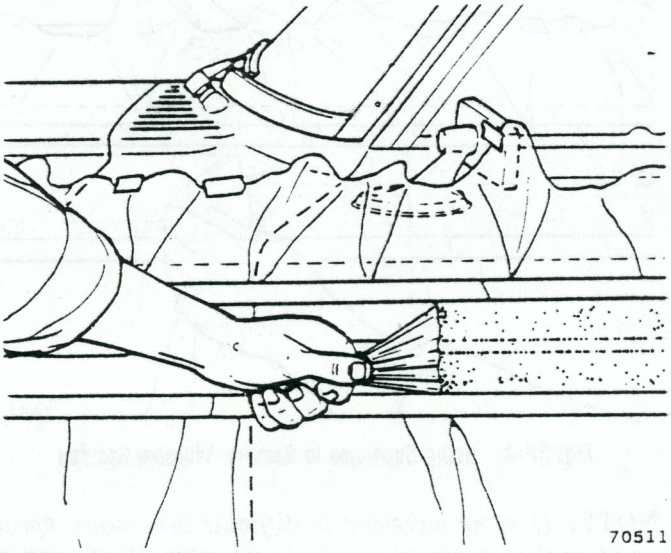

Fig. 3P-2 Peeling Decal from Panel

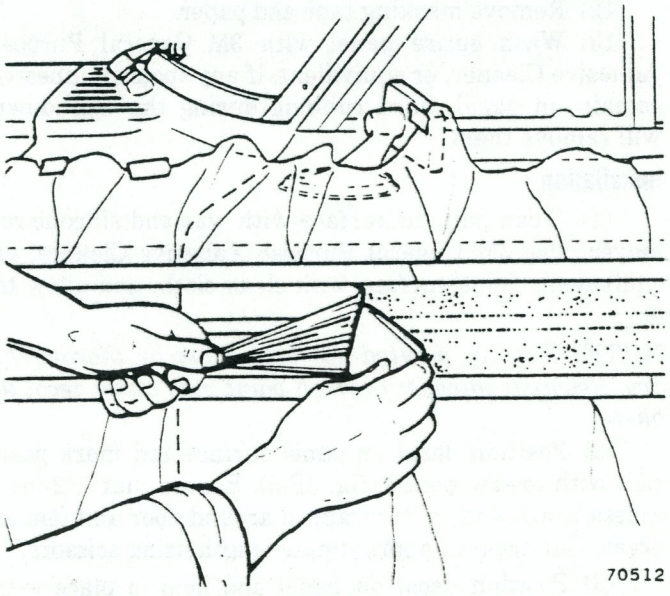

Fig. 3P-3 Using Squeegee to Assist in Removal of Decal

remaining adhesive. Use slow spray application and apply in uniform criss-cross pattern to obtain heavy coat.

WARNING: *Use 3M Adhesive Remover, or equivalent, only in well-ventilated area. Observe manufacturer's warnings printed on label.*

CAUTION: *Leaving Remover on surface for too short or long a period may render product ineffective. Allow Remover to work on adhesive surface for three to five minutes.*

(11) After five minutes, use squeegee to remove adhesive residue (fig. 3P-4).

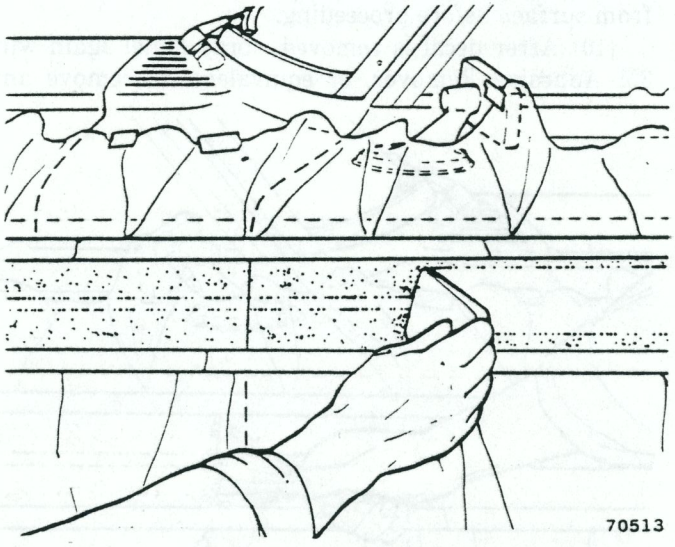

Fig. 3P-4 Using Squeegee to Remove Adhesive Residue

NOTE: *If some adhesive is difficult to remove, spray additional remover on troublesome spots. Wait approximately two minutes and squeegee remaining spots. Repeat as necessary.*

(12) Remove masking tape and paper.

(13) Wash entire panel with 3M General Purpose Adhesive Cleaner, or equivalent. If any spots of adhesive remain on panel, hard rubbing during the washdown will remove them.

Installation

(1) Clean painted surface with wax and silicone remover. Use 3M General Purpose Adhesive Cleaner, or equivalent. Wipe surface with clean cloth, and allow to dry.

NOTE: *Freshly painted surfaces must be thoroughly dry. Residual solvents in fresh paint may cause decal to blister.*

(2) Position decal on panel surface and mark position with grease pencil (fig. 3P-5). Ensure that 1/2-inch excess is allowed to be wrapped around door and fender areas. Cut decal to approximate length using scissors.

(3) Position decal on panel and hold in place with small strips of masking tape (fig. 3P-6). Be sure decal is aligned with decals on adjacent panels.

(4) Lift decal using masking tape as hinges (fig. 3P-7).

(5) Remove approximately 6 inches of paper backing from one end (fig. 3P-8).

NOTE: *To avoid pre-adhesion or stretching the decal, do not remove more than 6 inches of paper backing at one time.*

(6) Fold decal back to aligned position. With firm strokes, squeegee decal to panel while removing paper backing (fig. 3P-9).

(7) Where possible, extend decal 1/2 inch beyond corners or edges (fig. 3P-10) and wrap firmly using finger pressure and squeegee. Avoid trapping air in these areas.

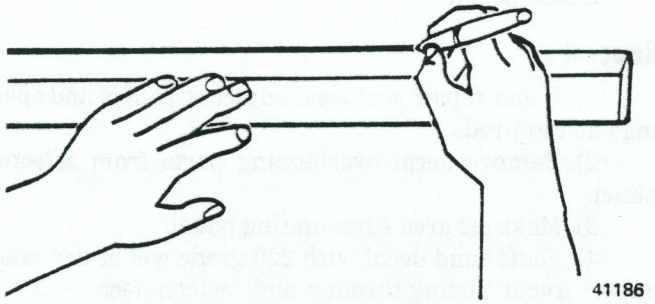

Fig. 3P-5 Marking Decal Position

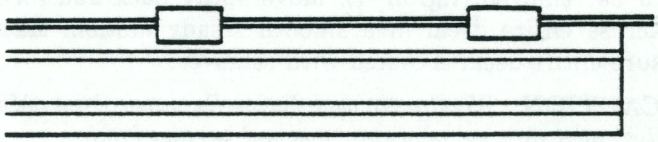

Fig. 3P-6 Positioning Decal on Panel

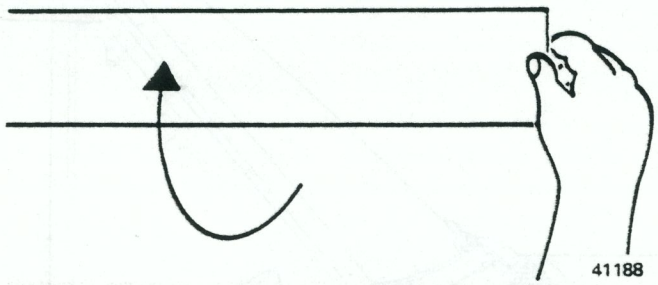

Fig. 3P-7 Lifting Decal

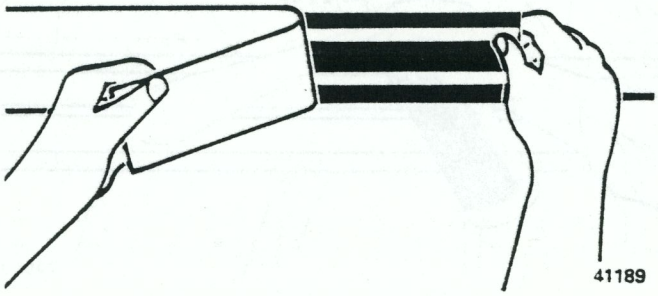

Fig. 3P-8 Removing Backing Paper

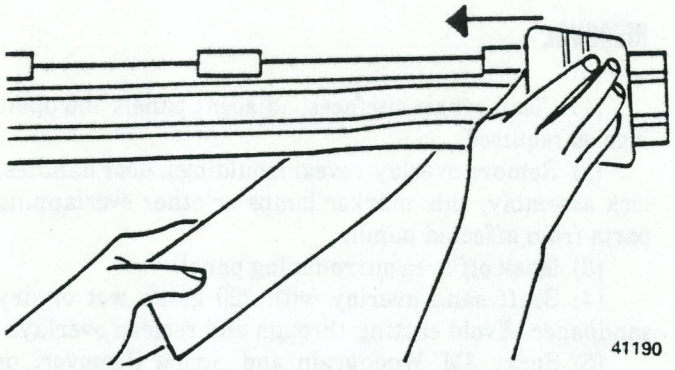

Fig. 3P-9 Installing Decal with Squeegee

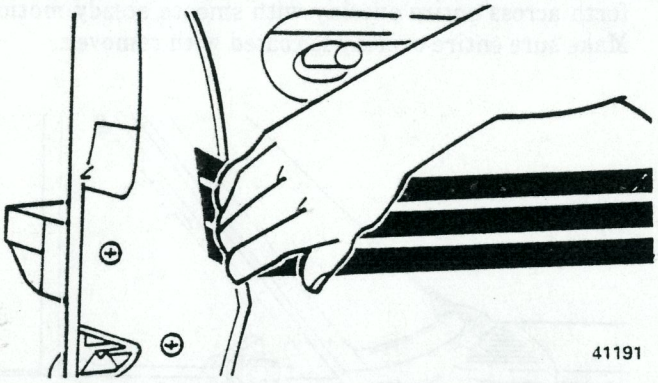

Fig. 3P-10 Installing Decal at Corners or Edges

(8) Remove easy-release paper from face of decal, if applicable.

(9) Inspect decal installation using reflected light to detect any irregularities that may have developed during installation. Remove all air or moisture bubbles.

(10) Install previously removed parts and clean up vehicle as required.

Installation of Intricate Decals

For large, intricately shaped decals, the following procedure will simplify installation.

(1) The use of wetting solution assures better bond between decal and painted surface. Prepare supply of wetting solution by thoroughly mixing two or three teaspoons of detergent (Joy, Vel, or equivalent) in one gallon of water.

NOTE: *Too much detergent reduces the effectiveness of the bond. DO NOT USE SOAP.*

(2) Place the decal on clean, flat surface with paper backing side up. Bend corner of decal toward the decorative face side, and with flick of finger, separate paper backing from decal. Hold decal firmly to surface of table and remove paper backing. Under hot, humid conditions, slight jerking motion aids in removing paper backing.

CAUTION: *Always remove the paper backing from the decal; never remove the decal from the backing as stretching may result.*

NOTE: *Hold decal in corners when removing paper backing as fingerprints adversely affect the adhesion.*

(3) Using clean sponge, apply ample wetting solution to decal adhesive and panel surface. The wetting solution permits ease of movement of decal while positioning it on panel surface.

(4) Immediately apply wetted decal to panel surface. Apply wetting solution to decorative face of decal to allow the squeegee to slip during application.

(5) Squeegee short section of decal at center. Lift right or left side of decal, position it straight and close to panel, and squeegee toward lifted edge. Avoid stretching decal at lifted end. Squeegee outward from center with firm, overlapping strokes.

(a) Lift upper area of decal (up to bonded area) and, working upward from bonded section at center, squeegee decal into place.

(b) Lift lower area of decal (up to bonded area) and, working downward from bonded section at center, squeegee decal into place.

NOTE: *If a wrinkle is trapped during squeegee operations, stop immediately. Carefully lift affected section. Align the section to the panel and remove wrinkle.*

EXTERIOR WOODGRAIN OVERLAYS

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Installation	3P-7	Repairs	3P-6
Preparation	3P-6	Vinyl Moulding Replacement—Wagoneer-Cherokee and Truck	3P-8

GENERAL

Exterior woodgrain overlay panels are made of a tough, durable, weather-resistant, opaque cast vinyl and have a pressure-sensitive back. The pressure-sensitive back is protected by a paper backing which is removed at installation. The woodgrain is embedded in the cast vinyl for a longer lasting, attractive appearance.

REPAIRS

Small nicks, bruises or scratches can be touched up with paint in much the same manner as painted surfaces. Proper color match can be obtained by blending small amounts of appropriate paint colors, then spot-painting the affected area of the overlay.

To repair blisters or air bubbles, pierce them with a sharp needle or pin. Work the trapped air out through the pin hole and press the overlay firmly against the panel. It may be necessary to preheat the panel slightly with Heat Gun J-25070 to soften the adhesive. Heat also may be applied to remove small wrinkles, irregularities, or bridging which may occur in the corners of the fuel tank filler opening.

NOTE: *Whenever the material must be stretched, do not slit or cut the overlay. Simply apply heat and press or squeegee the overlay smoothly and firmly into place.*

PREPARATION

Workroom temperature should be between 65°F and 90°F. Overlays should not be replaced in temperatures below 65°F.

The following equipment and materials are necessary for a quality overlay installation.

- Woodgrain and Stripe Remover (3M, or equivalent)
- Adhesive Remover (3M, or equivalent)
- Liquid detergent (Joy, Vel, or equivalent)
- Wax and silicone remover (3M General Purpose Adhesive Cleaner, or equivalent)
- Isopropyl alcohol (rubbing alcohol)
- Squeegee (4 to 5 inches wide, plastic or hard rubber)
- Water bucket and sponge
- Sandpaper (No. 220, 360 or No. 400, wet-or-dry type)
- Heat Gun J-25070 or infrared heat bulb and extension cord
- Clean wiping rags or paper towels
- Sharp knife or single-edge razor blade
- Scissors
- Sharp needle or pin
- Grease pencil

Prepare a supply of wetting solution by thoroughly mixing two or three teaspoons of detergent (Joy, Vel, or equivalent) in one gallon of water. The use of a wetting solution assures a better bond between overlay and painted surface. Too much detergent reduces the effectiveness of the bond. DO NOT USE SOAP.

Overlay replacement involving collision damage, or damage to underlying paint finish, requires that metal repair and refinish operations be completed before overlay is installed.

REMOVAL

(1) Clean repair surfaces, adjacent panels and openings as required.

(2) Remove overlay reveal mouldings, door handles, lock assembly, side marker lamps or other overlapping parts from affected panel.

(3) Mask off area surrounding panel.

(4) Scuff sand overlay with 220 grade wet or dry sandpaper. Avoid cutting through and reclean overlay.

(5) Spray 3M Woodgrain and Stripe Remover, or equivalent, on flange area first. Then spray entire overlay to be removed (fig. 3P-11). Move spray can back and forth across entire overlay with smooth steady motion. Make sure entire overlay is coated with remover.

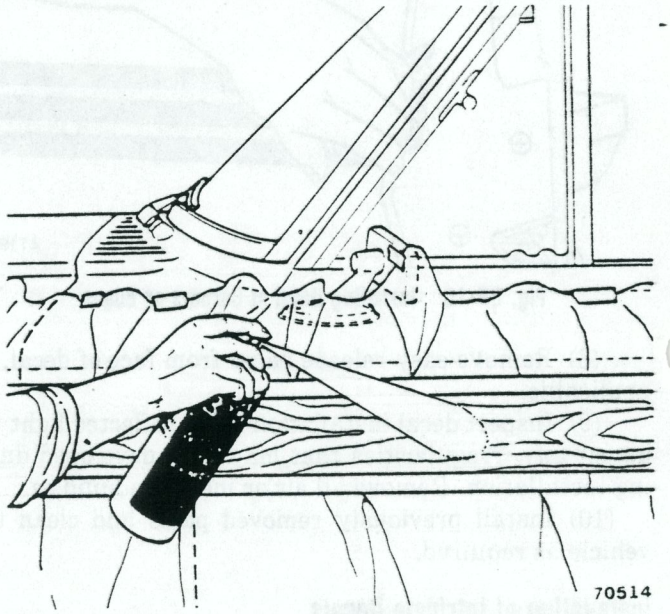


Fig. 3P-11 Spraying Remover on Overlay

CAUTION: *Woodgrain and Stripe Remover from 3M is designed for use on acrylic enamel surfaces only.*

WARNING: *Use 3M Woodgrain and Stripe Remover, or equivalent, only in a well-ventilated area. Observe manufacturer's warnings printed on label.*

(6) Spray entire panel again, this time moving spray up and down overlay.

(7) Allow remover to stay on overlay for 20 minutes.

(8) After 20 minutes, peel overlay away from flange areas. Then, start in one corner and peel overlay away from panel (fig. 3P-12). If there is any difficulty in peeling overlay away from panel, use squeegee to assist in removing it (fig. 3P-13).

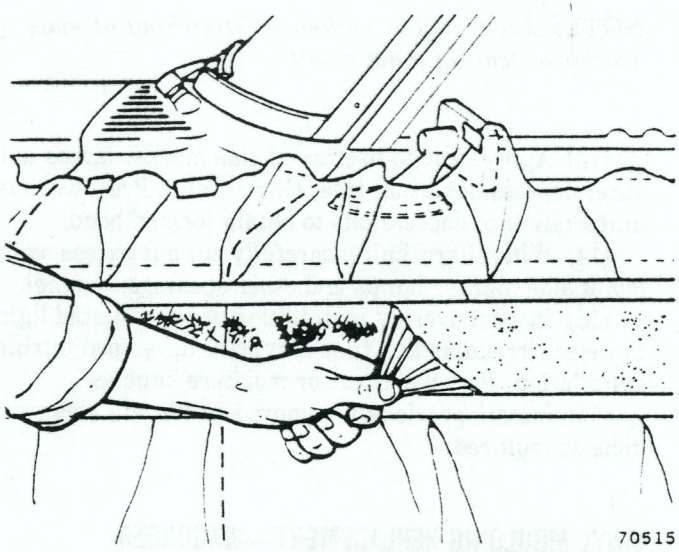


Fig. 3P-12 Peeling Overlay from Panel

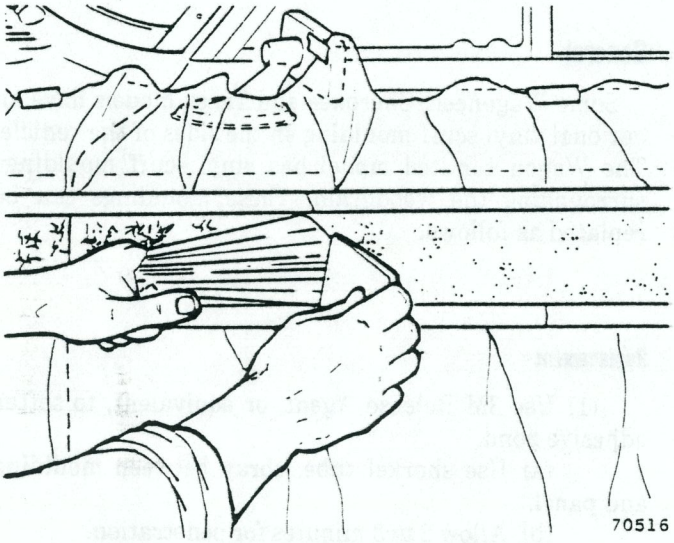


Fig. 3P-13 Using Squeegee to Assist in Removal of Overlay

(9) Scrape all Woodgrain and Stripe Remover from surface before proceeding.

(10) After overlay is removed, spray panel again with 3M Adhesive Remover, or equivalent, to remove any remaining adhesive. Use slow spray application and apply remover in uniform criss-cross pattern to obtain heavy coat.

WARNING: *Use 3M Adhesive Remover, or equivalent, only in well-ventilated area. Observe manufacturer's warnings printed on label.*

CAUTION: *Leaving remover on surface for too short or long period may render product ineffective. Allow remover to work on adhesive surface for three to five minutes.*

(11) After five minutes, use squeegee to remove adhesive residue (fig. 3P-14).

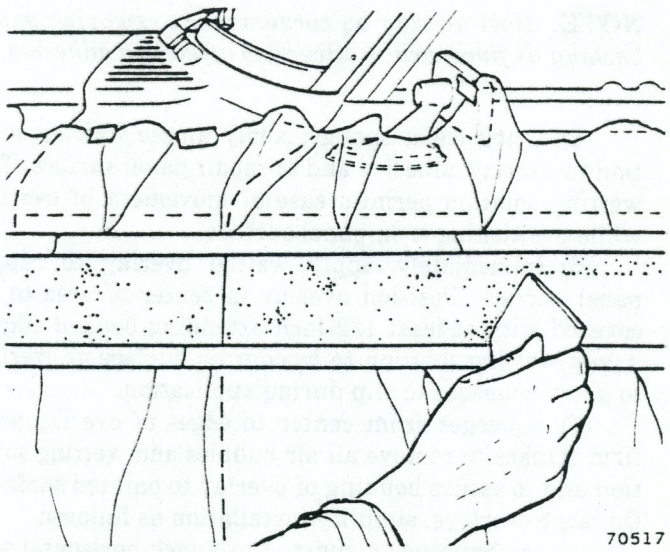


Fig. 3P-14 Using Squeegee to Remove Adhesive Residue

NOTE: *If some adhesive is difficult to remove, spray additional remover on troublesome spots. Wait approximately two minutes and squeegee remaining spots. Repeat as necessary.*

(12) Remove masking tape and paper.

(13) Wash entire panel with 3M General Purpose Adhesive Cleaner, or equivalent. If any spots of adhesive remain on panel, hard rubbing during the washdown will remove them.

INSTALLATION

(1) Scuff-sand painted surface with 360 or 400 sandpaper by dry sanding. Freshly painted surfaces must be thoroughly dry. Residual solvents in fresh paint may cause overlay to blister.

(2) Clean painted surfaces with wax and silicone remover (3M General Purpose Adhesive Cleaner, or equivalent). Wipe surface with clean cloth and allow to dry.

(3) Position overlay on repair panel surface, and mark approximate outline on overlay with grease pencil. Ensure that 1/2-inch excess is allowed to be wrapped around the door and fender areas. With scissors, cut overlay to approximate size. Overlay should be cut so that upper and lower edges extend halfway into area covered by mouldings.

(4) Place overlay on clean, flat surface with protective paper backing side up. Bend corner of overlay toward decorative face side, and with flick of finger, separate paper backing from overlay. Hold overlay firmly to surface of table and remove paper backing. Under hot, humid conditions, slight jerking motion aids in removing paper backing.

CAUTION: *Always remove the paper backing from the overlay; never remove the overlay from the backing as film stretching may result.*

NOTE: *Hold overlay by corners when removing paper backing as fingerprints adversely affect the adhesion.*

(5) Using clean sponge, apply ample wetting solution to overlay adhesive and to repair panel surface. The wetting solution permits ease of movement of overlay while positioning it on panel surface.

(6) Immediately apply wetted overlay to repair panel surface. Position overlay in center of area to be covered with at least 1/2 inch extending beyond edges. Apply wetting solution to woodgrain surface of overlay to allow squeegee to slip during application.

(7) Squeegee from center to edges of overlay with firm strokes to remove all air bubbles and wetting solution and to assure bonding of overlay to painted surface. On large overlays, simplify installation as follows:

(a) Squeegee a short, 4 to 6-inch horizontal section of overlay at center of panel. Lift right or left side of overlay, position it straight and close to panel, and squeegee toward lifting edge. Avoid stretching overlay at lifted end; squeegee progressively from middle with firm, overlapping strokes.

(b) Lift upper area of overlay (up to bonded area) and, working upward from bonded section at center, squeegee overlay into place.

(c) Lift lower area of overlay (up to bonded area) and, working downward from bonded section at center, squeegee overlay into place.

NOTE: *If a wrinkle is trapped during squeegee operations, stop immediately. Carefully lift affected section. Realign section to panel and progressively remove wrinkle. Do not lift overlay if only a few bubbles are trapped.*

(8) Notch corner or curved edges of overlay where necessary and trim off excess material.

(9) Allow 1/2-inch extra material beyond edges that are to be wrapped around flange areas.

CAUTION: *Use extreme care to avoid spilling isopropyl alcohol (rubbing alcohol) on trim or painted surfaces. Wipe spills immediately as alcohol will discolor trim or painted surfaces on prolonged contact.*

(10) To activate adhesive, wipe adhesive side of overlay with isopropyl alcohol.

(11) Warm overlay at edges by passing heat source, such as Heat Gun J-25070, over surface to soften it.

(12) Firmly press overlay into position with fingertips, a cloth, and finally a squeegee, alternately warming and pressing it until complete adhesion is obtained.

NOTE: *Avoid undue pulling or stretching at ends of overlay as tearing could result.*

(13) Apply heat to overlay at side marker lamps and other depressions using Heat Gun J-25070. Press overlay uniformly into depressions to obtain formed bond.

(14) With sharp knife, carefully cut out excess overlay at side marker lamps and other openings in panel.

(15) Inspect overlay installation using reflected light to detect irregularities that may have developed during installation. Remove all air or moisture bubbles.

(16) Install previously removed parts and clean vehicle as required.

VINYL MOULDING REPLACEMENT—WAGONEER-CHEROKEE AND TRUCK

General

Some Wagoneer, Cherokee and Truck models have an optional vinyl scuff moulding on the sides of the vehicle. The Wagon Limited model has vinyl scuff mouldings surrounding the woodgrain. These mouldings can be replaced as follows.

Replacement

(1) Use 3M Release Agent, or equivalent, to soften adhesive bond.

(a) Use shorkel tube, spray between moulding and panel.

(b) Allow 2 to 3 minutes for penetration.

(c) Spray second application and wait 3 minutes for adhesive bond to soften.

(2) Peel moulding from panel.

(3) Clean any adhesive residue from surface with cloth dampened with 3M General Purpose Adhesive Cleaner, or equivalent.

(4) To insure proper moulding alignment, stretch piece of string at desired level along panel and secure ends with tape.

(5) Position moulding on vehicle with backing tape attached, and cut to fit.

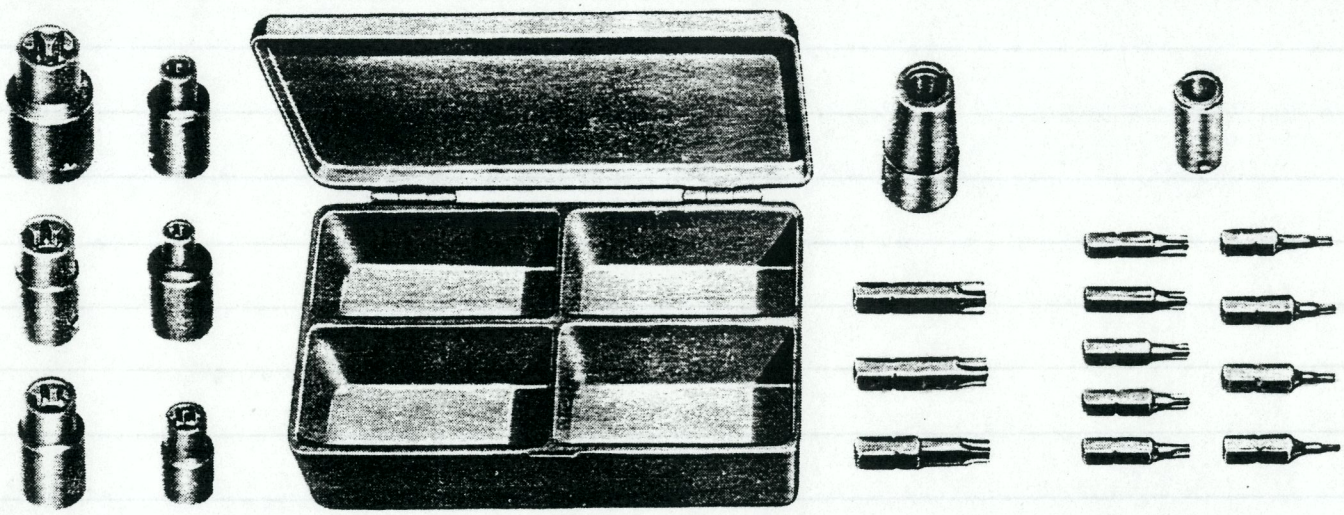
(6) Peel away backing tape and press moulding to panel with roller or heavy hand pressure, parallel with string.

(7) Remove string.

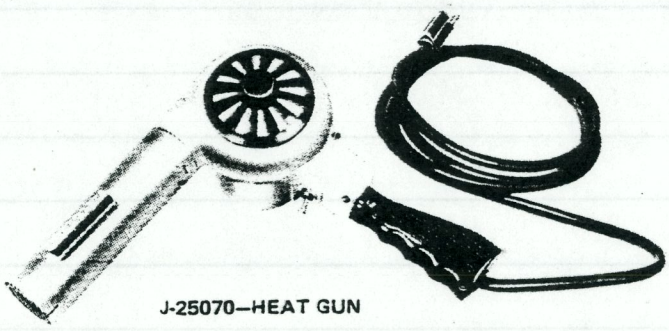
(8) Check moulding alignment and trim moulding with razor blade, if necessary.

(9) If moulding comes loose apply 3M Plastic and Emblem Adhesive, or equivalent, to moulding surface and press firmly to body.

Tools



J-25359-C—TORX BIT SET



J-25070—HEAT GUN

70301

NOTES

LIGHTING SYSTEMS 3R

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EXTERIOR LIGHTING SYSTEMS

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GENERAL

The wiring of the lighting systems is shown in the wiring diagrams which indicate the various units in relation to their positions in the vehicle. The wires in the various circuits are different colors or are marked by tracers.

All models have a 24-amp circuit breaker built into the switch for light system protection.

The upper and lower headlamp beams are controlled by a foot switch located on the toeboard.

HEADLAMPS

All models are equipped with a single headlamp system.

The round headlamp used with the CJ system is identified by the number 2D1 embossed on the sealed beam face. The large rectangular headlamp system is used on all Cherokee, Wagoneer and Truck models. All lamps contain two elements: one low beam and one high beam.

Replacement

Each sealed beam headlamp can be replaced only as a complete unit.

CJ Models

NOTE: *CJ headlamps have a number 2D1 molded into the glass at the top of the lens.*

(1) Remove attaching screw and pull door out slightly at bottom and push up to disengage upper retaining tab.

(2) Loosen screws in retaining ring, rotate ring to disengage from screws.

(3) Pull headlamp out and disconnect wire harness.

(4) Install replacement headlamp with number 2D1 at TOP of lamp.

(5) Install retaining ring and tighten screws.

(6) Install headlamp door and attaching screw.

(7) Check headlamp aim following procedure outlined below.

Cherokee-Wagoneer-Truck Models

(1) Remove headlamp door, if equipped.

(2) Remove screws attaching retaining ring and remove ring.

(3) Pull headlamp out and disconnect wire harness.

(4) Install replacement headlamp and connect to wire harness.

(5) Install retaining ring and attaching screws.

(5) Check headlamp aim following procedure outlined below.

(6) Install headlamp door and attaching screw, if equipped.

Headlamp Aiming Procedure

Lamps must be aimed on the **low beam.** They may be aimed either with mechanical aimers or by using a screen. Use HeadLight Aimer J-25300-10 which has the proper adapters for use with the large rectangular headlamps used on the Cherokee, Wagoneer and Truck models, follow instructions supplied with the equipment for proper headlamp aiming. If a screen is to be used, preparation for aiming is as follows:

(1) Locate vehicle in darkened area with level floor and with screen (wall) having nonreflecting white surface.

(2) Mark reference line on floor 25 feet away from and parallel to screen (fig. 3R-1).

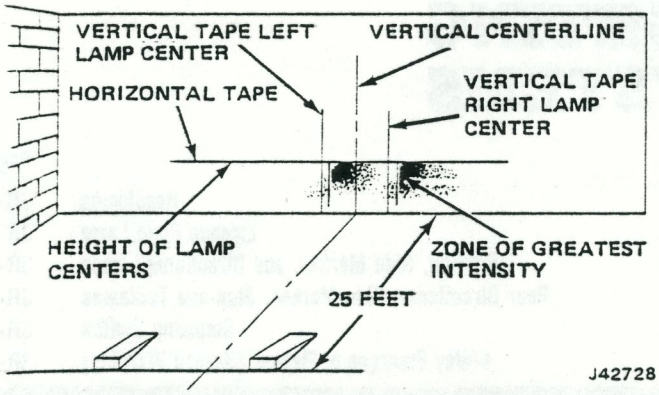


Fig. 3R-1 Headlamp Aiming

(3) Position vehicle perpendicular to screen and with headlamps directly over reference line.

(4) Locate middle tape on screen so it is aligned with centerline of vehicle.

(5) Equalize all tire pressures.

(6) Rock vehicle from side to side to equalize springs and shock absorbers.

(7) Measure distance between vehicle headlamp centers.

(8) Position marker tapes vertically on screen to right and left of middle tape at half this distance.

(9) Measure distance from center of each lamp to surface on which vehicle rests.

(10) Position marker tape horizontally on screen to cross vertical tapes at measured height of each lamp center respectively.

(11) Remove headlamp doors, if equipped.

(12) Clean headlamps.

(13) Turn headlamps on LOW beam.

NOTE: *Cover the lamp not being aimed.*

(14) Turn vertical aiming screw counterclockwise until lamp beam is considerably lower than horizontal reference line on screen (fig. 3R-2).

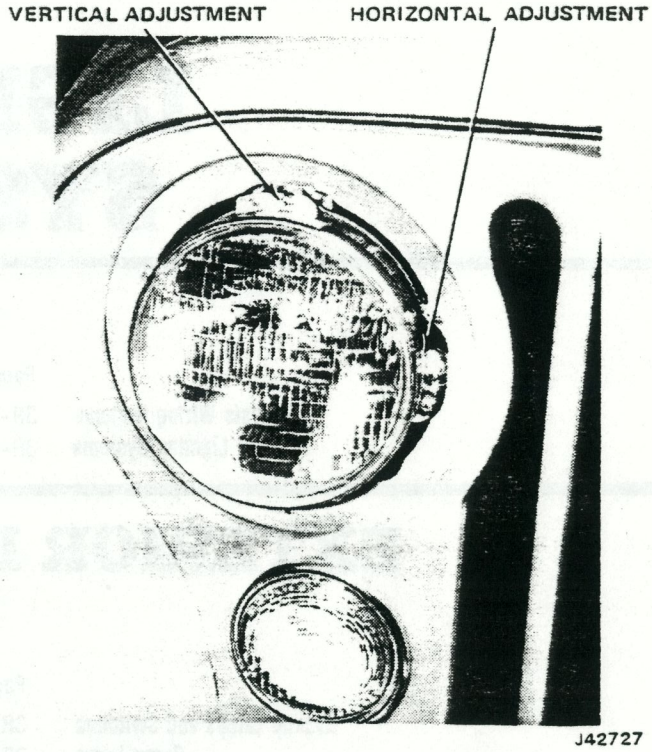


Fig. 3R-2 Headlamp Adjustment—Typical

(15) Turn screw clockwise until top edge of high intensity area is even with horizontal line.

(16) Turn horizontal aiming screw counterclockwise until beam is off centering tape.

(17) Turn same screw clockwise until left edge of high intensity area is 2 inches to right of lamp centerline (fig. 3R-1).

(18) Cover lamp that has been aimed and aim other lamp using same procedure.

Headlamp Switch

The switch is a two-position switch containing a rheostat for controlling instrument panel light brightness (fig. 3R-3). Rotating the knob clockwise dims the panel lights. Rotating the knob fully counterclockwise turns on the dome and courtesy lamps.

Headlamp Switch Replacement

(1) Disconnect harness connector plug from switch.

(2) Pull control knob out to second position.

(3) From behind instrument panel, depress knob release button (as shown in figure 3R-3, inset) and pull knob out of switch.

(4) Remove retaining nut and bezel.

(5) Remove switch through rear of instrument panel.

(6) When installing switch, make sure harness connector plug on switch is secure.

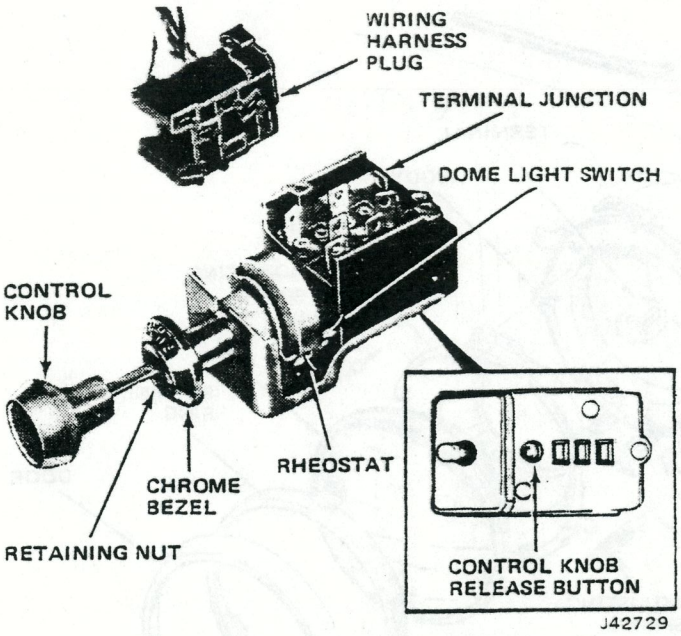


Fig. 3R-3 Headlamp Switch

Dimmer Switch Replacement

Refer to figure 3R-4.

(1) Remove harness plug from switch.

(2) Remove screws attaching dimmer switch to floorboard.

(3) Remove switch.

(4) Check operation of dimmer switch with Continuity Lamp J-21008. Connect one continuity lamp lead to switch input terminal (fig. 3R-4). Probe each output terminal with other continuity lamp lead. Current flow should alternate from one output terminal to the other as the switch is operated.

PARKING, SIDE MARKER AND DIRECTIONAL LAMPS

CJ Models

The parking lamps are mounted in the radiator guard panel just below the headlamps (fig. 3R-5). The lamps are on when headlamp switch knob is pulled out.

Parking and Directional Bulb

(1) Remove lens attaching screws.

(2) Remove lens.

(3) Replace bulb.

Parking Lamp Assembly

(1) Remove lens attaching screws.

(2) Remove lens and gasket.

(3) Remove housing from front panel.

(4) Disconnect wire connector from harness.

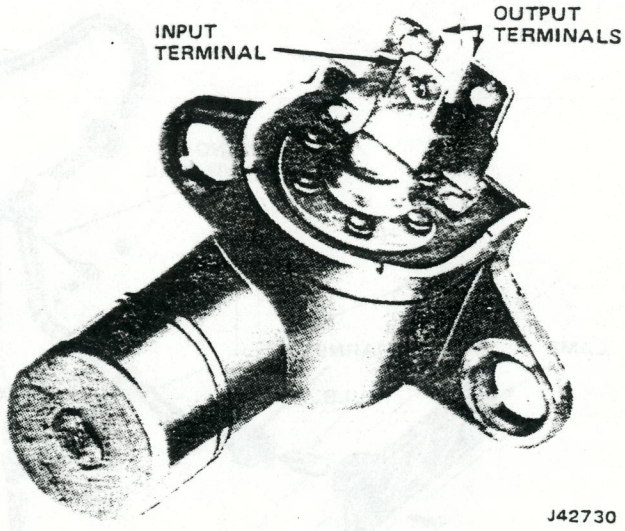


Fig. 3R-4 Headlamp Dimmer Switch

Side Marker Bulbs

(1) Reach under fender and twist socket a quarter turn counterclockwise to remove from housing.

(2) Replace bulb.

Cherokee-Wagoneer-Truck Models

The parking lamps are mounted in the panel just above the bumper (fig. 3R-6).

The front side marker lamps flash in unison with the front directional indicator bulb when the headlamps are not on. When the headlamps are on, the side markers flash alternately with the front directional signal lamps. Side markers and parking lamps come on when the headlamp switch is pulled out to any position.

To replace parking lamp bulbs on Cherokee, Wagoneer and Truck models, remove the lens and gasket to gain access to the bulb.

To replace side marker lamps, remove the lamp assembly. Twist the socket 1/4-turn counterclockwise to remove. Remove the bulb by pulling it straight out from the socket.

REAR DIRECTIONAL, SIDE MARKER, STOP AND TAILLAMPS

CJ and Sport Truck Models

Refer to figure 3R-7 for parts identification.

Taillamp Bulb Replacement

Remove lens attaching screws, lens and gasket. Clean lens and reflector before installing.

Taillamp Housing Replacement

Disconnect wiring, remove taillamp lens, and remove screws attaching taillamp assembly body and remove.

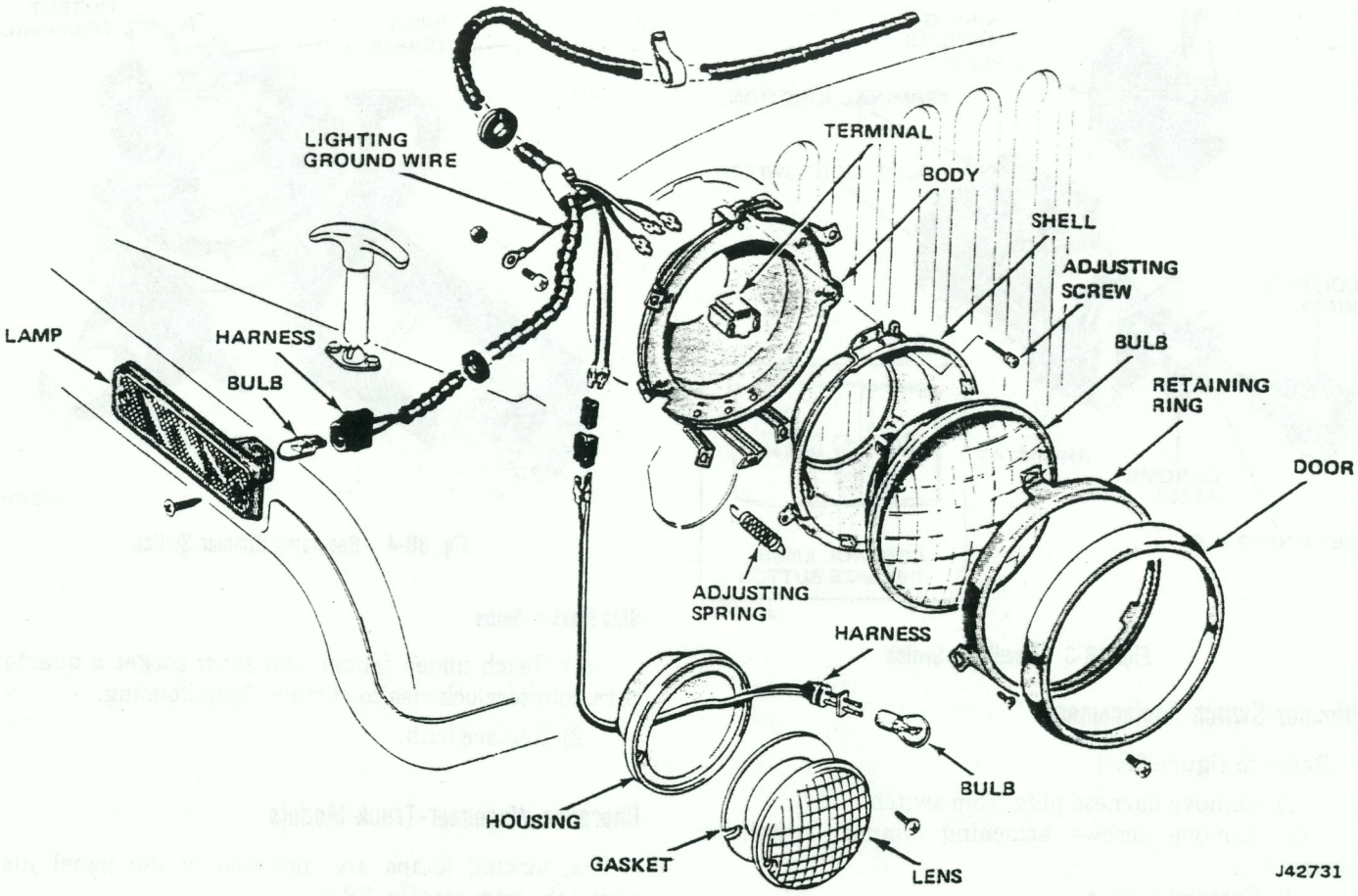


Fig. 3R-5 Headlamp, Parking, Directional and Side Marker Lamps—CJ Models

Side Marker Bulb Replacement

(1) Remove lens attaching screws, lens and gasket. Clean lens and reflector before installing.
(2) Pull side marker bulb straight out of socket.
(3) To install new bulb, push straight into socket.
(4) Position lens gasket and lens and install screws.

Cherokee

Refer to figure 3R-8 for parts identification.

Taillamp Bulb Replacement

Remove taillamp lens and remove bulb. Clean lens and housing before installing.

Taillamp Housing Replacement

(1) Remove interior rear quarter trim panel. On right side, pull panel out at top to remove. On left side, trim panel is attached with expandable clips. Use care in prying these clips out of their recesses so panel is not bent or damaged.
(2) Disconnect taillamp harness.
(3) Remove four attaching nuts and push housing out from corner posts.

Wagoneer

Refer to figure 3R-9 for parts identification.

Taillamp Bulb Replacement

Remove four lens attaching screws and lens. Replace bulb. Clean lens and reflector before installing.

Taillamp Housing Replacement

Refer to figure 3R-9 and follow housing replacement procedure as outlined for Cherokee models.

Truck with Townside Pickup Box

The lamp assemblies are mounted in the pickup box end caps (fig. 3R-10).

Taillamp Bulb Replacement

Remove lens attaching screws, lens and bulb. Clean lens and reflector before installing.

Taillamp Housing

(1) Remove lens attaching screws and lens.
(2) Remove housing attaching screws.
(3) Remove housing and disconnect lamp harness.

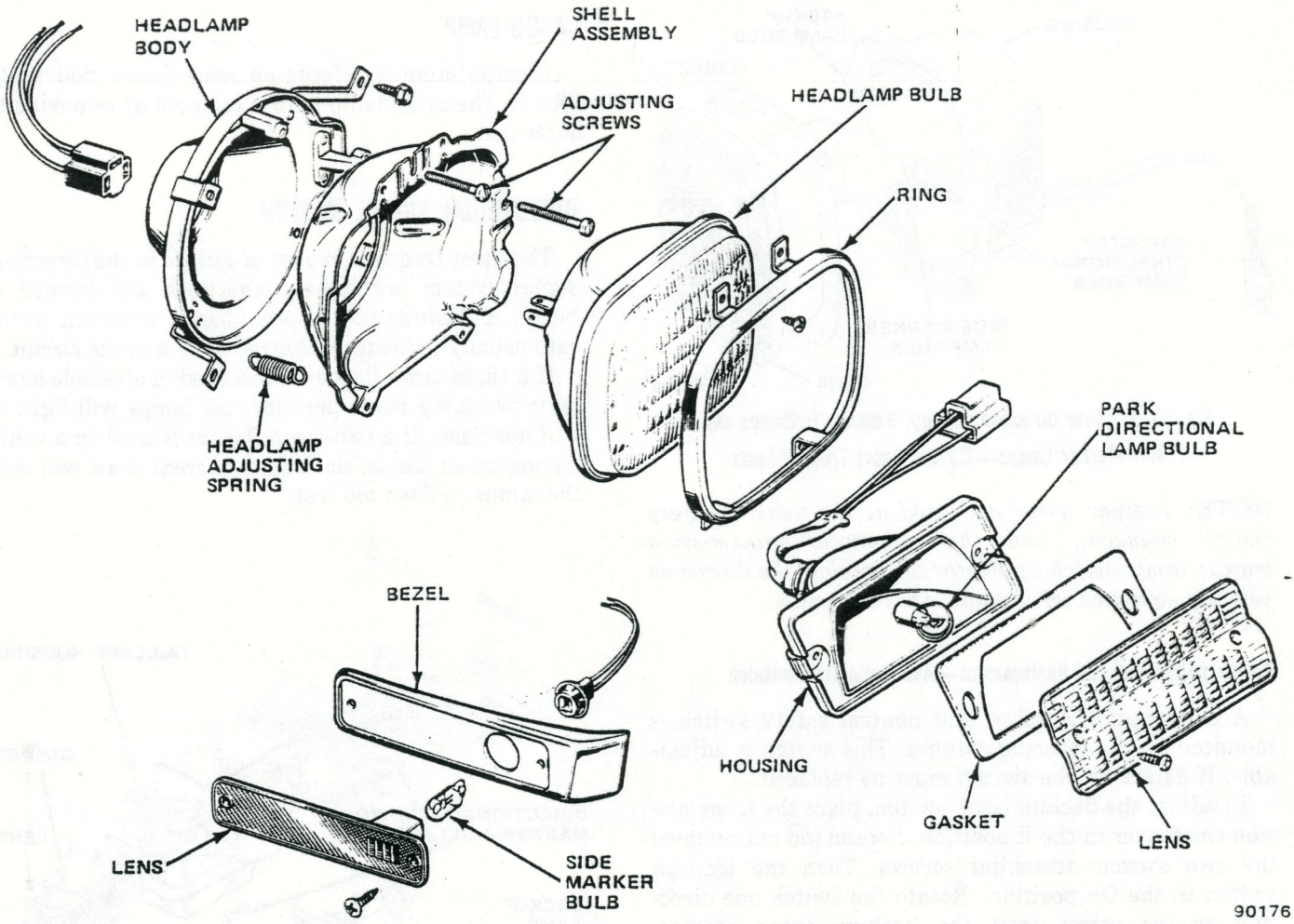


Fig. 3R-6 Headlamp, Parking, Directional and Side Marker Lamps—Cherokee-Wagoneer-Truck Models

LICENSE PLATE LAMP

CJ Models

The left taillamp illuminates the license plate. Refer to figure 3R-7.

Truck with Sport Truck Pickup Box

The lamp assemblies are the same as those used on CJ models. Refer to figure 3R-7 for parts identification and to procedural steps for CJ model for service procedures.

Cherokee and Wagoneer

The license plate lamp is attached to the tailgate and is a sealed unit. The lamp is removed by removing the lamp attaching screws and disconnecting the wire harness.

Truck with Townside Pickup Box

The license plate lamp is attached to the rear frame crossmember. Bulb replacement is accomplished by removing the bulb lens. The ground circuit for the license plate bulb is completed through metal-to-metal contact between the bulb bracket, license plate bracket, and the frame (fig. 3R-10).

When equipped with step bumper, the lamp wiring must be disconnected from the original lamp and connected to the step bumper license lamp extension wire.

BACKUP LAMPS AND SWITCHES

To replace a bulb, remove the backup lamp or taillamps lens, as required.

Switch Adjustment and Replacement—Manual Transmission

The backup lamp switch is threaded into the right rear corner of the transmission cover housing. The backup lamp switch is actuated by the reverse shift rail.

The backup lamp switch is not serviceable or adjustable and must be replaced as a unit.

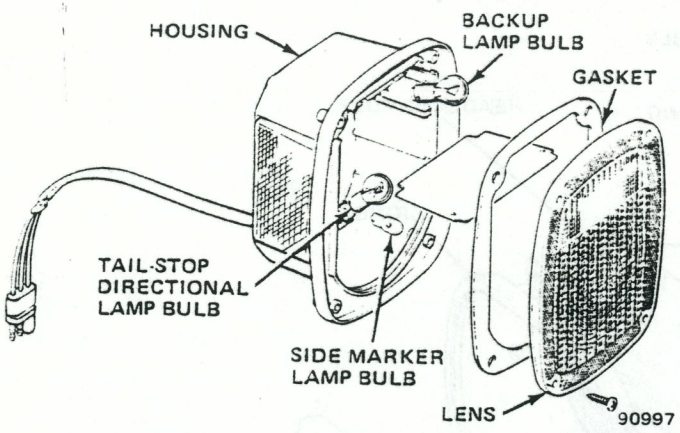


Fig. 3R-7 Rear Directional, Stop, Backup, Taillamps and Side Marker Lamps—CJ and Sport Truck Models

NOTE: *Jumper wires are used at the neutral safety switch connector and the automatic transmission backup lamp switch connector to complete the circuit on vehicles equipped with manual transmission.*

Switch Adjustment and Replacement—Automatic Transmission

A combination backup and neutral safety switch is mounted on the steering column. This switch is adjustable. If defective, the switch must be replaced.

To adjust the backup lamp switch, place the transmission shift lever in the R position. Loosen (do not remove) the two switch attaching screws. Turn the ignition switch to the On position. Rotate the switch one direction or the other until the backup lamps operate. Tighten the attaching screws. Check the switch for an engine start in the N and P positions. The engine must not start in R, D, 2 or 1 position.

As an aid to adjusting the backup lamp switch, install a test lamp to the lamp side of the switch and ground one side of a test lamp. When the test lamp lights, the backup lamps are operating.

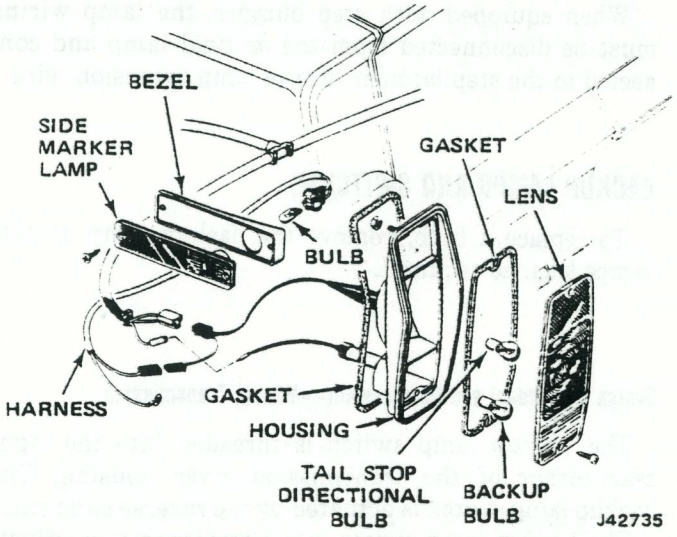


Fig. 3R-8 Rear Directional, Stop, Backup and Taillamps—Cherokee

CARGO LAMP

A cargo lamp is offered on some Truck models (fig. 3R-11). The cargo lamp bulb is replaced by removing the outer lens.

DIRECTIONAL SIGNAL SWITCH

The most frequent causes of failure in the directional signal system are loose connections and burned out bulbs. A flashing rate approximately twice the normal rate usually indicates a shorted bulb is in the circuit.

If a three-lamp flasher is installed in a vehicle having only two lamp bulbs per side, the lamps will light but will not flash. If a two-lamp flasher is used on a vehicle having three lamps, the higher current draw will cause the lamps to flash too fast.

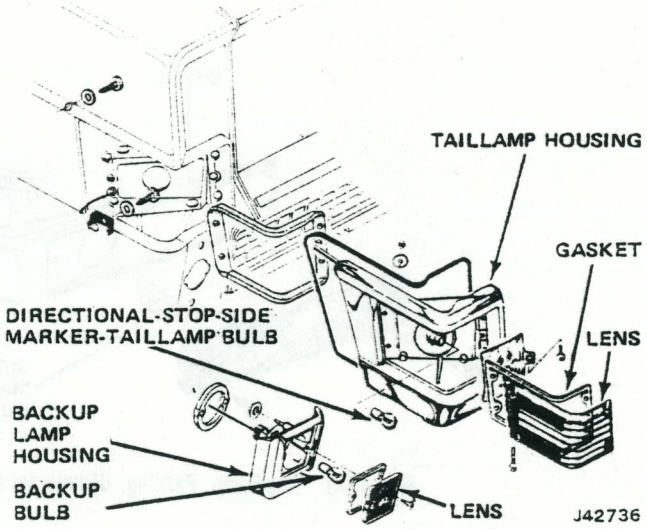


Fig. 3R-9 Rear Directional, Stop, Backup and Taillamps—Wagoneer

If there is no signal at any front, rear or indicator lamp, check the fuse.

If fuse checks okay, substitute a known good flasher. If a new flasher does not cure the problem, check the signal system wiring connections at the fuse and at the steering column connector.

NOTE: *If the brake stoplamps function properly, the rear signal lamp bulbs are okay.*

The directional flasher is mounted directly to the fuse panel. Refer to the wiring diagram at the rear of the manual for circuitry.

Switch Removal

(1) Disconnect battery negative cable.

(2) Remove horn center button by pulling straight out.

(3) Remove screws, bushing, receiver and spring.

(4) Remove steering wheel nut. Note alignment of steering wheel to steering shaft index marks for later installation.

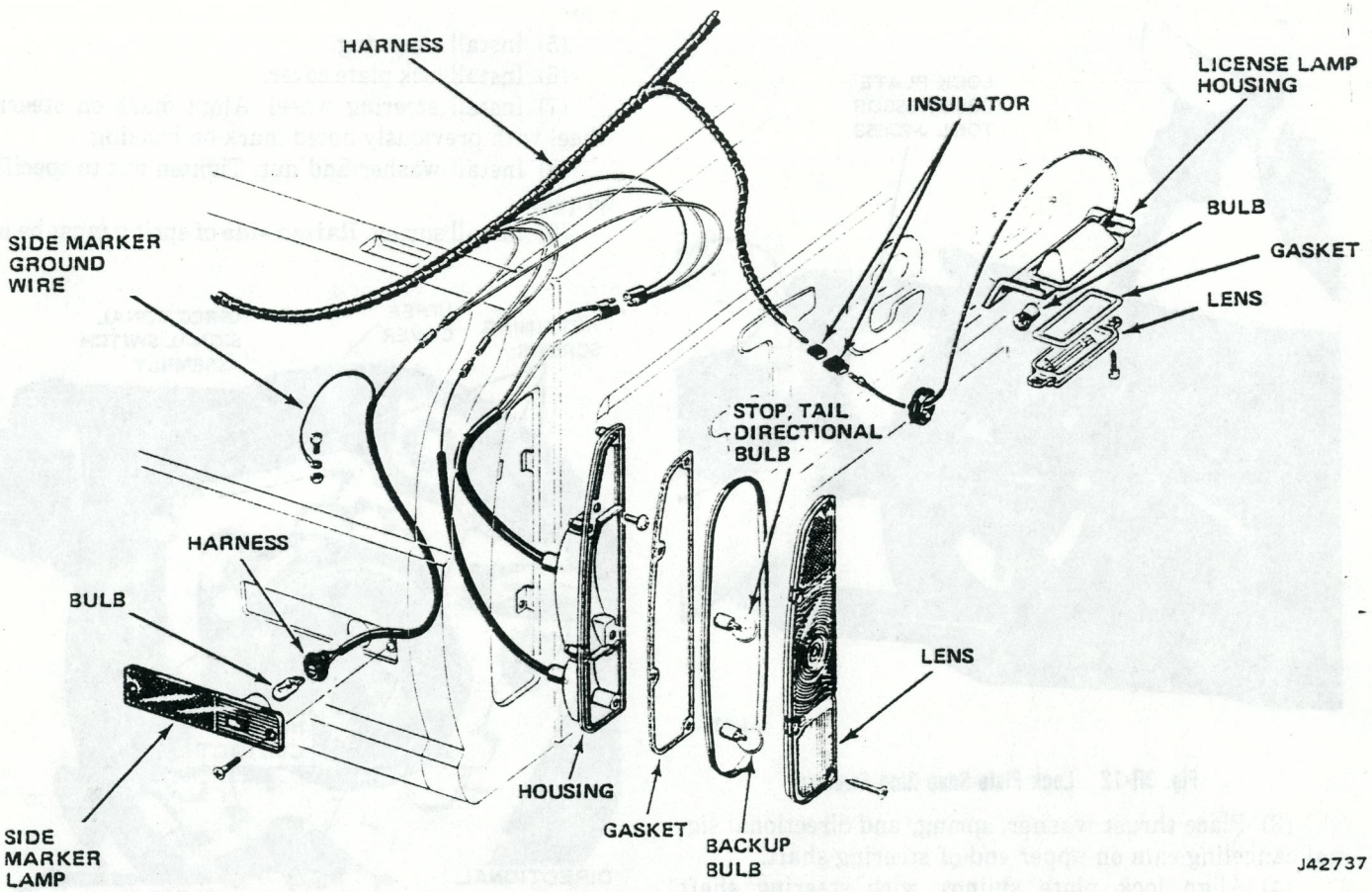


Fig. 3R-10 Rear Directional, Stop, Backup, Taillamps and Side Marker—Townside Truck

(5) Remove steering wheel with Steering Wheel Puller J-21232-01.

(6) Lift lock plate cover.

(7) Use Lock Plate Compressor Tool J-23653 to depress lock plate (fig. 3R-12).

(8) Pry round wire snap ring from steering shaft groove.

(9) Remove Lock Plate Compressor Tool, snap ring, lock plate, directional signal canceling cam, upper bearing preload spring and thrust washer from steering shaft.

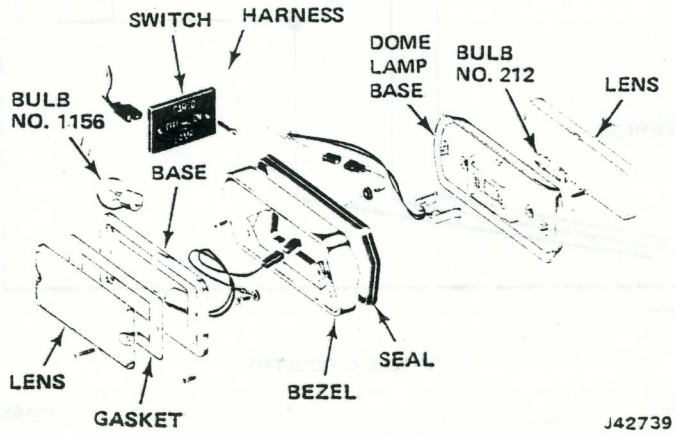


Fig. 3R-11 Cargo Lamp—Truck

(10) Place directional signal actuating lever in right turn position and remove lever.

(11) Depress hazard warning light switch, located on right side of column adjacent to the key lock, and remove button by turning in a counterclockwise direction.

(12) Remove directional signal wire harness connector block from its mounting bracket on right side of lower column.

NOTE: *On vehicles equipped with automatic transmission, use a stiff wire, such as a paper clip, to depress the lock tab which retains the shift quadrant lamp wire in the connector block.*

(13) Remove directional signal switch retaining screws and pull directional signal switch and wire harness from column (fig. 3R-13).

Switch Installation

(1) Guide wire harness into position and carefully align switch assembly.

NOTE: *Assure that actuating lever pivot is correctly aligned and seated in the upper housing pivot boss prior to installing the retaining screws.*

(2) Install directional signal lever and actuate directional signal switch to assure correct operation.

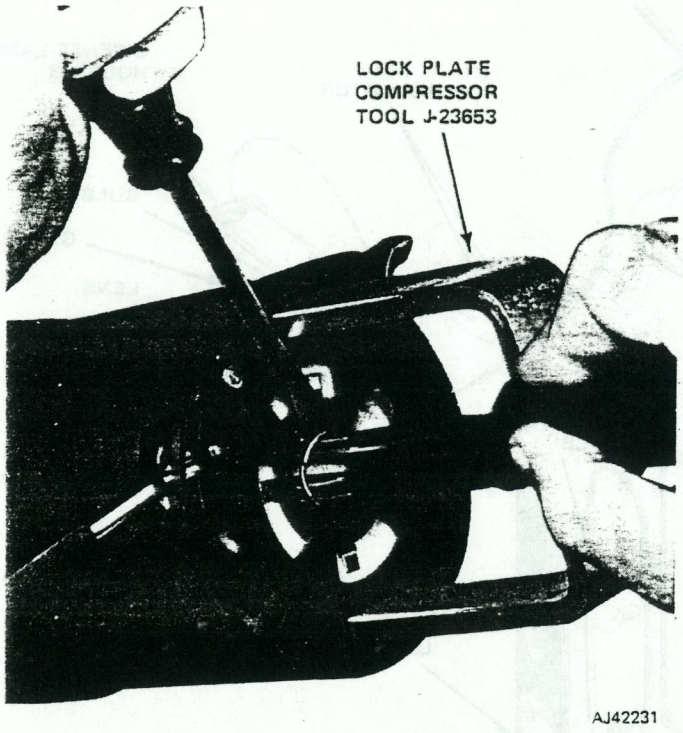


Fig. 3R-12 Lock Plate Snap Ring Removal

(3) Place thrust washer, spring, and directional signal canceling cam on upper end of steering shaft.

(4) Align lock plate splines with steering shaft splines and place lock plate in position with directional signal canceling cam shaft protruding through dogleg opening in lock plate.

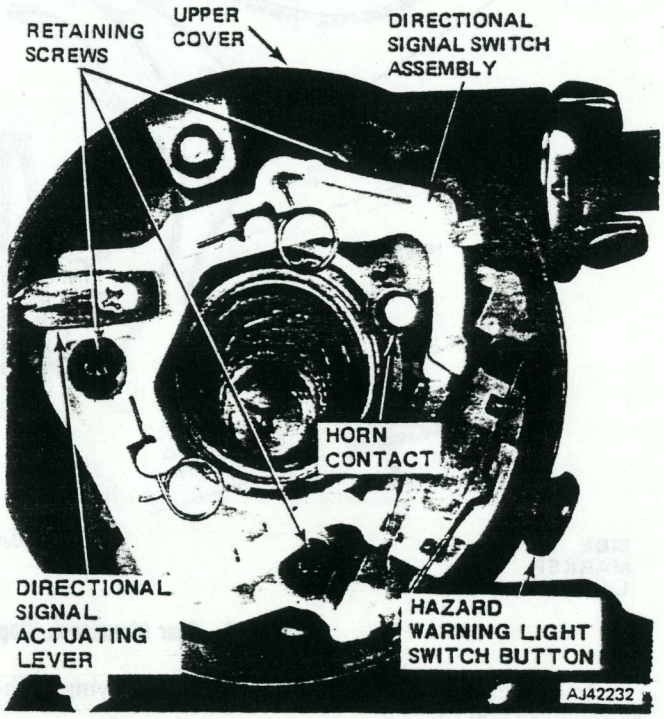
(5) Install snap ring.

(6) Install lock plate cover.

(7) Install steering wheel. Align mark on steering wheel with previously noted mark on housing.

(8) Install washer and nut. Tighten nut to specified torque.

(9) Install spring. **Raised side** of spring must be **up**.



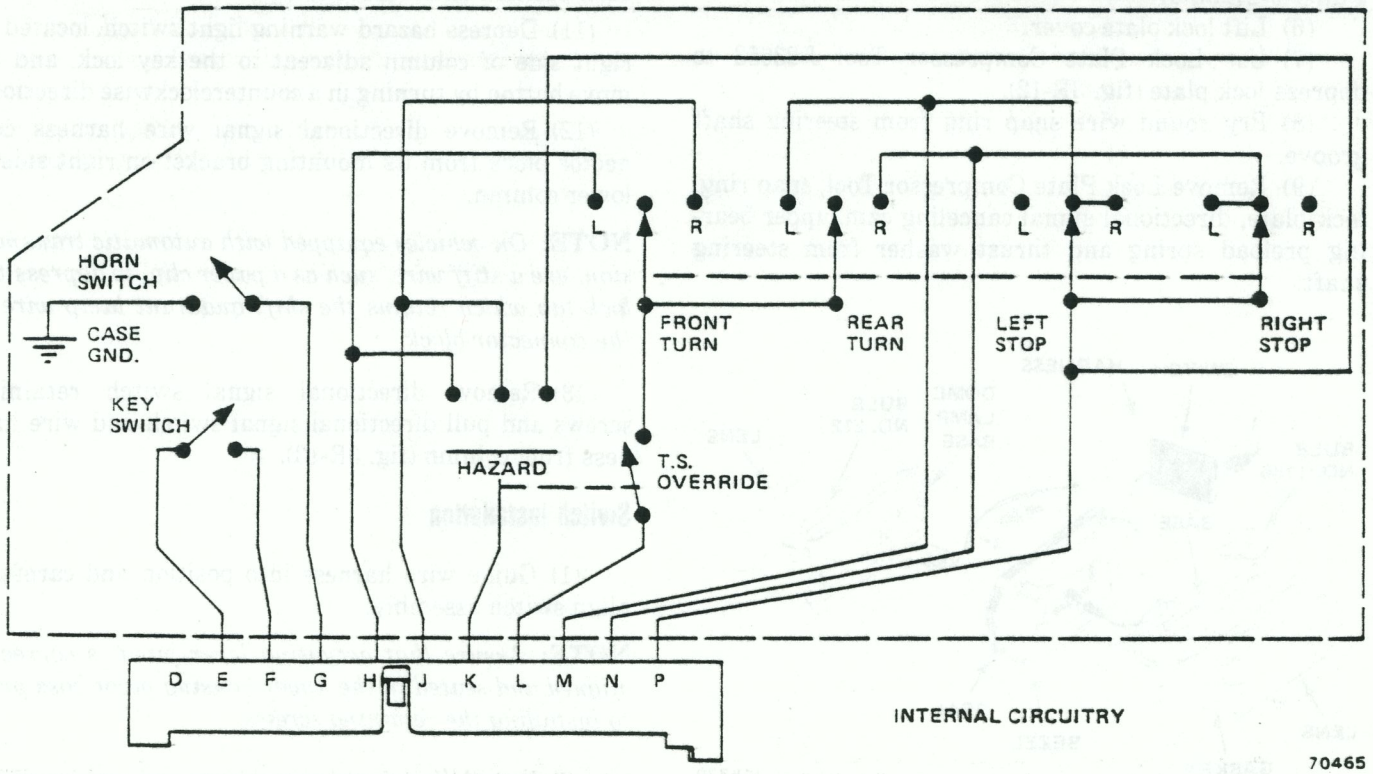


Fig. 3R-13 Directional Signal Switch

(10) Install receiver and bushing. Receiver must be free to move after bushing screws are tightened.

(11) Line up notch on receiver with nib on horn button. Push button until in snaps into place.

4-WAY EMERGENCY FLASHER (HAZARD WARNING)

All models are equipped with a four-way emergency flasher system. With the switch activated, the two front and two rear directional signal lamps flash on and off simultaneously with both directional signal indicator lamps on the instrument clusters.

This system makes use of the conventional directional signal wiring and bulbs, but has a separate battery feed wire, flasher unit and switch. It is possible to leave a vehicle with the 4-way flasher operating, with the ignition switch and vehicle doors locked. When the 4-way flasher is turned on, the normal directional signal supply is disconnected at the directional signal switch and a separate battery feed circuit is connected into the switch from the fuse panel. The 4-way flasher circuit uses a special heavy-duty flasher. Since the 4-way warning flasher is of the heavy-duty type, it will flash from one to six bulbs at a constant rate. Flashing indicator lights do not necessarily mean that *all* signal bulbs are flashing.

The 4-way emergency flasher switch is a part of the directional signal switch.

To operate the system, push in on the switch button.

The 4-way flasher can only be canceled by pulling out on the flasher switch knob.

Refer to Directional Signal Switch for 4-way flasher switch removal or replacement procedure.

The battery feed for the 4-way flasher system is in the fuse panel.

STOPLAMP SWITCH

The stoplamp switch is self-adjusting and is the same for all models. The switch is retained in its mounting bracket by a spring clip which engages the threaded portion of the switch housing (fig. 3R-14). The switch may be removed by pulling straight out of the mounting bracket and retainer.

Adjustment

(1) Depress brake pedal and hold in depressed position.

(2) Push stoplamp switch completely into mounting bracket until switch bottoms.

(3) Release brake pedal and allow it to return to undepressed position. Brake pedal will push switch to properly adjusted position.

(4) Check switch operation. Stoplamps should operate after 3/8 inch to 5/8 inch of pedal travel.

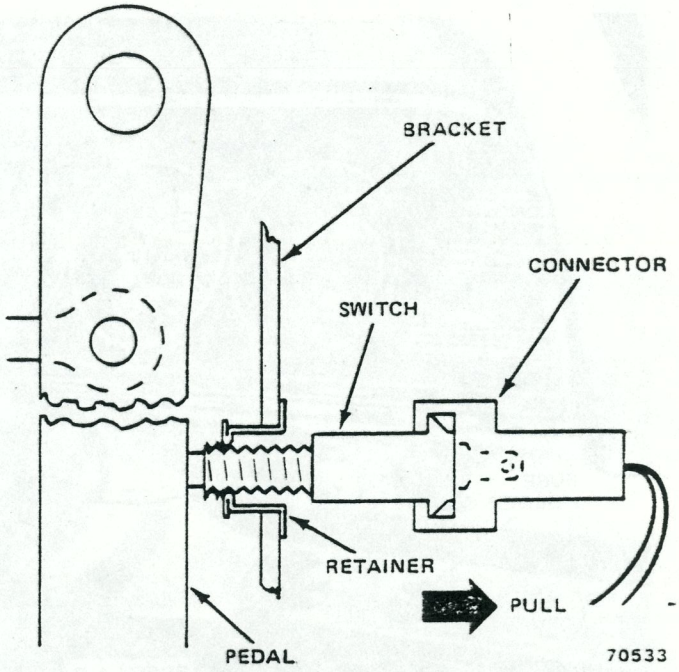


Fig. 3R-14 Stoplamp Switch

Stoplamp Switch Electrical Test

This test requires a voltmeter.

(1) Ground one lead of voltmeter.

(2) Probe each connection of stoplamp switch with other lead of voltmeter.

(a) With switch plunger depressed (brake not applied), one switch connector should indicate voltage and the other should not.

(b) With switch plunger released (brake applied), both switch leads should show voltage.

FOG LAMPS

The fog lamps are available on all models. Mounting locations vary depending on vehicle model and optional equipment. The switch is located on the far left side of the instrument panel (fig. 3R-15).

NOTE: *Fog lamps are turned off by the circuit relay when the high beam driving lamps are turned on. The circuit relay is located on the right front wheelhouse panel near the blower motor. Refer to Wiring Diagrams at the end of this manual for details.*

Aiming Fog Lamps

(1) Position vehicle on a flat surface, facing and approximately 25 feet from wall.

(2) Remove lamp stone shields (fig. 3R-16).

(3) Loosen lamp attaching hardware. Turn headlamp and fog lamp switches ON (fig. 3R-15), adjust lamp beams as follows:

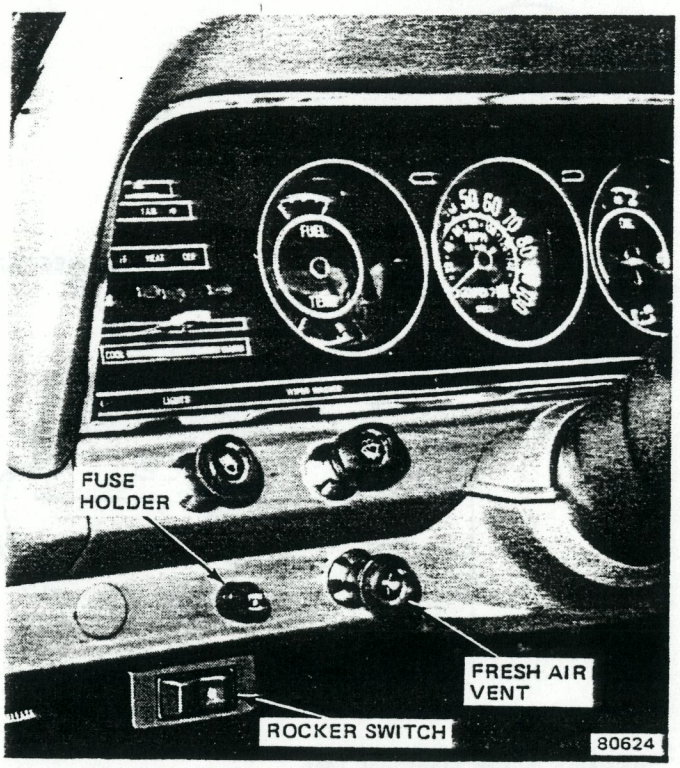


Fig. 3R-15 Fuse Holder and Switch Location—Typical

(a) Horizontal distance between light beams on wall should be same size as distance between lamps on front bumper.

(b) Vertical height of light beams on wall should be 4 inches less than height of lamps on front bumper.

(4) Tighten lamp attaching hardware.

(5) Turn off headlamp and fog lamp switches.

(6) Install lamp stone shields.

Lamp Element Replacement

(1) Remove lamp stone shields (fig. 3R-16).

(2) Remove screws attaching bezel to lamp body. Remove bezel from lamp body.

(3) Remove lens and reflector assembly from lamp body.

(4) Remove bulb holder from lens and reflector assembly.

(5) Remove lamp element from bulb holder and install replacement lamp element.

(6) Install bulb holder in lens and reflector assembly.

(7) Position lens and reflector assembly in lamp body with TOP of lens at top of lamp body.

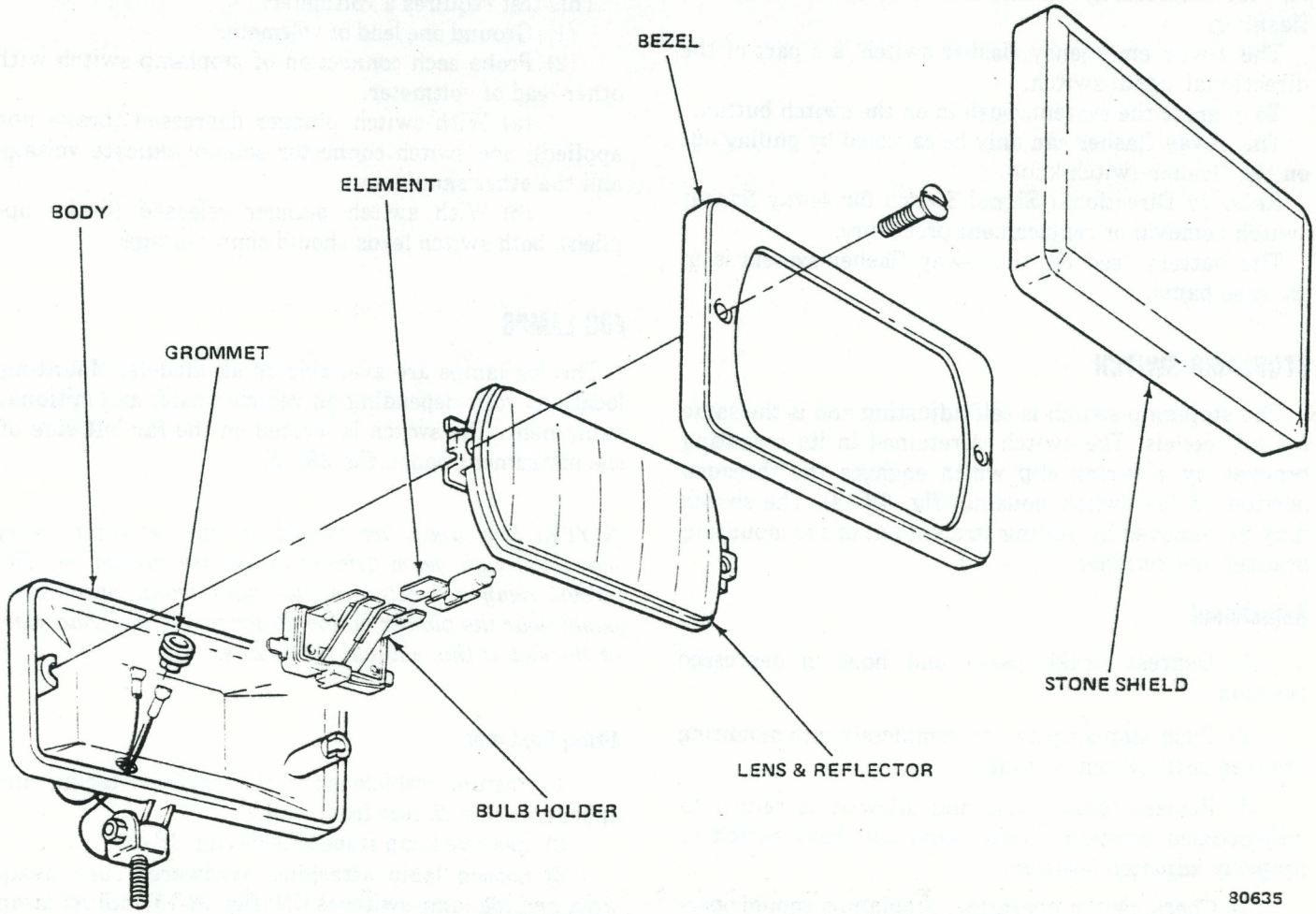


Fig. 3R-16 Fog Lamp Components

(8) Position bezel on lamp body and install attaching screws.

(9) Install stone shield on lamp.

Switch Replacement

(1) Remove switch from instrument panel and disconnect electrical harness (fig. 3R-17).

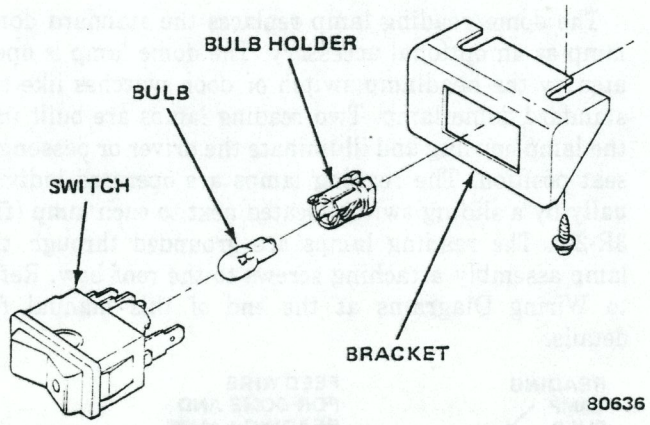


Fig. 3R-17 Fog Lamp Switch Components

(2) Connect harness to replacement switch and install switch in instrument panel.

ENGINE COMPARTMENT LAMP

This optional lamp obtains current at the battery terminal of the starter solenoid. A single wire incorporating a fusible link for protection passes current to the lamp assembly. The lamp assembly has a mercury switch which completes the circuit through the hood assembly when the hood is open. When the hood is closed, the mercury within the lamp assembly opens the circuit and the lamp does not light (fig. 3R-18).

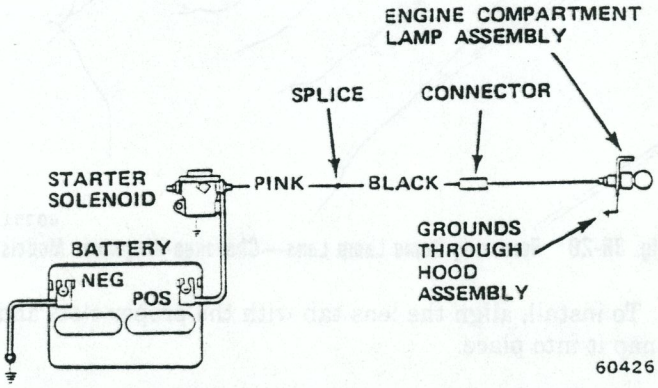


Fig. 3R-18 Engine Compartment Lamp Wiring

INTERIOR LIGHTING SYSTEM

	Page
Cargo Lamps	3R-13
Courtesy Lamps/Dome Lamps	3R-11
Dome/Reading Lamp	3R-12
Glove Box Lamp	3R-13
Instrument Cluster Lamps	3R-13

COURTESY LAMPS/DOME LAMPS

CJ Models

CJ models equipped with the hardtop have a dome lamp located above the liftgate. When removing the hardtop, disconnect the wire connector located on the left C-pillar. The lamp is operated by turning the headlamp switch knob counterclockwise to the stop.

The dome lamp lens can be removed by squeezing the lens together to disengage the retaining tabs (fig. 3R-19). The dome lamp assembly can be removed after removing the attaching screws.

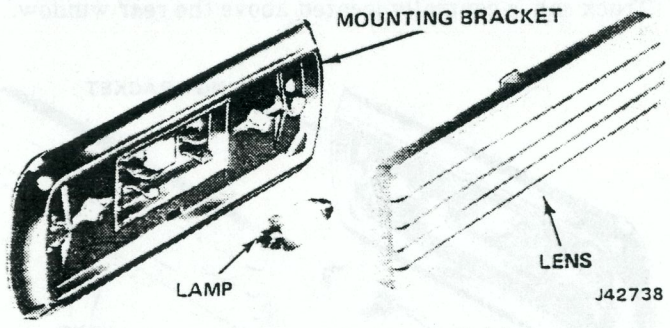


Fig. 3R-19 Dome Lamp—CJ Models

Cherokee-Wagoneer Models

The courtesy and dome lamps operate when the doors are opened. The door pillar switch provides a ground for the circuit.

Battery feed is from the headlamp switch. When the doors are closed, the dome and courtesy lamps are operated by rotating the headlamp switch knob counterclockwise to the stop. The ground for the lamps is then through the headlamp switch. The standard round dome lamp lens has three irregularly spaced barbed tabs that are inserted into slots in the dome lamp base to retain it. The lens is removed by pulling it downward or by prying it down with a small screwdriver (fig. 3R-20).

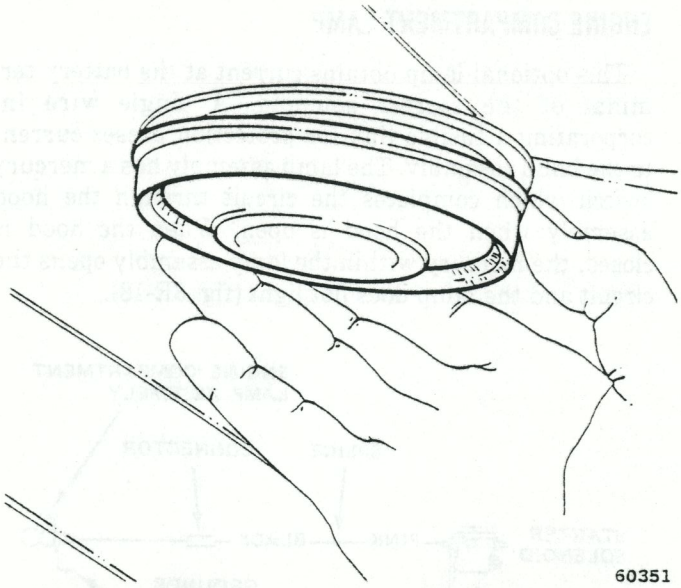


Fig. 3R-20 Removing Dome Lamp Lens—Cherokee-Wagoneer Models

To install, align the lens tab with the proper slots and snap it into place.

Truck Models

The courtesy and dome lamps operate when the doors are opened. The door pillar switch provides a ground for the circuit.

Battery feed is from the headlamp switch. When the doors are closed, the dome and courtesy lamps are operated by rotating the headlamp switch knob counterclockwise to the stop. The ground for the lamps then is made through the headlamp switch.

The dome lamp lens can be removed by squeezing the lens together to disengage the retaining tabs (fig. 3R-21). The dome lamp assembly can be removed after removing two attaching screws. The dome lamp bracket in the Truck cab is centrally located above the rear window.

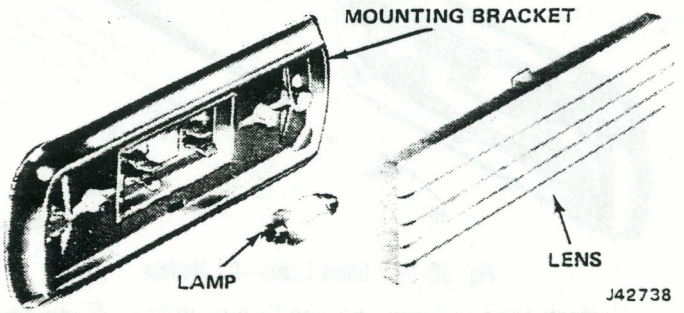


Fig. 3R-21 Dome Lamp—Truck Models

LIGHTED VANITY MIRROR

Cherokee-Wagoneer Models

The lighted vanity mirror (fig. 3R-23) is attached to the passenger sun visor. It has one lamp assembly mounted at each end of the vanity mirror. The lamp switch is located on the right side of the mirror assembly.

DOME/READING LAMP

Cherokee-Wagoneer Models

The dome/reading lamp replaces the standard dome lamp as an optional accessory. The dome lamp is operated by the headlamp switch or door switches like the standard dome lamp. Two reading lamps are built into the lamp housing and illuminate the driver or passenger seat position. The reading lamps are operated individually by a sliding switch located next to each lamp (fig. 3R-22). The reading lamps are grounded through the lamp assembly attaching screws to the roof bow. Refer to Wiring Diagrams at the end of this manual for details.

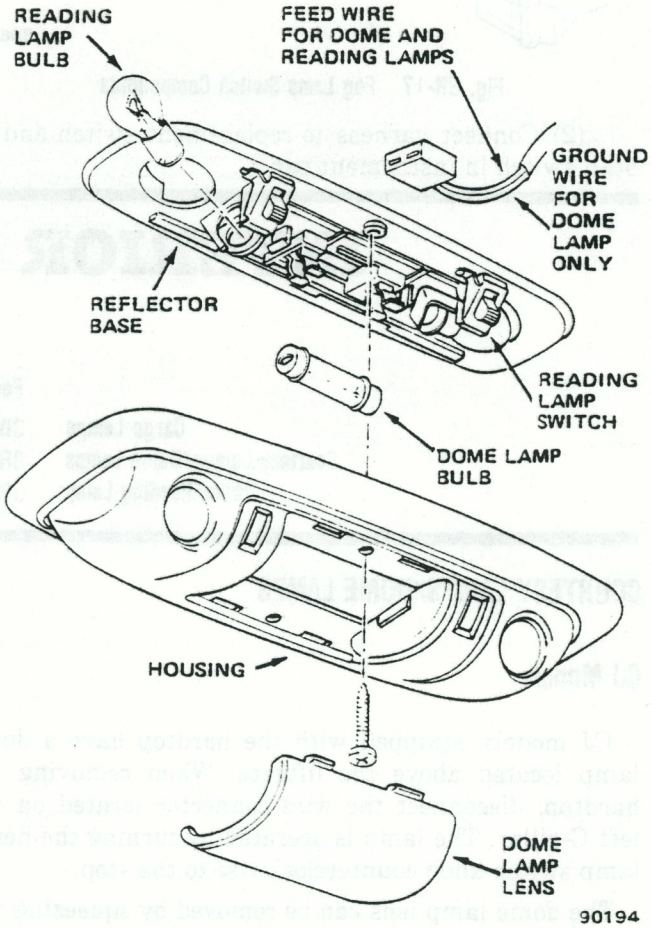


Fig. 3R-22 Dome/Reading Lamp—Cherokee-Wagoneer Models

The lighted vanity mirror assembly is equipped with a short harness and connector to allow removal without dropping the headliner. The short harness is connected to the dome/reading lamp harness. The circuit is grounded at the front roof rail and obtains current from the dome/reading lamp circuit. Refer to Wiring Diagrams at the end of this manual for details.

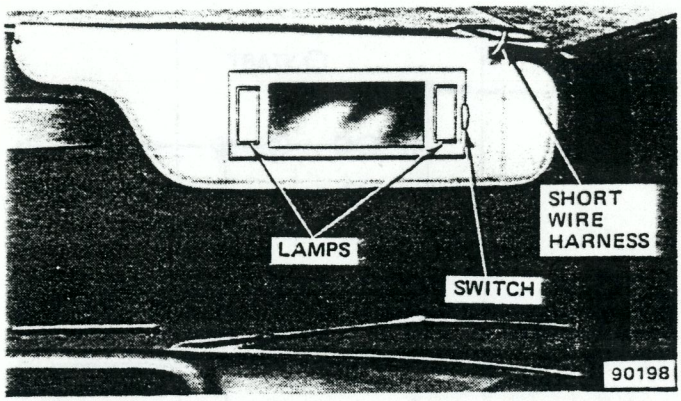


Fig. 3R-23 Lighted Vanity Mirror—Cherokee-Wagoneer Models

CARGO LAMP

Cherokee-Wagoneer Models

The cargo lamp is located in the rear headlining and controlled by the headlamp switch, door switches, and cargo lamp switch. The cargo lamp switch may be operated from the rear of the vehicle after lowering the tailgate glass. The cargo lamp switch provides an additional ground switch for the cargo lamp.

NOTE: *The cargo lamp on the Truck models is addressed in the exterior lighting system section of this chapter.*

GLOVE BOX LAMP

Current passes from the stoplight switch feed to the glove box lamp socket. The glove box lamp switch is grounded to the instrument panel and thus has no ground wire. When the glove box is open, the switch completes the ground circuit through the instrument panel. Refer to Wiring Diagrams at the end of this manual for details.

INSTRUMENT CLUSTER LAMPS

The instrument cluster lamps are covered in detail in Chapter 3C.

CHASSIS WIRING HARNESS

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Circuit Breakers	3R-15	Specifications	3R-17
Fuse Panel	3R-15	Wiring Harness Components	3R-13
Ignition Switch	3R-14		

WIRING HARNESS COMPONENTS

Main Harness Connector

All models have a main wiring harness connector located at the left upper corner of the dash panel. This connector is made up of the engine and forward lamp harness at the engine compartment and the fuse and instrument panel harness at the passenger compartment side.

The connector can be removed from the dash panel by removing the center bolt from the engine compartment side and the two attaching screws from the driver's side. Be careful not to bend the male spade terminals when removing or installing the connector. The center of the connector is filled with a non-conductive grease to prevent corrosion of the terminals. If any wires are replaced on the engine compartment side, the terminal opening must be resealed with a durable waterproof sealer. **Do not use string-type body caulk as a sealer.**

Fusible Links

Fusible links are harness wires covered with a special non-flammable insulation. The links protect circuits which are not normally fused due to carrying high amperage loads or because of their location in the chassis.

They are used to prevent major harness damage in the event a short circuit, short to ground or overload condition occurs.

All Jeep models are equipped with fusible links, located in the engine compartment, which protect the circuits shown in the Wiring Diagrams.

Each link is of a fixed value for the specific load. Replacement links are listed in the parts catalog.

NOTE: *Failure of a fusible link is often caused by a grounded circuit; therefore, the cause of the failure must be determined prior to installing a new link.*

Fusible Link Replacement

(1) Disconnect battery negative cable.

(2) Follow one end of the link to the terminal end. Follow the remaining end to wire harness.

(3) Remove harness tape approximately 2 inches from where link enters harness; the soldered splice will be visible.

(4) Following the wiring diagram, determine which circuit(s) may have caused the failure. Test the circuit(s)

using an ohmmeter or test light until ground condition is located and corrected.

(5) Unsolder link from harness, solder replacement link to harness wire(s).

NOTE: *Solder joint MUST be made with rosin core solder only. DO NOT use acid or acid core solder. Protect harness wires from damage when soldering.*

(6) Tape harness using plastic electrical tape.

(7) Route wire as originally installed and make connection.

(8) Connect battery negative cable and check operation of the circuit(s) involved.

IGNITION SWITCH

The ignition switch is mounted on the lower section of the steering column and is connected to the key lock assembly by a remote lock rod.

Removal

(1) Place key lock in Off—LOCK position and remove two switch attaching screws.

(2) Disconnect switch from remote rod.

(3) Disconnect harness connector and remove switch from steering column.

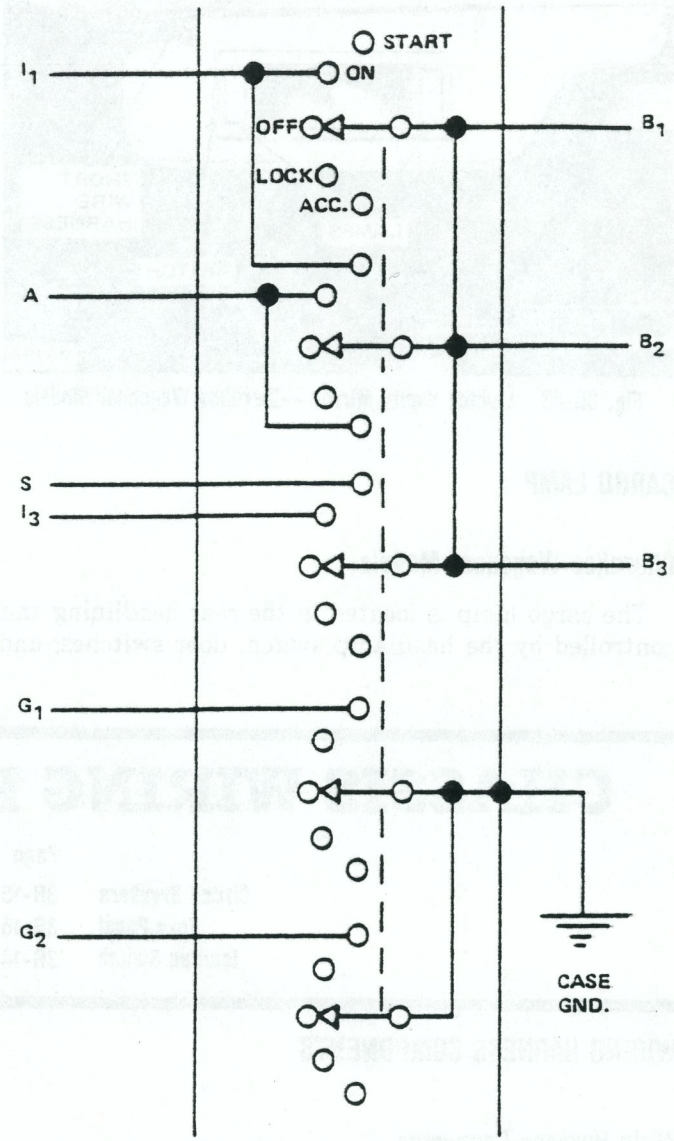
Testing

The ignition switch terminals are shown in figure 3R-24.

To test the ignition switch circuitry and continuity, place the slide bar in the position to be tested and use either an ohmmeter or Continuity Light J-21008.

Ignition switch slide bar positions can be easily identified by first locating the alignment hole located in the flat portion of the switch adjacent to the terminals. Starting from the alignment hole end of the switch, the switch positions are: Accessory, Off—LOCK, Off, On, and Start. Each position has a detent stop except START which is spring loaded to release when the key is released.

No electrical resistance should be indicated (test lamp on) between two connected terminals. The maximum voltage drop between any two connected terminals, as shown in the Ignition Switch Chart, should not exceed 12.5 millivolts per amp. For example: If a 10-amp load is drawn through the switch, maximum voltage drop should be 10 x 0.0125 or 0.125 volt.



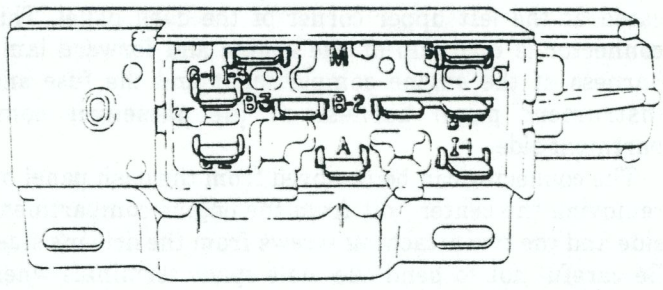


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Fig. 3R-24 Ignition Switch Terminals

Installation

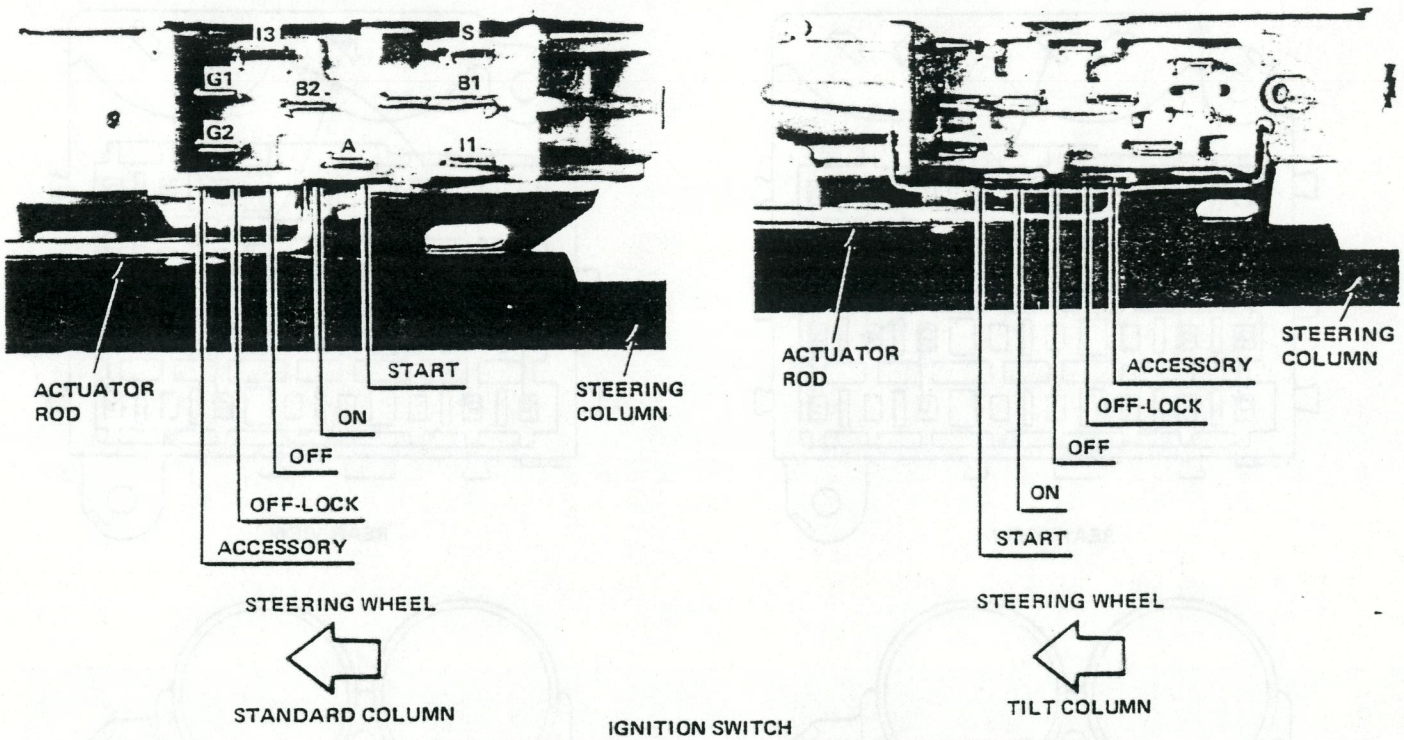
Standard Column

(1) With actuator rod disconnected, position switch as shown in figure 3R-25.

(2) Move slider to extreme left (Accessory position).

NOTE: *The left side of the ignition switch is toward the steering wheel.*

(3) Position actuator rod in the slider hole and install switch to steering column being careful not to move the slider out of the detent.



IGNITION SWITCH

POSITION	CIRCUIT	
START	I-1, B-1 & S G-1, G-2	CONNECTED GROUNDED
ON	I-1 & B-1 A & B-2 1-3 & B-3	CONNECTED CONNECTED CONNECTED
OFF	OPEN	
OFF-LOCK	OPEN	
ACCESSORY	A & B-2	CONNECTED

B-1, B-2 & B-3 (COMMON CONNECTION)

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Fig. 3R-25 Ignition Switch Positions

(4) Hold key in Accessory position and push switch down column slightly to remove slack in actuator rod.

(5) Tighten attaching screws securely.

(6) Connect white connector and then black connector to switch.

(7) Install steering tube cover.

Tilt Column

(1) With actuator rod disconnected, position switch as shown in figure 3R-25.

(2) Move slider to extreme right (Accessory position).

NOTE: *The right side of the ignition switch is downward from the steering wheel.*

(3) Position actuator rod in slider hole.

(4) Install switch to steering column but do not tighten attaching screws.

(5) Lightly push switch down column (away from steering wheel) to remove lash in actuator rod, while holding key in Accessory position. Be careful not to move slider out of detent.

(6) Tighten attaching screws securely.

(7) Connect white connector and then black connector to ignition switch.

(8) Install steering tube cover, if removed.

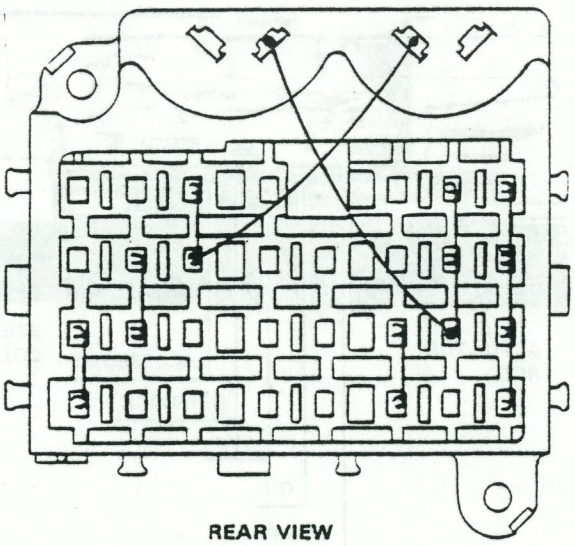
FUSE PANEL

The fuse panel is located on the passenger compartment side of the dash panel, attached to the main harness connector (figs. 3R-26 and 27).

CIRCUIT BREAKERS

CJ Models

Headlamps are protected by a 24-amp circuit breaker located in the headlamp switch.



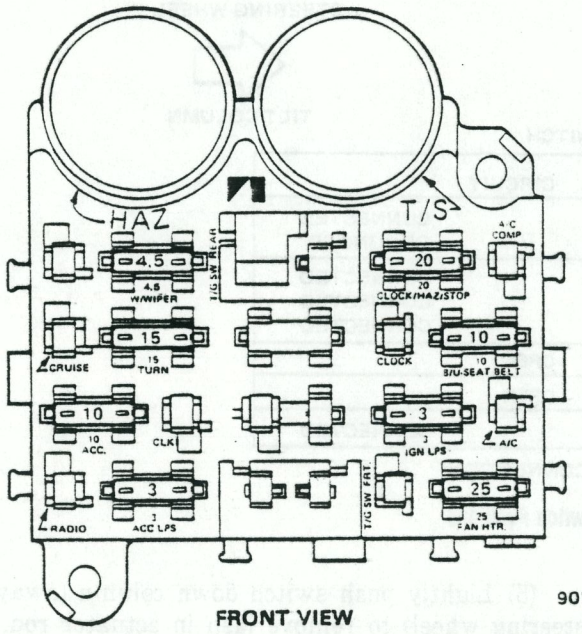
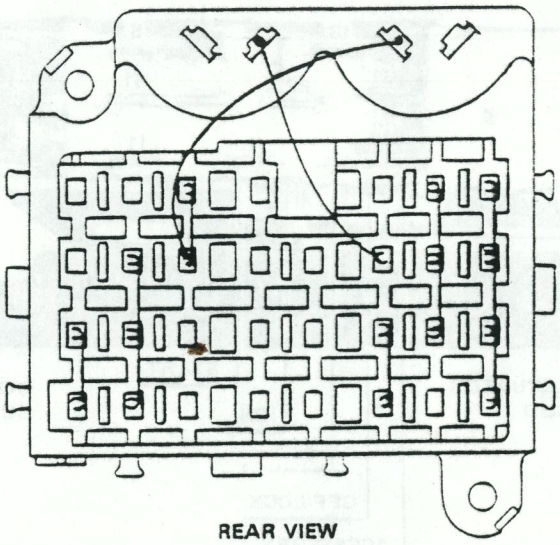


Fig. 3R-26 Fuse Panel Circuitry and Fuse Application—CJ Models



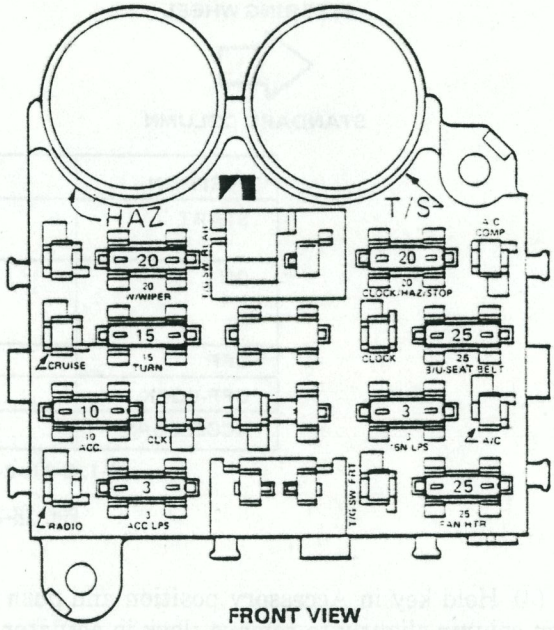


Fig. 3R-27 Fuse Panel Circuitry and Fuse Application—Cherokee-Wagoneer-Truck Models

Cherokee-Wagoneer-Truck Models

Headlamps are protected by a 24-amp circuit breaker located in the headlamp switch.

The tailgate window circuits are protected by two 30-ampere circuit breakers located in the fuse panel.

One circuit breaker is used in the instrument panel switch circuit and the other is used in the tailgate key operated switch circuit.

Torque Specifications

Service Set-To Torques should be used when assembling components.

Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	Service Set-To Torque		Service In-Use Recheck Torque	
	USA (in-lbs)	Metric (N·m)	USA (in-lbs)	Metric (N·m)
Steering Wheel Nut	35 ft-lbs	48	30-40 ft-lbs	41-54
Directional Signal Switch Handle	25	3	15-30	2-3
Hazard Warning Knob Mounting Screws	5	0.5	2-5	0.2-0.5

All Torque values given in inch-pounds and newton-meters with dry fits unless otherwise specified.

70377B

Tools

J-23653 LOCK
PLATE COMPRESSOR

J-21008
CONTINUITY LAMP

J-21232-01 FRONT PUMP
OIL SEAL REMOVER
(STEERING WHEEL PULLER)

J-25300-10
HEADLIGHT AIMER

42271B

NOTES

HORN SYSTEMS 3S

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General	3S-1	Horn System Diagnosis and Repair	3S-1
Horn Adjustment	3S-2	Specifications	3S-2

GENERAL

The horn circuit includes horn(s), horn relay, battery, steering column wiring harness, horn ring, and the body sheet metal.

Wagoneer, Cherokee and Truck model horns are located on the radiator grille face panel behind the plastic grille. The grille must be removed to gain access to the horns.

CJ model horns are located on the inner left wheelhouse.

A cadmium-plated ground screw is used to attach the horn(s) to the body. **Do not** substitute other types of ground screws as they may become corroded and cause a loss of ground.

To reduce the current flow through the horn ring contacts, a relay is used between the battery and horn. The horn relay consists of an electromagnet and a set of contacts arranged so that when the magnet is energized an armature is attracted and the contacts close. A spring keeps the contacts open when the unit is at rest. The horn-ring contacts carry only relay current, while the relay opens and closes the circuit between the horn and battery (fig. 3S-1).

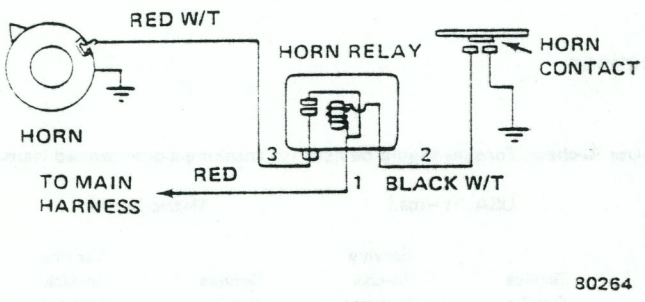

Fig. 3S-1 Horn Circuit Schematic

A fusible link is incorporated in the main wiring harness to furnish protection against major harness damage.

When a grounded circuit or overload occurs in the horn circuit, damage will be limited to the fusible link.

HORN SYSTEM DIAGNOSIS AND REPAIR

In case of horn system failure, proceed as follows:

(1) Using a test light or voltmeter, check for battery voltage in the red lead to relay before individual components are tested or replaced.

(2) A lack of voltage indicates fusible link or harness is open and cause of failure must be determined and repaired prior to installing a replacement fusible link or other components.

(3) The replacement fusible link is supplied in the proper length with a terminal connector on one end.

(4) Inspect wiring between horn, relay and battery for loose connections, faulty insulation, corroded terminals, or improper ground connection at horn base.

NOTE: *Be sure the clip on the horn mounting bracket cuts through the inner wheelhouse to ensure a good ground.*

(5) If horn does not operate when ring or button is depressed, ground number 2 terminal (fig. 3S-1) of horn relay with a jumper lead. If horn operates, this indicates proper operation of horn and relay.

(6) Inspect horn ring switch and wire from switch to relay carefully for source of trouble.

CAUTION: *Do not ground red lead.*

(7) If horn does not operate, ground number 2 terminal and connect a jumper lead from horn relay terminals 1 to 3.

(8) If horn now operates, a faulty horn relay is indicated.

(9) If it does not operate, check wiring and connections between the horn relay terminal number 3 and horn for continuity.

(10) Connect a jumper lead from horn base to the vehicle chassis or engine and repeat the above tests.

(11) If horn now operates, remove attaching screw, horn and mounting bracket, clean mating surfaces.

(12) Install horn, mounting bracket and attaching screw, tightened screw to 15 foot-pounds (20 N•m) torque.

(13) If horn still does not operate, horn is inoperative and must be replaced.

(14) To check for bad component ground, place a voltmeter between component and ground. If a sizable voltage is shown on the meter, repair the poor ground connection.

(15) Continuous horn operation is usually caused by improper ground in horn ring or button wiring.

HORN ADJUSTMENT

Adjust current by turning the adjusting screw counterclockwise to decrease the current until the specified current is reached. Current adjustment is very sensitive. Therefore, care must be taken not to turn the horn adjustment screw too far. Turn only 1/10 of a turn at one time.

(1) Check for normal battery voltage (about 12.6 volts).

(2) Connect ammeter in series between horn and battery and read current as shown in figure 3S-2.

(3) Adjust current to 4.5 amps.

NOTE: *Do not stuff rags or other materials in the horn protector to muffle the sound while adjusting, as this changes the vibration frequency and would give a raise in current setting. When adjusting a set of horns, each horn should be connected and adjusted separately, then check for tone by operating as a pair.*

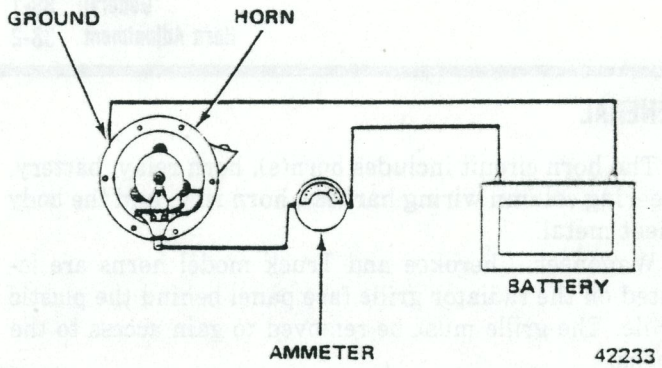

Fig. 3S-2 Connection for Horn Adjustment

SPECIFICATIONS

Electrical Specifications

Item	Current Flow
Horn	4-5 Amps

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Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (ft – lbs)		Metric (N·m)	
	Service Set-To Torque	Service In-Use Recheck Torque	Service Set-To Torque	Service In-Use Recheck Torque
Horn Bracket Screw	15	8-17	20	11-23

All Torque values given in foot-pounds and newton-meters with dry fits unless otherwise specified.

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WINDSHIELD WIPERS 3T

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CJ WINDSHIELD WIPER

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Pivot Shaft Body and Linkage	3T-2
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Washer Pump	3T-3
Wiper and Washer Control	3T-2
Wiper Arm Replacement	3T-2
Wiper Blade Replacement	3T-1

GENERAL

All CJ models are equipped with a two-speed, electric wiper motor.

The motor is mounted on the lower left corner of the windshield (fig. 3T-1).

WIPER BLADE REPLACEMENT

The wiper blade assembly is removed from the wiper arm by holding the blade away from the windshield, and pushing it firmly against the tip of the arm to compress the locking spring and disengage the retaining pin. At

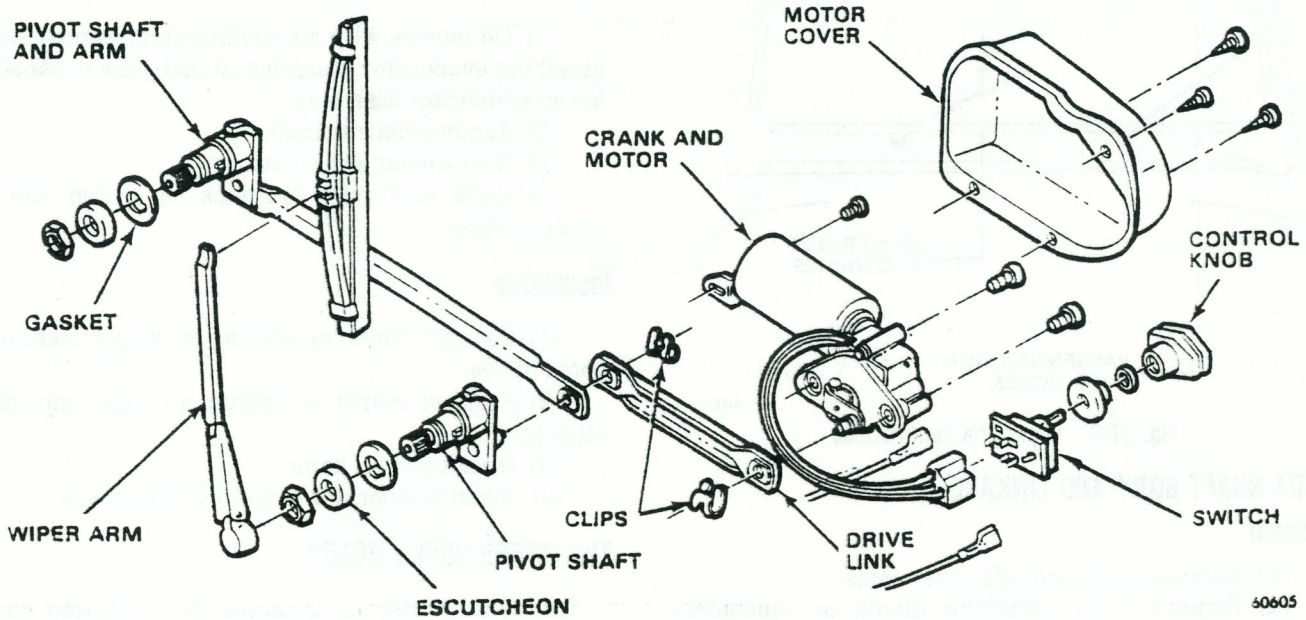


Fig. 3T-1 Windshield Wiper Components

the same time, pivot the blade clockwise to unhook it from the end of the arm.

To install, place blade assembly on wiper arm and snap blade assembly into position.

WIPER ARM REPLACEMENT

(1) Remove windshield wiper arm from pivot shaft body with Remover Tool J-22128 as shown in figure 3T-2.

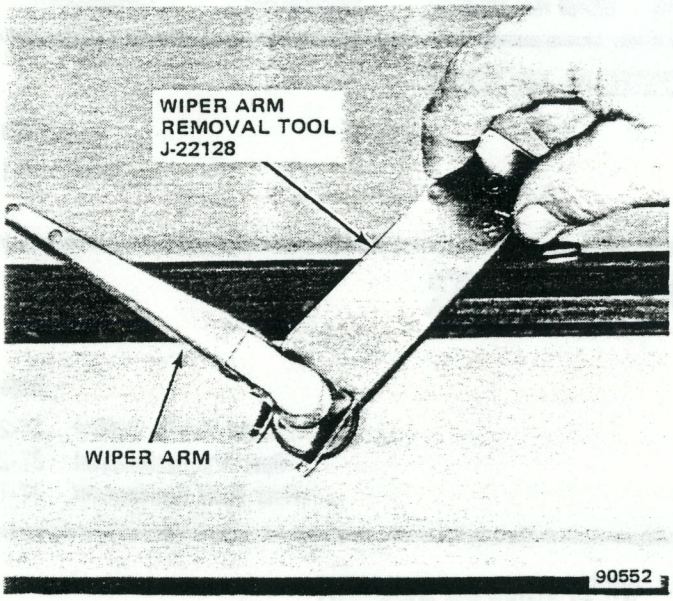


Fig. 3T-2 Wiper Arm Removal

(2) To install, push wiper arm over pivot shaft. Be sure pivot shaft is in Park position and wiper arm is positioned as shown in figure 3T-3.

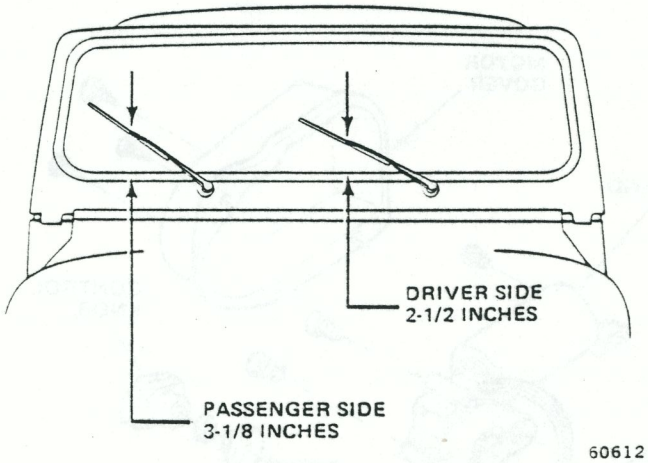


Fig. 3T-3 Wiper Arm Park Position

PIVOT SHAFT BODY AND LINKAGE

Removal

(1) Remove right and left wiper arms.

(2) Remove nuts attaching pivots to windshield frame.

(3) Remove necessary top components from windshield frame.

(4) Remove right and left windshield holddown knobs and fold windshield down.

(5) Remove right and left access hole covers.

(6) Disconnect wiper motor drive link from left wiper pivot.

(7) Remove pivot shaft body and linkage from access hole.

Installation

(1) Install pivot shaft body and linkage in windshield frame.

(2) Connect wiper motor drive link to left wiper pivot.

(3) Install right and left access hole covers.

(4) Raise windshield to upright position and install right and left windshield holddown knobs.

(5) Install nuts attaching pivots to windshield frame.

(6) Install right and left wiper arms.

(7) Install necessary top components on windshield frame.

WIPER AND WASHER CONTROL

The control switch is mounted on the instrument panel. The switch is a through-type multi-position switch which does not require grounding for proper operation.

The two-speed wiper motor is energized for continuous wiping action by turning the control knob in a clockwise direction.

The electric washer pump is operated by depressing the wiper control knob.

Removal

(1) On models with air conditioning, remove screws attaching evaporator assembly to instrument panel and lower evaporator assembly.

(2) Remove control knob.

(3) Remove nut and switch.

(4) Mark wire color locations on switch and disconnect wires.

Installation

(1) Connect wires to switch, in proper location as noted above.

(2) Position switch in instrument panel and install attaching nut.

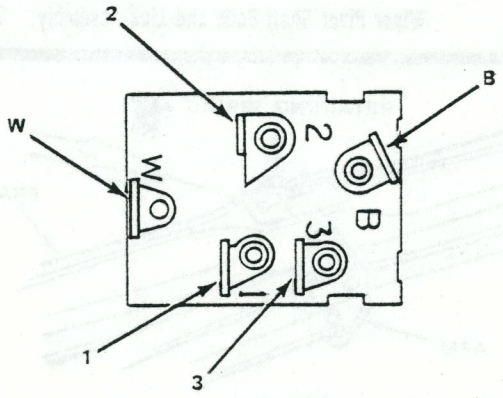
(3) Install control knob.

(4) Install evaporator assembly, if removed.

TWO-SPEED WIPER MOTOR

The wiper motor is protected by a 4.5-amp circuit breaker in the fuse panel.

When the wiper switch is moved to the low speed position, current flows from the fuse panel to terminal B (fig. 3T-4) of the wiper switch, through the wiper switch to terminal 2, then through the green wire to the motor low speed brush and through the armature to ground.



Selector Position	
Off or Park	B-1
Low Speed	B-2
High Speed.	B-3
Wash	B-W

80343

Fig. 3T-4 Continuity Test for Wiper Switch

With the wiper switch in the high speed position, current flows from the fuse panel to terminal B of the wiper switch, through the wiper switch to terminal 3, then through the red wire to the motor high speed brush and through the armature to ground.

When the wiper switch is turned off, current flows from the fuse panel to terminal B of the wiper switch, through the wiper switch to terminal 1, then through the black wire to the park contact points to the motor low speed brush and through the armature to ground. When the cam on the wiper drive gear opens the park contact points, the feed circuit to the motor low speed brush is interrupted and the motor is in park.

Troubleshooting Procedures

The wiper motor may be operated independently of the switch to aid in determining defective components.

NOTE: *The wiper motor must be grounded for proper operation and during all wiper tests.*

With ignition switch on, check for 12-volts at switch terminal B. If 12-volt test lamp lights but wiper motor does not operate, connect a jumper wire from ground strap on motor to a good body ground. If motor still does not operate, disconnect wiring from switch. Using a jumper wire, connect switch terminals 2 and B. This connection should give low speed operation. If wiper motor does not operate in low speed, there is an open in the green wire, a defective internal motor connection or a stuck low speed brush.

To obtain high speed, connect a jumper wire between terminals 3 and B. If wiper motor fails to operate, there is an open in the red wire, a defective internal motor connection, or a stuck high speed brush.

With the wiper blades in a position other than park, connect a jumper wire between terminals 1 and B. The wiper blades should run on low speed and stop in the park position. If the motor does not run after making the jumper connection, there is an open in the black wire, a defective internal motor connection, a misaligned or damaged set of contact points or a bad connection through the park point set to the low speed brush. If the wiper motor runs but does not park, the cam on the drive gear is not sufficiently breaking the contact points.

If wiper motor operation is intermittent, a defective solder joint, wiring connection, body ground or worn brush may cause the condition.

Removal with Crash Pad

NOTE: *Without crash pad, remove wiper motor cover.*

(1) Remove necessary top components from windshield frame.

(2) Remove right and left windshield holddown knobs and fold windshield down.

(3) Remove left access hole cover.

(4) Disconnect drive link from left wiper pivot.

(5) Disconnect wiper motor wire harness from switch.

(6) Remove attaching screws and remove wiper motor.

Installation with Crash Pad

(1) Position wiper motor on windshield frame and install attaching screws.

(2) Connect wiper motor wire harness to switch.

(3) Connect drive link to left wiper pivot.

(4) Install left access hole cover.

(5) Raise windshield to upright position and install right and left windshield holddown knobs.

(6) Install necessary top components on windshield frame.

WASHER PUMP

The electric washer pump assembly is mounted in the water reservoir. The impeller motor case is grounded to the body sheet metal by a black ground wire. It is energized by a yellow feed wire from the single blade terminal on the control switch.

CHEROKEE - WAGONEER - TRUCK WINDSHIELD WIPER

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Wiper Blade Replacement	3T-4
Wiper Motor	3T-16
Wiper Pivot Shaft Body and Link Assembly	3T-5

GENERAL

The two-speed electric windshield wipers and electric washers are standard equipment. An optional intermittent wiper system provides a pause between wipe cycles for use during conditions of very light precipitation.

The controls for the windshield wipers are mounted on the instrument panel to the left of the steering column.

The electric wipers are operated by turning the control knob to the right. For intermittent operation, turn knob to the left. Electric washers are actuated by depressing the wiper control knob.

The wiper arms are actuated by a link and pivot assembly attached to the wiper motor.

The wiper motor is mounted to an adapter plate mounted to dash panel.

The wiper arms move in a tandem-like action and park to the right side of the car.

CAUTION: *The wiper arms and blades must not be moved manually from side to side or damage could result.*

WIPER BLADE REPLACEMENT

(1) To remove wiper blade from mounting pin on wiper arm, pull up on retainer spring and remove wiper blade (fig. 3T-5).

(2) To install, push blade frame onto mounting pin so that retainer spring engages pin. Be sure blade is securely attached to arm.

WIPER BLADE ELEMENT REPLACEMENT

(1) Place frame of wiper blade on a firm surface with notched end of blade element backing strip as shown in figure 3T-6.

(2) Pull up and twist counterclockwise plastic backing strip, unlocking backing strip from retaining tab.

(3) Slide backing strip down and align with next retaining tab, twist slightly and unlock backing strip from retaining tab.

(4) Repeat procedure for remaining tabs until blade element is detached from frame.

(5) To install, engage notched end of blade element backing strip with first wiper blade frame retaining tab.

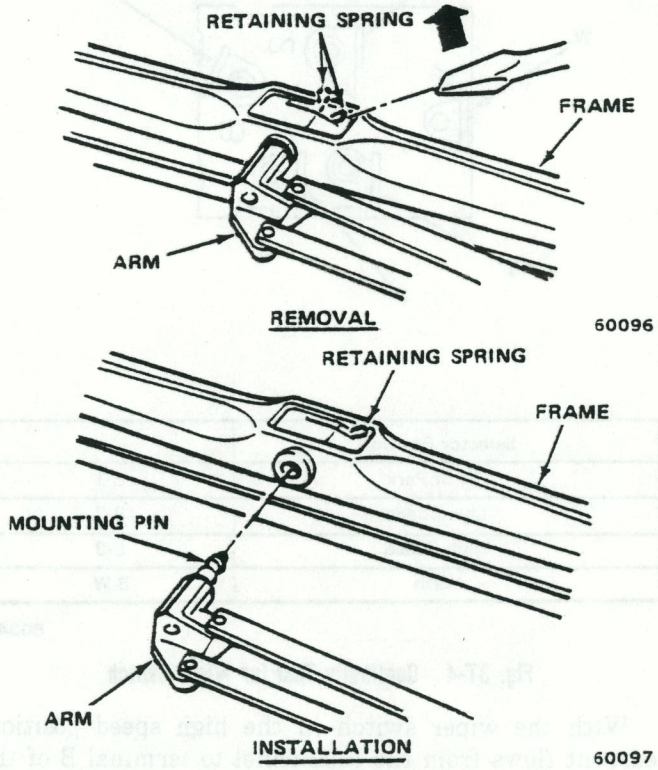


Fig. 3T-5 Wiper Blade Replacement

(6) Slide backing strip up and align with next backing strip.

(7) Repeat procedure for next three retaining tabs.

(8) For last retaining tab, place frame on firm surface, pull up and twist backing strip clockwise, locking strip into retaining tab.

WIPER ARM REPLACEMENT

(1) Raise blade end of arm from windshield and move spring tab away from pivot shaft. Disengage auxiliary arm retainer clip (driver's side only) from pivot pin and pull wiper arm from pivot shaft.

(2) To install, start wiper on pivot shaft, position auxiliary arm on pivot and slide retaining clip down to lock arm in position. Push wiper arm down on pivot shaft until it bottoms. Be sure that pivot shaft is in Park position and wiper arm is positioned as shown in figure 3T-7.

(3) Wet windshield and recheck Park position by operating wiper motor several times—ON and OFF.

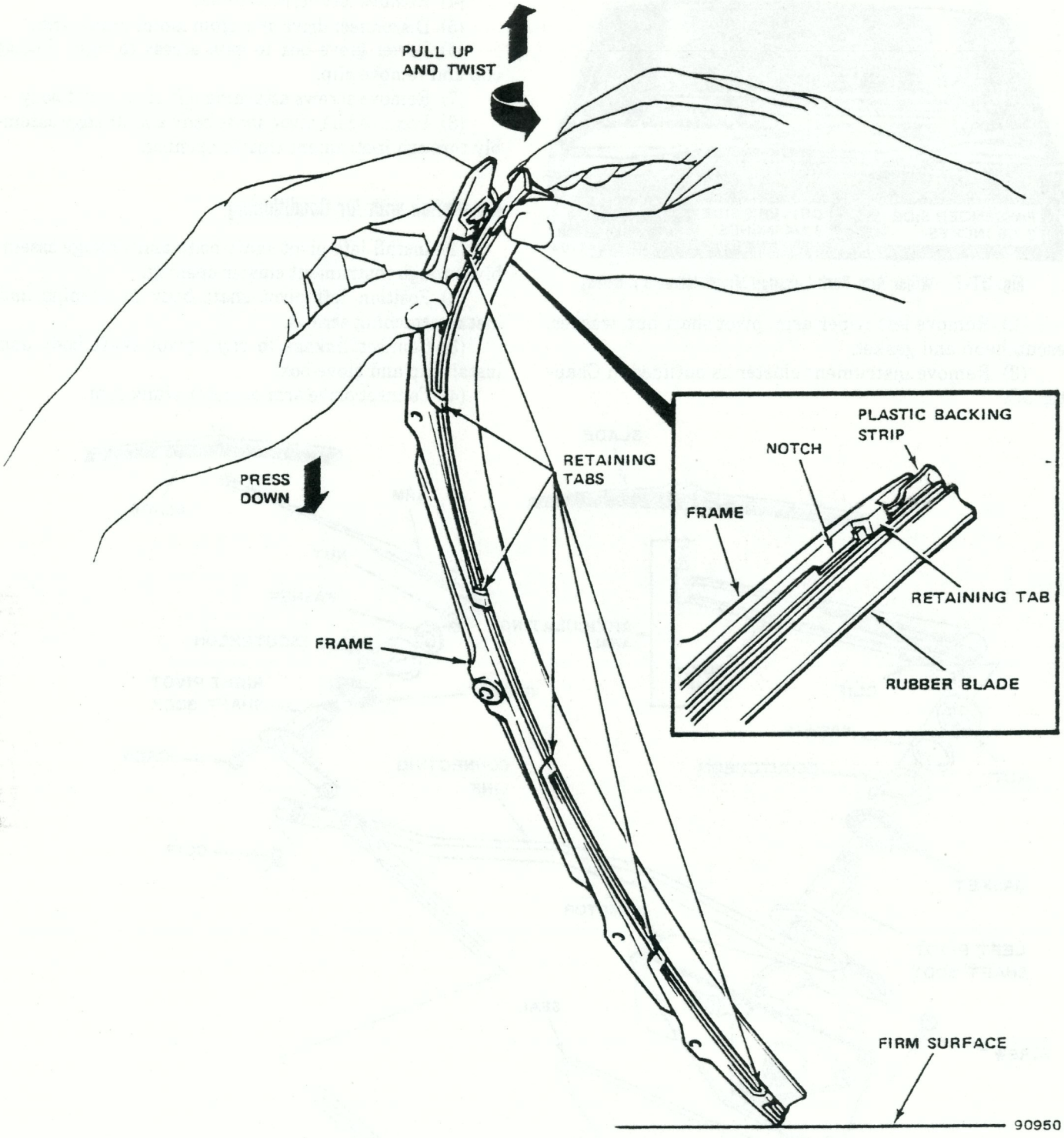


Fig. 3T-6 Wiper Blade Element Replacement

WIPER PIVOT SHAFT BODY AND LINKAGE

Removal without Air Conditioning

(1) Remove wiper arms, pivot shaft nuts, washers, escutcheons, and gaskets (fig. 3T-8).

(2) Disconnect drive arm from motor crank.

(3) Remove individual links where necessary to remove pivot shaft bodies without excessive interference.

Installation without Air Conditioning

(1) Install wiper pivot shafts and linkage.

(2) Connect drive arm to motor crank.

(3) Install gaskets, escutcheons, washers, pivot shaft nuts, and wiper arms.

Removal with Air Conditioning

(1) Disconnect battery negative cable.

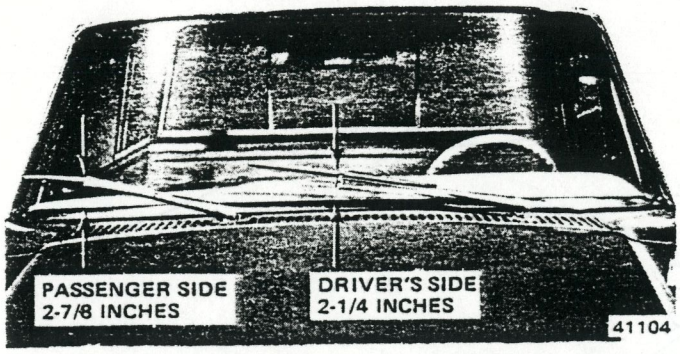


Fig. 3T-7 Wiper Arm Park Location Measurements (Inches)

(2) Remove left wiper arm, pivot shaft nut, washer, escutcheon and gasket.

(3) Remove instrument cluster as outlined in Chapter 3C.

(4) Remove left defroster duct.

(5) Disconnect drive arm from motor crank arm.

(6) Lower glove box to gain access to right linkage clip and remove clip.

(7) Remove screws attaching left pivot shaft body.

(8) Remove left pivot shaft body and linkage assembly through instrument cluster opening.

Installation with Air Conditioning

(1) Install left pivot shaft body and linkage assembly through instrument cluster opening.

(2) Position left pivot shaft body in opening and install attaching screws.

(3) Connect linkage to right pivot shaft body and install clip and glove box.

(4) Connect drive arm to motor crank arm.

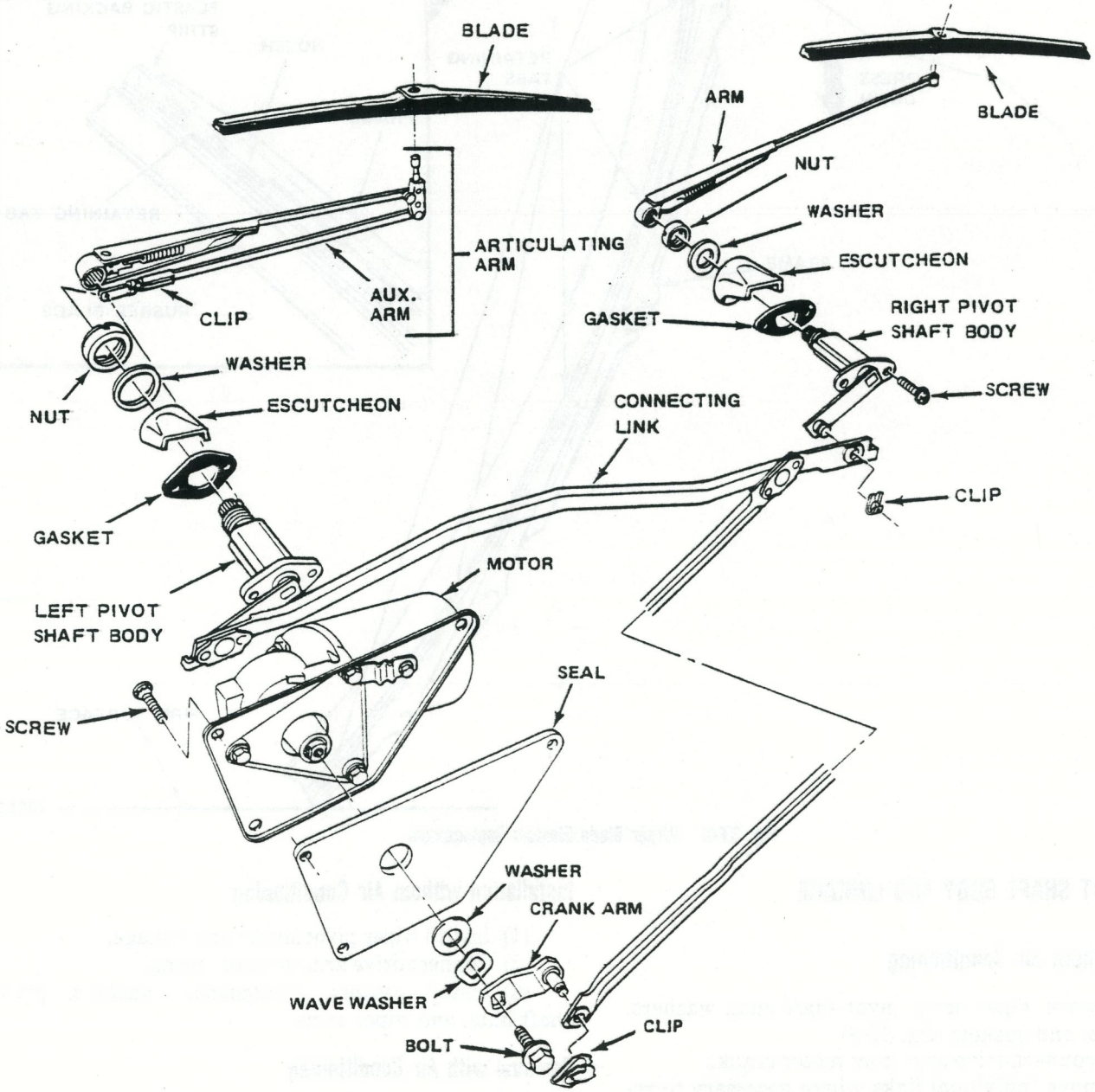


Fig. 3T-8 Windshield Wiper Components

(5) Install left defroster duct.

(6) Install instrument cluster as outlined in Chapter 3C.

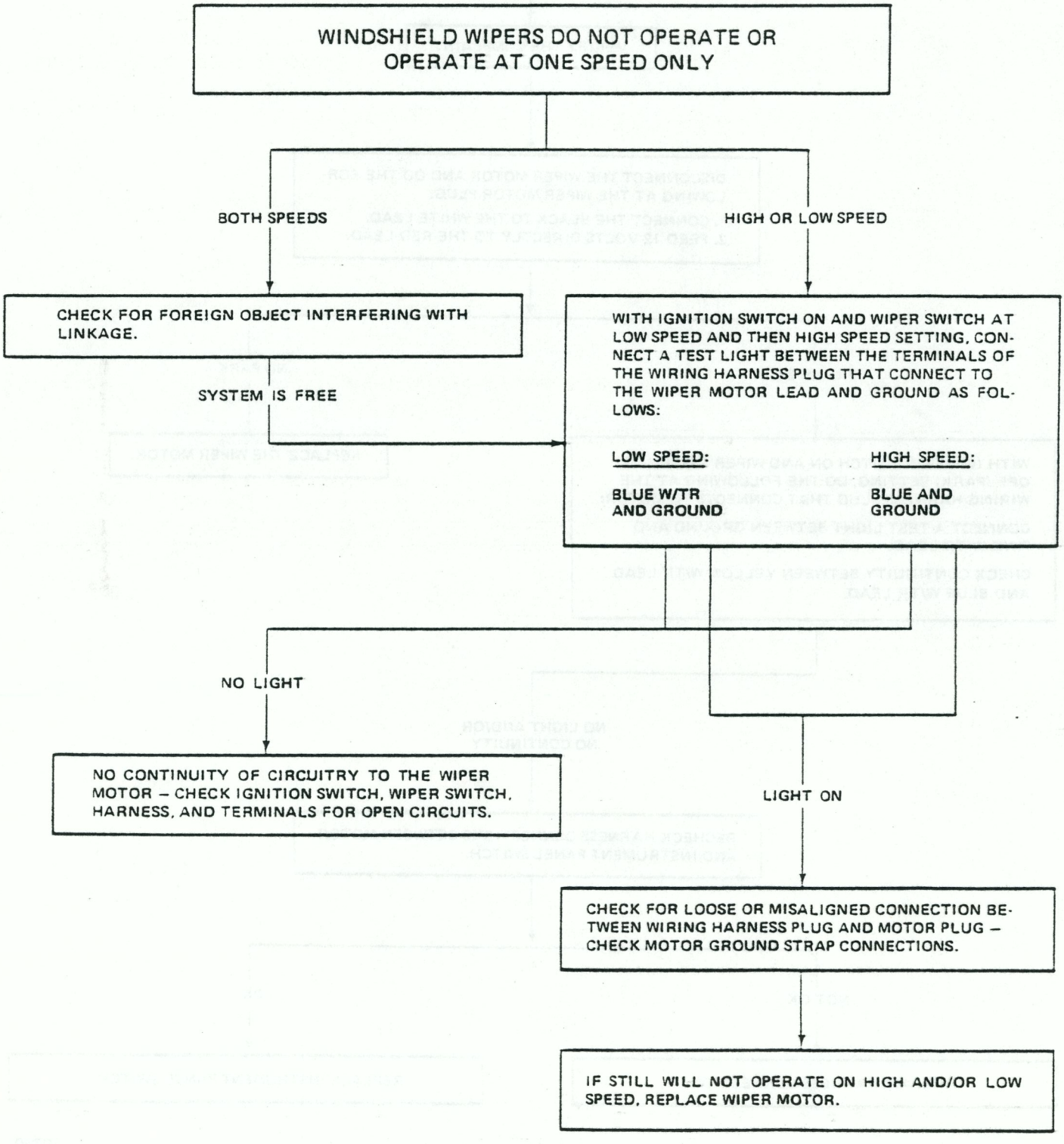
(7) Install gasket, escutcheon, washer, pivot shaft nut and left wiper arm.

(8) Connect battery negative cable.

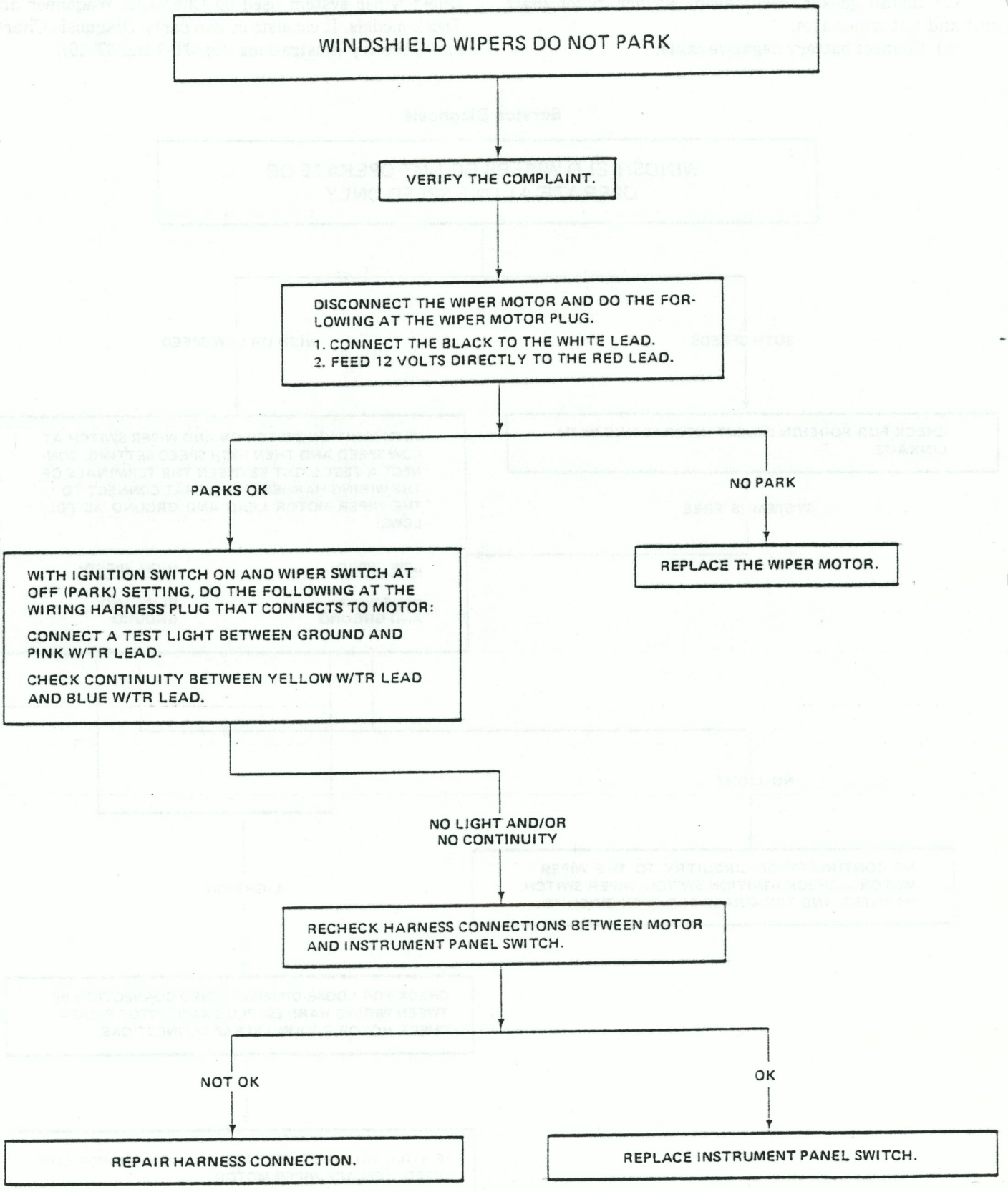
DIAGNOSIS AND CIRCUITRY

This section is a guide to troubleshooting the windshield wiper system used on Cherokee, Wagoneer and Truck models. It consists of two parts: Diagnosis Charts and Circuitry Illustrations (fig. 3T-9 and 3T-10).

Service Diagnosis



Service Diagnosis (Continued)



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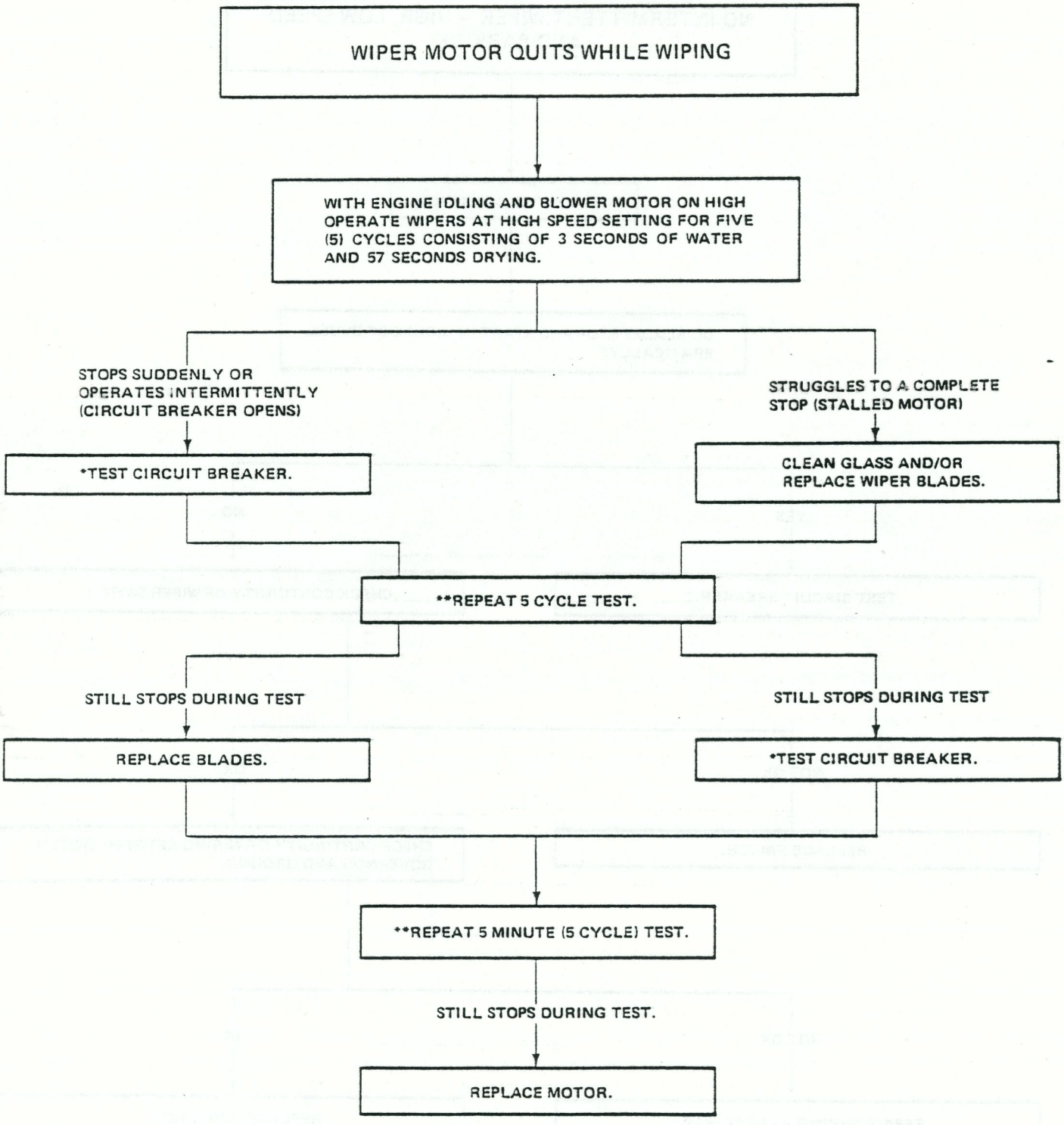
Service Diagnosis (Continued)



* CIRCUIT BREAKER IS INTEGRAL WITH INSTRUMENT PANEL SWITCH.

** ALLOW MOTOR TO COOL TO 140° F OR LOWER BEFORE STARTING REPEAT TESTS. IF MOTOR IS 140° F OR LOWER, THE HAND CAN BE HELD AGAINST MOTOR WITHOUT DISCOMFORT.

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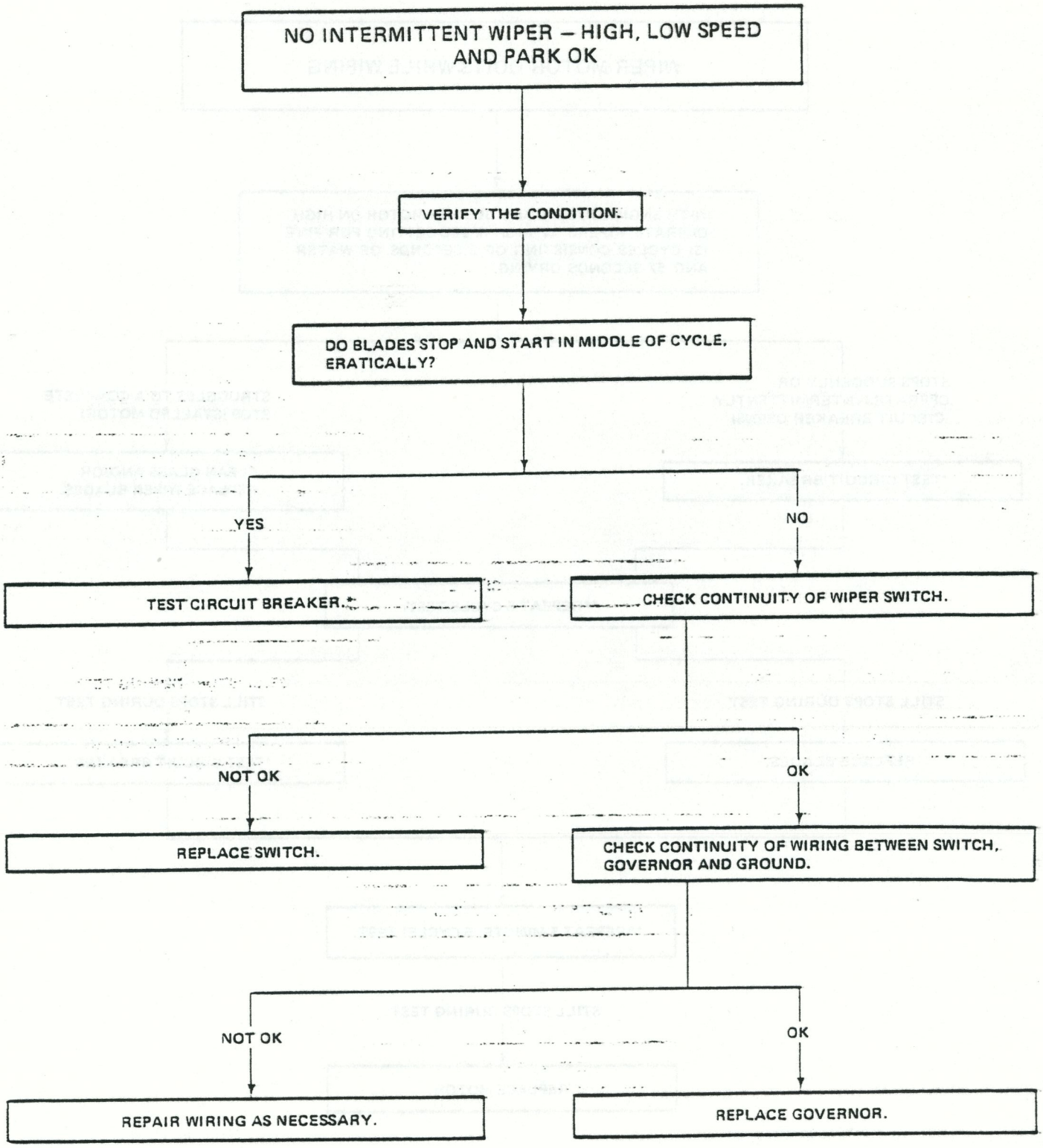
Service Diagnosis (Continued)



*WIPER SWITCHES HAVE INTERNAL CIRCUIT BREAKERS WHICH REQUIRE REPLACEMENT OF ENTIRE SWITCH.

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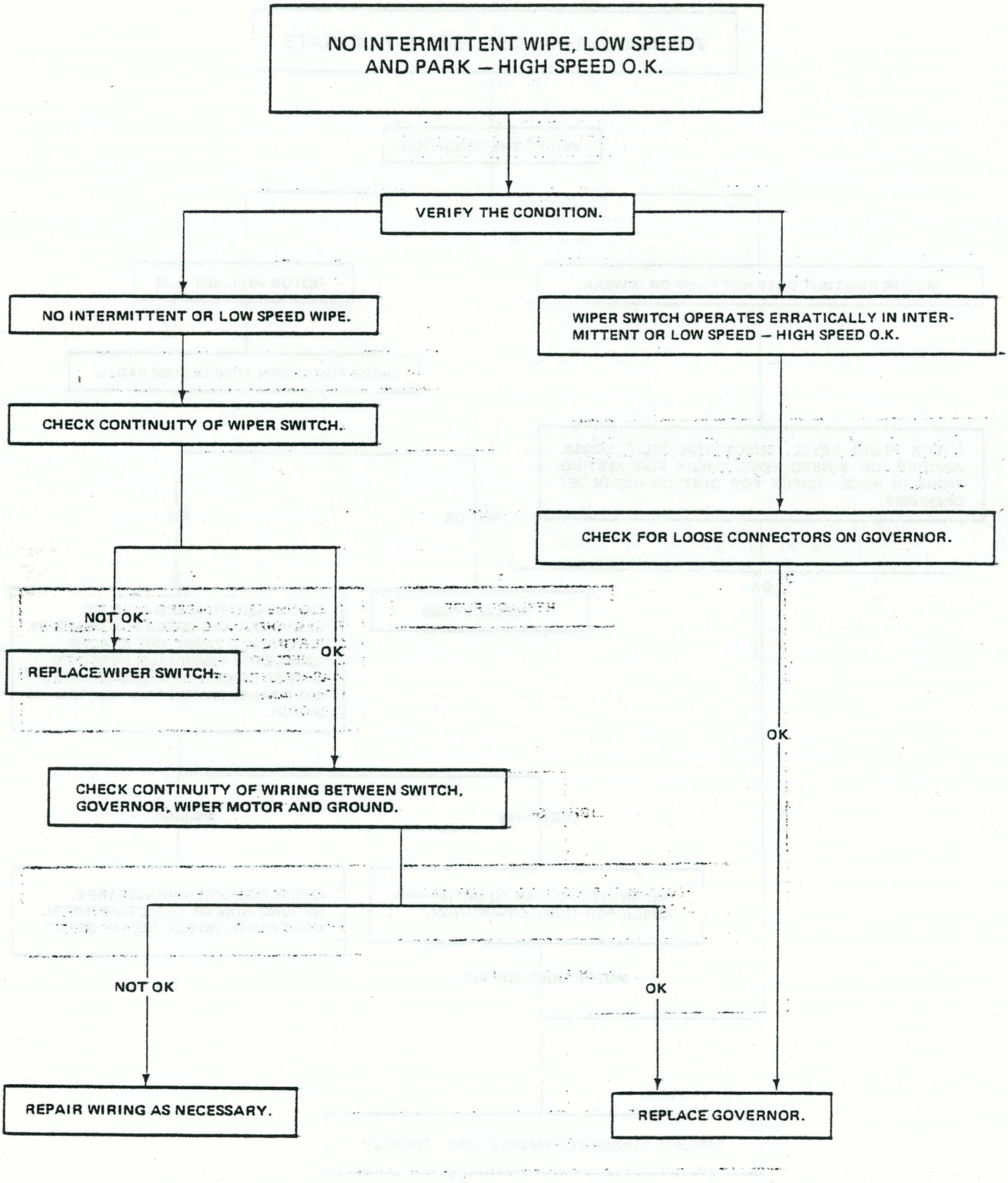
Service Diagnosis (Continued)



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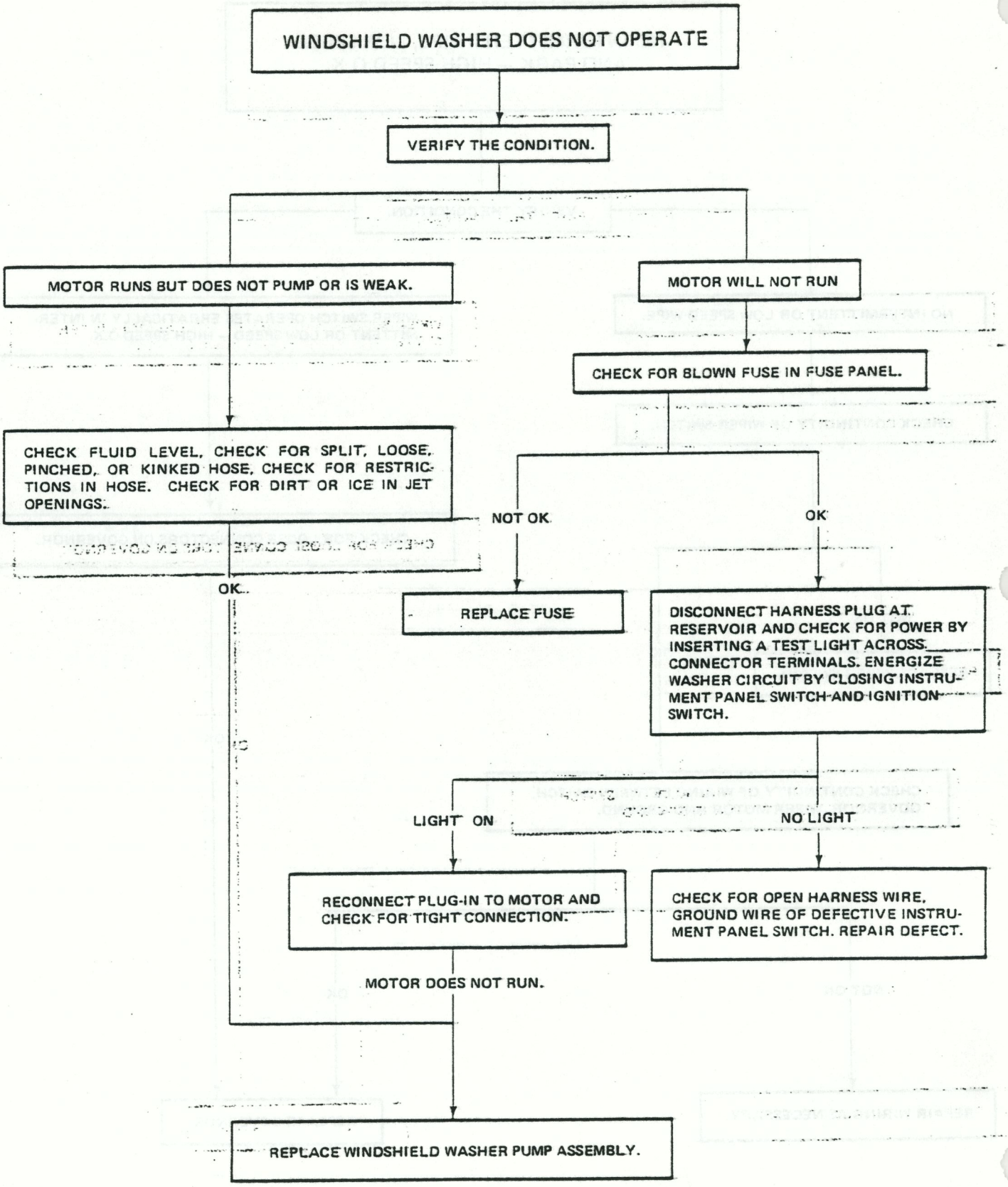
Service Diagnosis (Continued)



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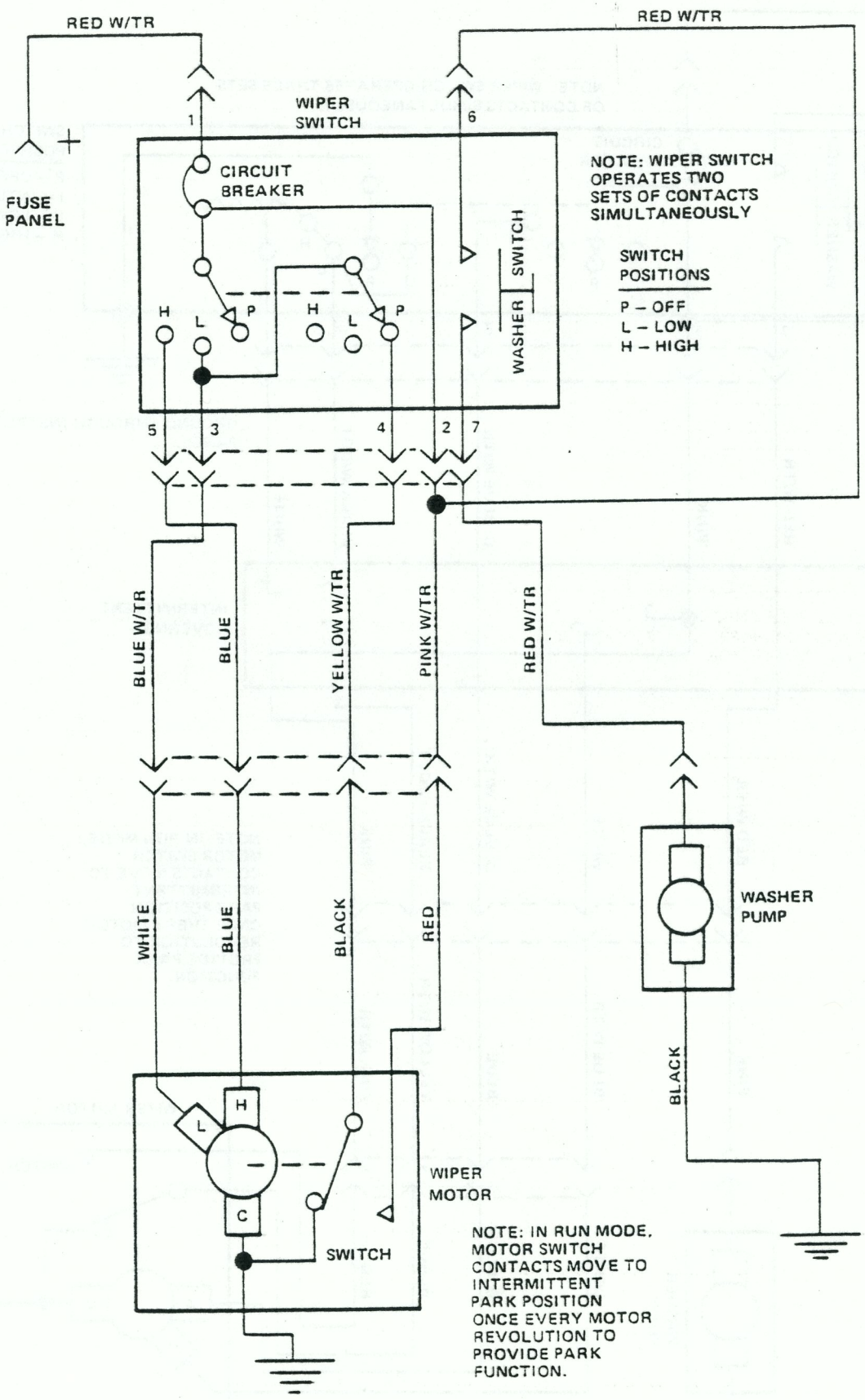

Fig. 3T-9 Windshield Wiper Circuitry

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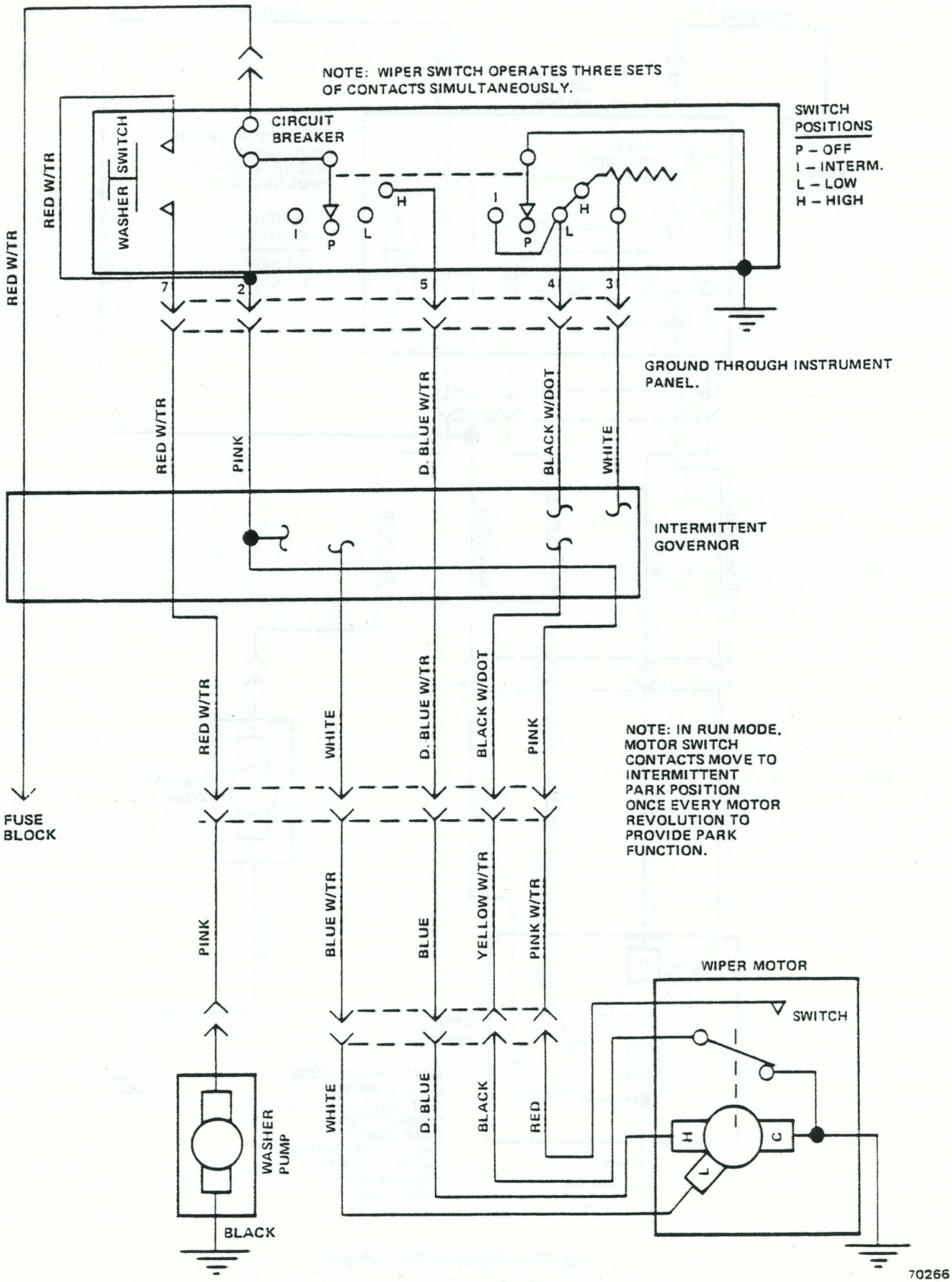


Fig. 3T-10 Windshield Wiper with Intermittent Governor Circuitry

CONTROL SWITCH

Removal

A one-way friction spring in the control knob retains it to control switch shaft. This one-way spring allows knob to be installed but prevents its removal unless spring tension is released.

(1) Disconnect battery negative cable.

(2) To remove, locate small notch at base of knob and insert a small screwdriver at that point. Apply pressure to release spring and pull knob from shaft.

(3) Remove slotted trim nut from front of switch.

(4) Push switch through instrument panel, disconnect from harness and remove.

Installation

(1) Connect switch to harness and push through instrument panel.

(2) Install slotted trim nut on front of switch and tighten.

(3) Align control knob and push on shaft.

(4) Connect battery negative cable.

Switch Test

(1) Check wiper switch continuity using Continuity Light J-21008 or an ohmmeter. Continuity should exist between terminals at various switch positions as shown in figure 3T-11.

(2) Variable resistance between number 4 and 5 terminals of an intermittent wiper system must be checked with an ohmmeter. This resistance controls governor operation for intermittent wiping. If intermittent wipe cycle is not operating, but system does operate at both low and high speed, resistance between number 4 and 5 terminals should be checked. With switch control knob rotated to full counterclockwise position, ohmmeter should indicate 5600 to 8400 ohms. As control knob is rotated in a clockwise direction, resistance should decrease to a minimum of 100 to 900 ohms.

(3) If continuity and resistance do not check out as specified, switch must be replaced. Check wiring for proper continuity if switch tests indicate proper operation.

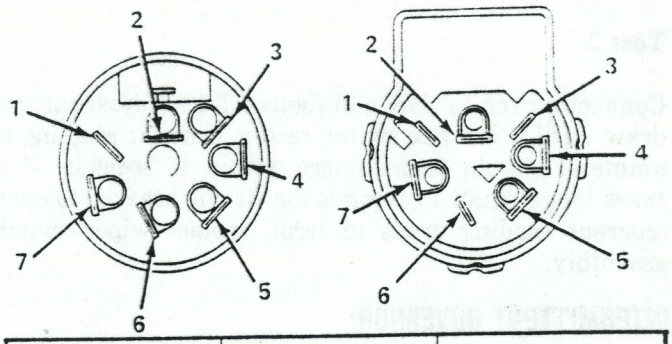
Circuit Breaker Test

The circuit breaker is located in the wiper control switch and has a rating of 7 amps.

Two separate tests are necessary to check for correct circuit breaker operation.

Test 1

Connect switch to tester as shown in figure 3T-12. Adjust current draw until it equals circuit breaker rating. Leave switch connected to tester for ten minutes. Current reading on ammeter should remain at rated current. If circuit breaker opens during ten minute period, replace wiper switch assembly.



	Standard	Intermittent
Off or Park	1-2 3-4	1-2 4-5
Low Speed	1-2-3	1-2 4-5 to Case 4-5
High Speed	1-2-5	1-2-3 4-5 to Case 4-5
Intermittent		1-2 4-5 to Case 4-5 Variable Resist. 1-9K to 7 K
Wash	1-2 6-7	1-2 6-7

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Fig. 3T-11 Continuity Test for Wiper Switches

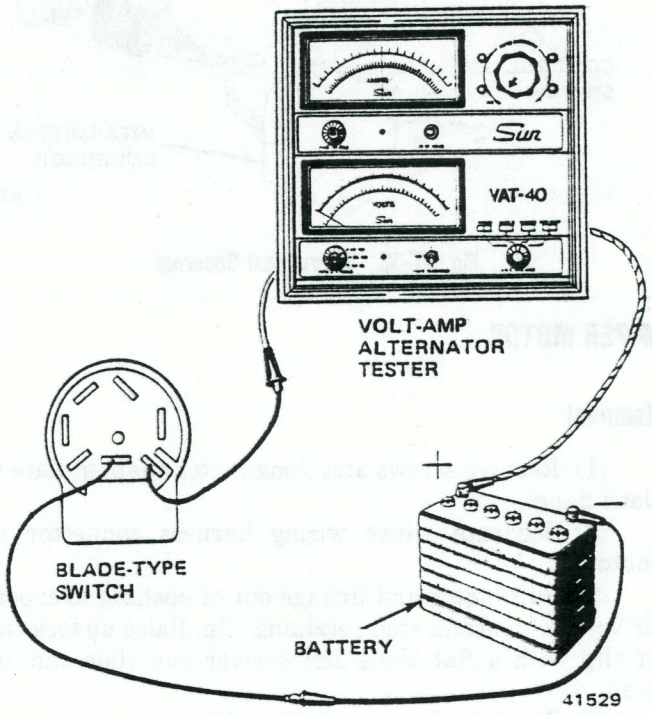


Fig. 3T-12 Circuit Breaker Test

Test 2

Connect switch as shown in figure 3T-12. Adjust current draw until it is twice switch rating. Current reading on ammeter should drop to zero within 15 seconds. If it takes longer than 15 seconds for circuit breaker to open (current reading drops to zero), replace wiper switch assembly.

INTERMITTENT GOVERNOR

To check the intermittent governor accurately requires electronic testing equipment. However, if the intermittent wipe cycle is not satisfactory, check related components such as the motor, control switch, and connecting wires. If all components function properly, install a new governor.

The electronic governor assembly is contained in a two-inch cube which is attached to an instrument panel bracket adjacent to the wiper control switch. The 6-inch governor lead plugs into the wiper control switch and the shorter, 4-inch lead plugs into the instrument panel harness (fig. 3T-13).

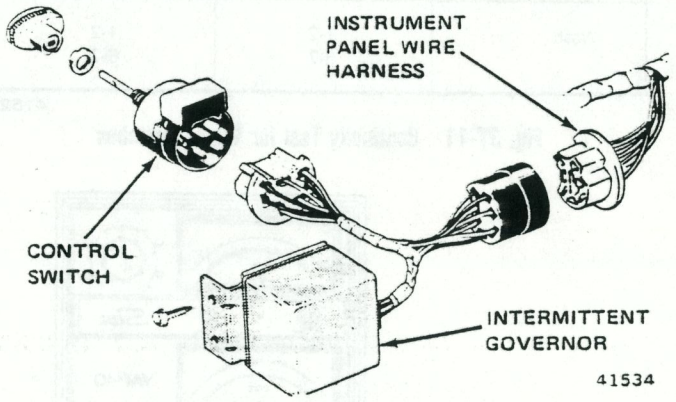


Fig. 3T-13 Intermittent Governor

WIPER MOTOR

Removal

(1) Remove screws attaching motor adapter plate to dash panel.

(2) Separate wiper wiring harness connector at motor.

(3) Pull motor and linkage out of opening to expose drive link-to-crank stud retaining clip. Raise up lock tab of clip with a flat blade screwdriver and slide clip off stud.

(4) Remove wiper motor assembly.

Installation

(1) Position wiper motor assembly and insert crank stud into drive link bushing.

(2) Press retaining clip onto stud and slide it in place in stud groove (fig. 3T-14). Check for positive retention.

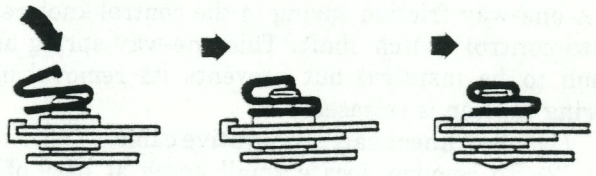


Fig. 3T-14 Linkage Retainer Clip Installation Sequence

(3) Install wiper motor attaching screws. Tighten attaching screws to 25 inch-pounds (3 N•m) torque.

Current Draw Test—On Vehicle

(1) Remove wiper arms and blades and disconnect motor lead.

(2) Connect negative lead of ammeter to positive battery post (fig. 3T-15).

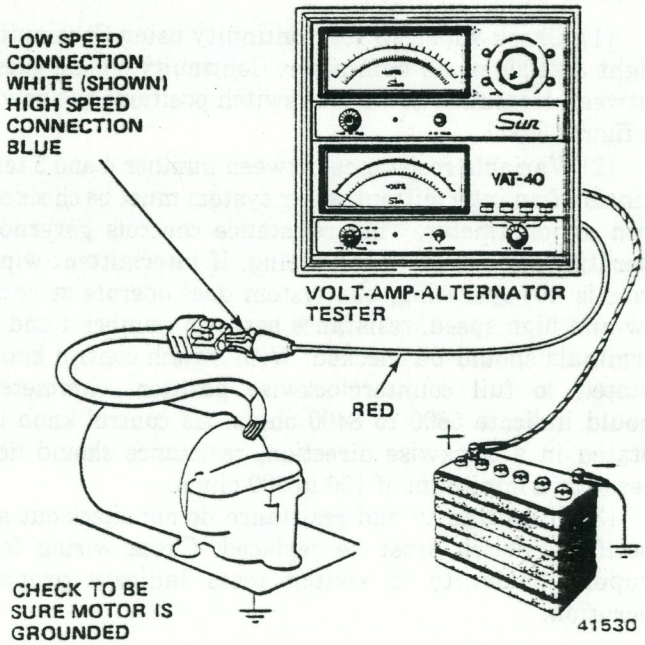


Fig. 3T-15 Wiper Motor Current Draw Test Connections

(3) Connect other ammeter test lead to blue wire w/tracer terminal (low speed) of motor harness. Current draw should be approximately one amp but not more than three amps.

(4) Connect blue wire terminal (high speed). Current draw should remain about the same. In either case, current draw should not exceed three amps.

Park Test

(1) Disconnect motor from harness connection. Temporarily contact a battery feed to either blue or blue w/tracer wire to move wiper arms and blades away from normal park position.

(2) Insert jumper wire from white to black wire terminals (fig. 3T-16).

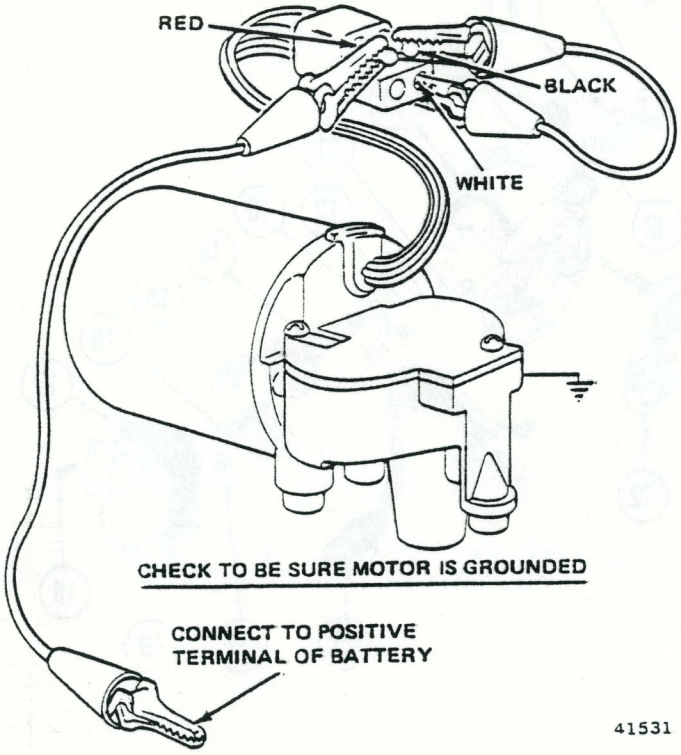


Fig. 3T-16 Park Test

(3) Contact a battery feed to red wire terminal of motor harness. Motor should operate until wipers have reached normal park position.

(4) If wiper motor does not park correctly, replace or repair wiper motor.

Disassembly

CAUTION: *The motor field consists of two permanent ceramic-type magnets which can be damaged by pounding on the motor housing or the magnets.*

NOTE: *Mark position of drive crank with respect to output shaft for correct assembly.*

(1) Remove drive crank attaching nut, drive crank, spring washer, and plain washer (fig. 3T-17).

(2) Remove screws attaching mounting bracket to motor. Separate bracket from motor and remove screw attaching ground strap to bracket.

(3) Remove screws attaching gear housing cover to housing. Remove cover and gasket.

(4) Remove idler gear and pinion by pressing shaft (with push nut) out of gear housing.

(5) Remove motor through-bolts and motor housing.

NOTE: *The field magnets will hold the armature in the motor housing as it is removed from the gear housing.*

(6) Remove end play spring, output gear and shaft, switch lever, switch washer, and seal from gear housing.

(7) Remove brushes, harness, and springs from end head.

(8) Remove end head assembly.

(9) Remove parking lever pin from gear housing.

(10) Remove all old lubricant from gear housing and components.

(11) Inspect gear housing and all components for damage or excessive wear. Replace damaged or excessively worn components.

(12) Apply a coating of American Motors All Purpose Lubricant, or equivalent, to all bearing surfaces and gears.

Assembly

(1) Position gear housing on a flat surface with inside of housing facing up.

(2) Position switch washer and switch lever in gear housing with cam rider pointing toward output shaft hole.

(3) Install seal and output gear and shaft in gear housing. Make certain switch lever is clear of cam and gear assembly.

(4) Position idler gear and pinion on shaft, and insert shaft through switch lever and switch washer into gear housing. Use a drift and hammer to lightly tap shaft to proper depth. **A 0.001 to 0.007-inch clearance between push nut and gear must be maintained to prevent preloading the idler gear.**

(5) Install end play spring in gear housing.

(6) Install parking lever pin in gear housing.

(7) Attach brush terminals and switch terminals to end head.

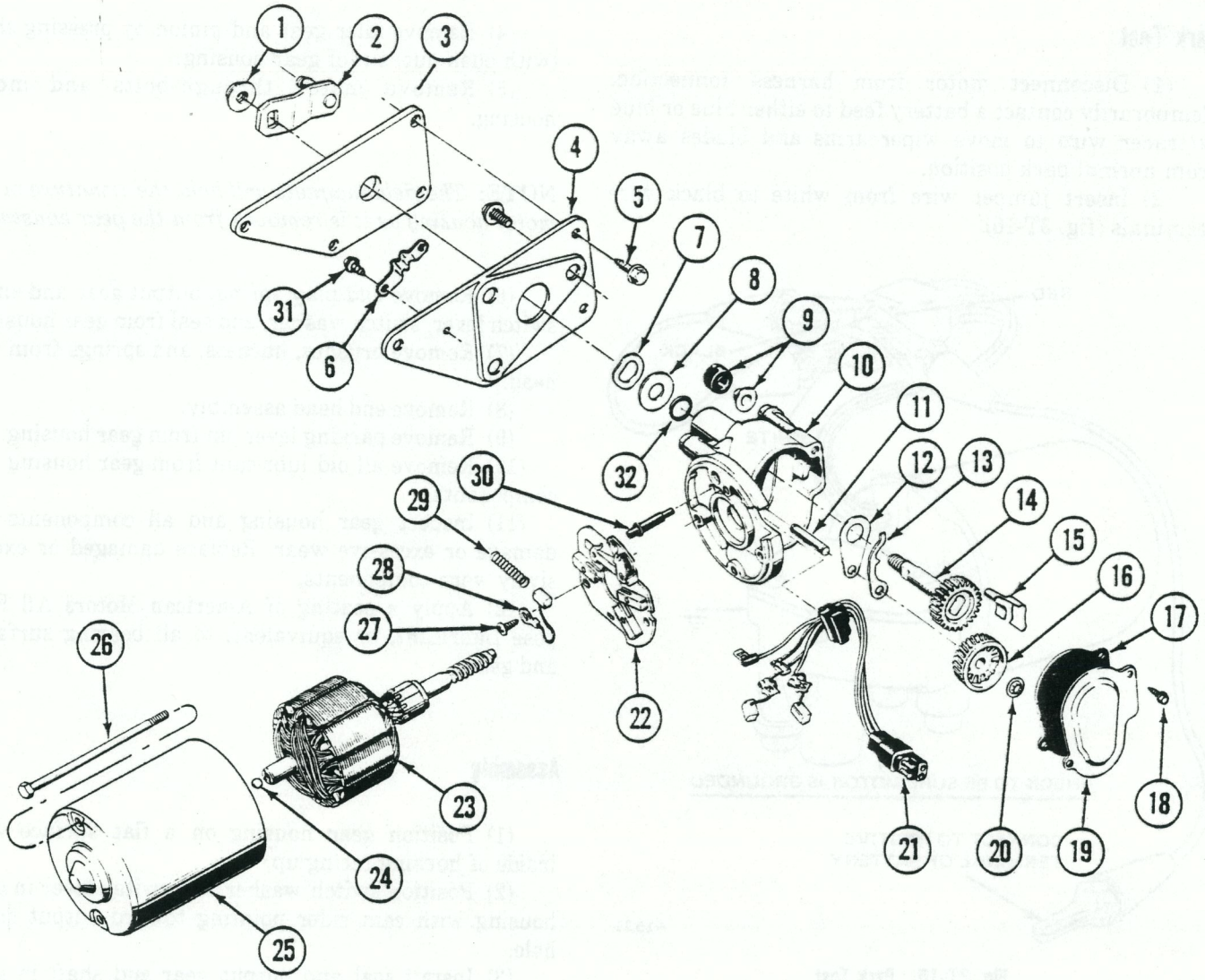
(8) Position end head on gear housing and secure with attaching screws.

(9) Install springs and brushes in end head. Hold each brush in the fully retracted position with tag wire as shown in figure 3T-18.

(10) Apply a small amount of lubricant to armature end shaft and ball.

(11) Install armature in gear housing and remove tag wire brush retainers.

NOTE: *Make certain plastic thrust button in end play spring is bearing against end of armature shaft.*



1.	NUT	11.	SHAFT	22.	END HEAD
2.	DRIVE CRANK	12.	SWITCH WASHER	23.	ARMATURE
3.	SEAL	13.	SWITCH LEVER	24.	BALL
4.	BRACKET	14.	OUTPUT GEAR AND SHAFT	25.	MOTOR HOUSING
5.	SCREW	15.	END PLAY SPRING	26.	BOLT
6.	GROUND STRAP	16.	IDLER GEAR AND PINION	27.	SCREW
7.	SPRING WASHER	17.	GASKET	28.	BRUSH
8.	PLAIN WASHER	18.	SCREW	29.	SPRING
9.	GROMMET	19.	COVER	30.	PARKING LEVER PIN
10.	GEAR HOUSING	20.	PUSH NUT	31.	SCREW
		21.	BRUSHES AND HARNESS	32.	SEAL

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Fig. 3T-17 Wiper Motor and Transmission Components

(12) Install motor housing on armature, holding armature worm gear to prevent magnetic field from pulling armature out of position in gear housing.

(13) Align indicator marks on motor housing and gear housing before inserting through-bolts.

(14) Install through-bolts securing motor housing to gear housing.

(15) Apply generous amount of lubricant to gear housing cavity.

(16) Position gasket and cover on gear housing and install two attaching screws.

(17) Position motor assembly and ground strap on mounting bracket and install ground strap attaching screw.

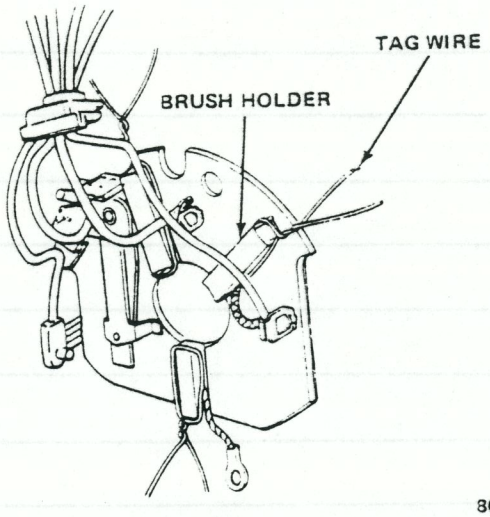

Fig. 3T-18 Tag Wire Brush Retainers

(18) Install grommets in mounting bracket and secure motor assembly to bracket with attaching screws. Tighten attaching screws to 23 inch-pounds (3 N•m) torque.

(19) Install plain washer and spring washer on output shaft, position drive crank on output shaft in the marked position from which it was removed, and install nut. Tighten nut to 120 inch-pounds (14 N•m) torque.

WINDSHIELD WASHERS

The electric pump assembly is mounted in the bottom of the water reservoir. The impeller motor case is grounded to the car body by a ground wire. It is energized by a feed wire from the number 6 and 7 terminals on the control switch.

SPECIFICATIONS

Torque Specifications

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

	USA (in-lbs)		Metric (N-m)	
	Service Set-To Torque	In-Use Recheck Torque	Service Set-To Torque	In-Use Recheck Torque
Wiper Motor MTG. Plate to Cowl	23	15-35	3	2-4
Windshield Wiper Pivot to Cowl	118	100-135	13	11-15

All Torque values given in newton-meters and inch-pounds with dry fits unless otherwise specified.

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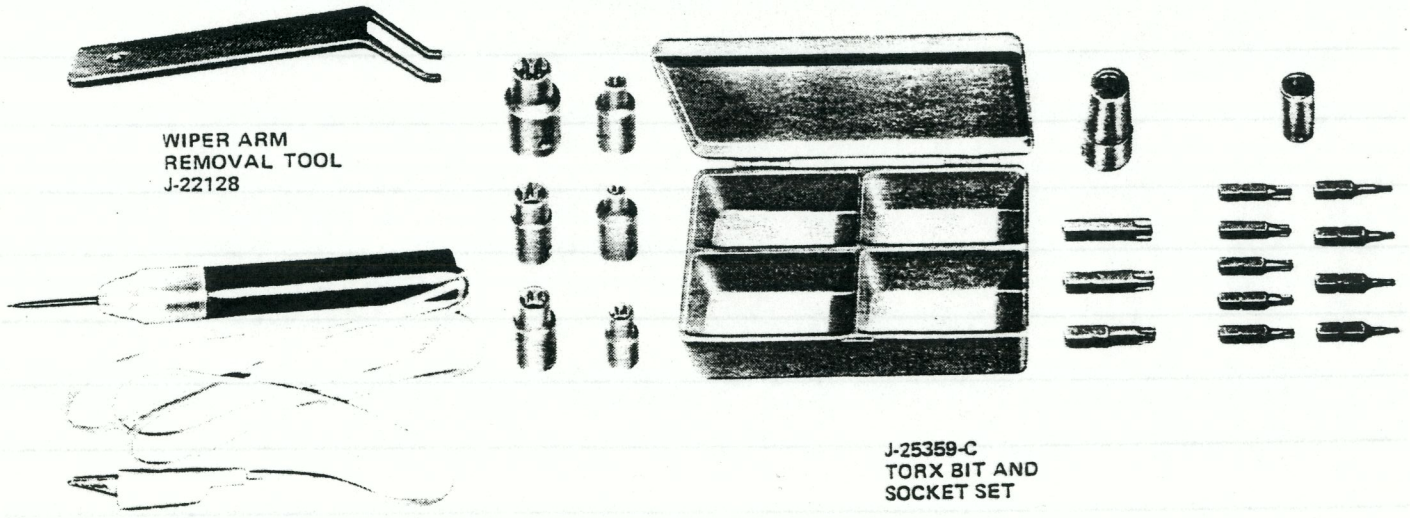
Tools



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NOTES

TAILGATE WINDOW DEFOGGER 3U

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Grid Repair	3U-3		

GENERAL

The electrically-heated tailgate window grid consists of two vertical bus bars and horizontal rows of heating elements of silver-bearing, ceramic enamel compound that is fused to the inside surface of the tailgate glass. A control switch, pilot lamp, timer-relay and wire harness complete the circuit.

Braided wire, soldered to each bus bar at 2-1/2-inch intervals, serves as the electrical feed and ground for the grid. The grid feed wire is attached to the timer-relay, mounted inside the tailgate. The feed to the relay is supplied by a wire attached to the fuse panel power tailgate terminal (fig. 3U-1).

A separate control circuit, connected to the heater control switch, operates the relay and timer in the relay.

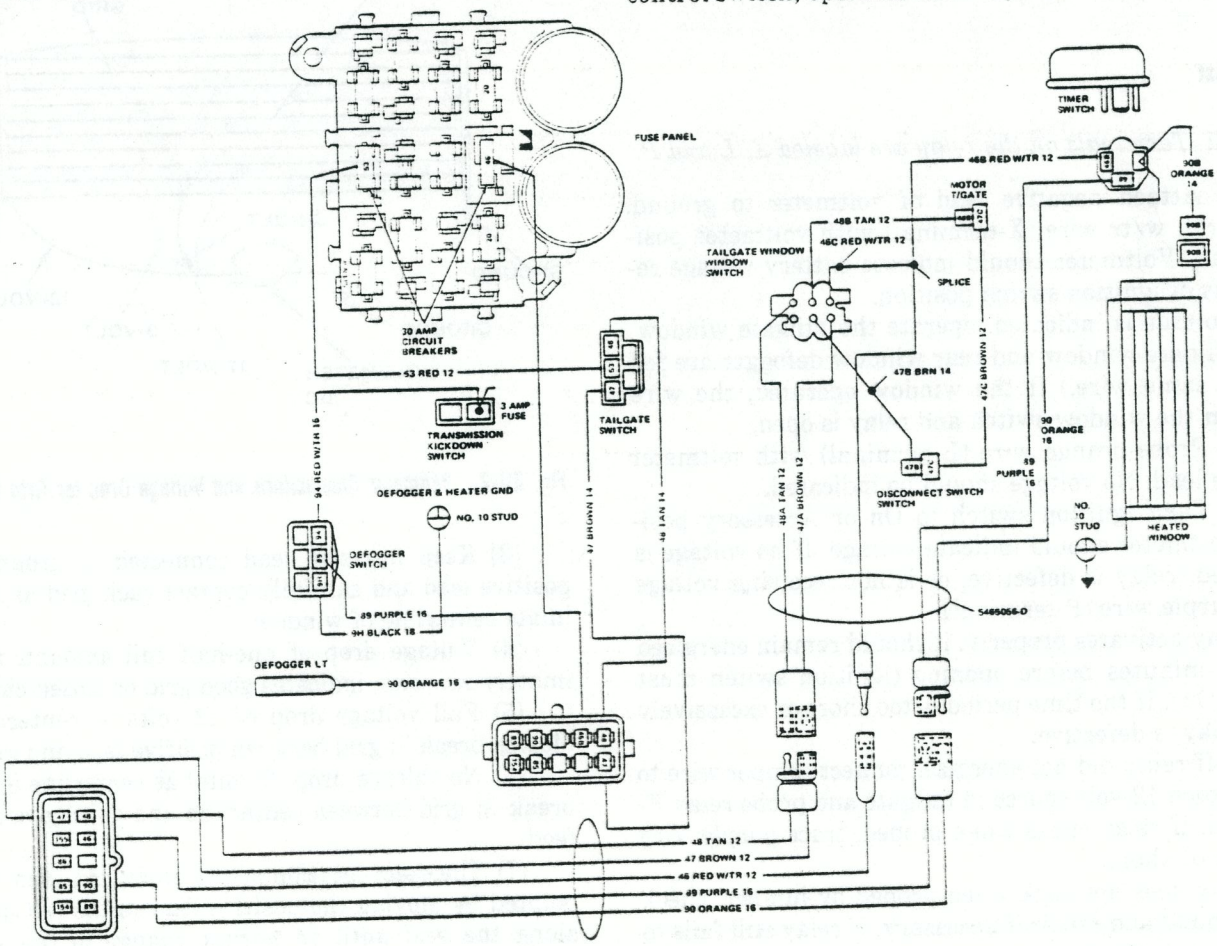

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Fig. 3U-1 Heated Rear Window Wiring Diagram

With the control switch on the instrument panel activated and ignition switch On, the relay contacts close. The timer in the relay operates the defogger for 8 to 12 minutes, depending on the ambient temperature, or until the control switch or ignition switch is turned Off. The pilot lamp indicates system operation.

NOTE: *The defogger switch and the electric tailgate window switch are serviced as an assembly.*

TESTING

Switch Test

(1) Turn ignition switch On and press defogger switch.

(2) Disconnect optional equipment wiring harness at connector under dash. Connect a 12-volt test lamp from purple wire (89) to a good ground (fig. 3U-1). Test lamp should light.

(3) Shut off defogger switch and test lamp should not light.

(4) To test indicator light, disconnect orange wire from lamp. Connect jumper wire from accessory terminal of new fuse panel to orange wire. With ignition switch turned to Accessory position, the lamp should light.

Relay Test

NOTE: *Terminals on the relay are labeled X, L and P.*

(1) Attach negative lead of voltmeter to ground. Probe red w/tr wire (X-terminal) with voltmeter positive lead. Voltmeter should indicate battery voltage regardless of ignition switch position.
If no voltage is indicated, operate the tailgate window. (The tailgate window and rear window defogger are fed by the same wire.) If the window operated, the wire between the window switch and relay is open.

(2) Probe orange wire (L-terminal) with voltmeter positive lead. No voltage should be indicated.

(3) Turn ignition switch to On or Accessory position. Voltmeter should indicate voltage. If no voltage is indicated, relay is defective, or is not receiving voltage from purple wire (P-terminal).

If relay activates properly, it should remain energized 8 to 12 minutes before opening (ignition switch must remain On). If the time period is too short or excessively long, relay is defective.

(4) If relay did not energize, connect jumper wire to known good 12-volt source in tailgate and probe relay P-terminal. If relay clicks when probed, trace purple wire for open or short.

If relay does not click when probed by jumper, check relay ground and repair if necessary. If relay still fails to operate, it is defective.

Grid Test

When a grid is inoperable due to an open circuit, the area of glass normally cleared by that grid will remain fogged or iced until adequately warmed by the adjacent grids. Use the following procedure to locate a broken grid.

(1) With engine running at idle, press tailgate window defogger switch. Defogger lamp should light, indicating defogger operation.

NOTE: *The feed wire is connected to the right side (passenger side) of the window and the ground connection is on the left side of the window.*

(2) Use 12vdc voltmeter and contact positive lead of voltmeter to right side (feed) vertical bus element on inside surface of glass. Contact negative lead to left side (ground) bus element (fig. 3U-2). Voltage drop indicated on meter should be 11 to 13 volts. Connect negative lead of voltmeter to good ground—meter reading should not change.

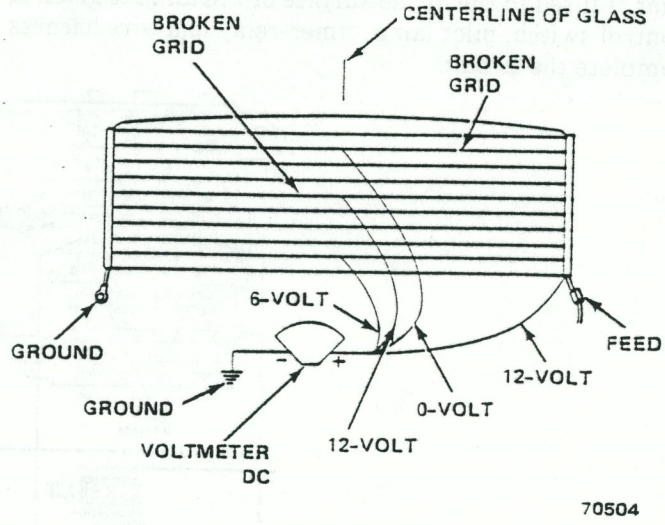

Fig. 3U-2 Voltmeter Connections and Voltage Drop for Grid Continuity

(3) Keep negative lead connected to ground. Use positive lead and carefully contact each grid at approximate centerline of window.

(4) Voltage drop of one-half full amount, approximately six volts, indicates good grid or closed circuit.

(5) Full voltage drop of 12 volts at centerline indicates break in grid between positive lead and ground.

(6) No voltage drop (0 volts) at centerline indicates break in grid between centerline and voltage source or feed.

(7) The exact location of the break can then be pinpointed by moving the positive lead to the left or right along the grid until an abrupt change in the voltage reading is noticed.

Grid Repair

Once a broken or open grid is located, repairs can be accomplished using the grid repair kit in accordance with the following procedure.

(1) Using suitable marking pencil, mark location of broken or open grid on exterior surface of glass.

(2) Using fine steel wool, lightly rub area to be repaired (inside of tailgate window). Clean area with isopropyl alcohol (rubbing alcohol).

(3) Attach two strips of cellulose tape (inside of tailgate window) above and below break in grid as shown in figure 3U-3.

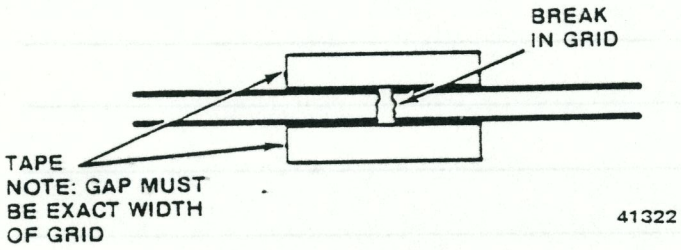

Fig. 3U-3 Tailgate Window Defogger Grid Repair

(4) Mix repair coating until uniform in consistency, with silver particles mixed throughout fluid. Apply coating to break in grid with small brush furnished in kit. Apply heavy coat of mixture, extending approximately 1/4 inch on either side of break.

(5) Start engine and press defogger switch. Run engine for one minute. Turn ignition switch off.

(6) Apply second heavy coat of mixture to break in grid, extending about 1/4 inch on either side of break.

(7) Start engine and press defogger switch. Run engine until defogger completes cycle (pilot light goes off). Turn ignition switch off.

(8) Remove cellulose tape from inside of tailgate window.

(9) Check repaired area for continuity. **Do not touch repaired area.**

CAUTION: *Do not clean repaired area for 24 hours. Then clean inside of tailgate window with liquid window cleaner.*

(10) Clean pencil markings from exterior surface of glass.

NOTE: *If a more finished appearance is desired, repaired area may be stained with tincture of iodine.*

NOTES

RADIO SOUND SYSTEMS 3V

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GENERAL

All Jeep radios are transistorized and have an output impedance of 3.2 ohms. They operate with the ignition switch in the On or Accessory positions. All models use non-adjustable, whip-style antennas. Antennas used with CB radios are slighly longer than those used with other radios.

On radios with pushbutton tuning the AM or FM stations may be preselected, using the five pushbuttons, or manually tuned. On all radios, the left-hand knob controls power (on and off) and volume. The right-hand knob controls station selection. All radios also have adjustment for the bass and treble tone quality.

AM/FM radios have a slide switch to select AM or FM reception and controls for left-right, front-rear speaker balance. During stereo reception, a small indicator light glows. The light is off during FM monaural reception. Cherokee and Wagoneer models use four speakers with the stereo radio. A speaker is mounted in each front door and rear quarter trim panel. A front-to-rear speaker fader control is used with the four-speaker system. It is located behind the manual station tuning knob. CJ and truck models use a two-speaker system with the stereo radio. On truck models a speaker is mounted in each front door. On CJ models a speaker is mounted on each side of the instrument panel.

In addition to the above features, all Citizen Band (CB) radios have a switch to change from broadcast band radio listening into the CB receive or transmit mode.

CAUTION: *Do not operate the CB radio with the antenna disconnected. Radio damage can result.*

The radio manufactured date, model and serial number are stamped on the radio case.

Setting the Pushbuttons

To set each pushbutton for automatic tuning, proceed as follows:

(1) Move vehicle outside building and away from high tension lines.

(2) Permit radio to warm up for several seconds.

(3) Pull pushbutton out about 1/2 inch to unlock tuner.

(4) Select station with manual tuning knob.

(5) Push pushbutton in as far as it goes (to lock the tuner) and then release it. This station is now set for automatic tuning.

(6) Follow the same procedure for the remaining pushbuttons.

Radio Polarity

When servicing the radio, the A (power) lead must be connected to the positive side of the power source. If connected to the negative side, the radio will not operate and damage to components will result.

The radio is grounded internally. The ground return circuit is completed by grounding the radio chassis to the instrument panel. When testing on the bench, a ground jumper wire must be attached between the radio chassis and the negative terminal of a 12-volt battery or power supply to complete the power circuit.

ANTENNA TRIMMER

Antenna trimmer adjustment is necessary to match the vehicle radio circuit to the vehicle antenna. The adjustment should be made after installation of a radio or antenna, or after repair to a radio. The adjustment also should be checked whenever radio reception is unsatisfactory.

Adjuster Location

- AM and AM/FM radio: just above the tuning control.
- AM/FM stereo with tape player: in the tape cartridge slot.
- AM/FM/CB: just left of pushbuttons on face plate.

Trimmer Adjustment

The trimmer adjustment should be made when the radio is tuned to a very weak station. It is not necessary to be able to receive an understandable station. The object is to obtain the greatest volume while the volume control is at a medium setting.

(1) Switch radio to the AM broadcast band.

(2) Turn on radio and allow to warmup for several seconds.

(3) Turn station control knob to 1400 KC range and obtain radio station signal. Turn to medium volume.

(4) On AM and AM/FM radios, remove inner and outer station tuning control knobs (radios without tape player). On AM/FM/Tape radios, open tape door. On AM/FM/CB radio the AM adjustment is on the face of the radio. The CB adjustment procedure is found in the Tuning Antenna Splitter section.

(5) Engage small slotted screw head with standard screwdriver.

(6) Turn screw left or right until the greatest vol ume can be obtained **without touching the volume control.**

(7) Install inner and outer tuning control knobs, if removed.

CONTROLS

AM Radio

The AM radio (fig. 3V-1) has one dash-mounted speaker as standard equipment. The dial bulb is controlled by the on-off switch; therefore, the bulb has no brilliance control.

AM/FM Multiplex Radio

An optional AM/FM two-speaker stereo radio is available on CJ and truck models. Both speakers are mounted in the instrument panel on CJ models and in the doors on truck models (fig. 3V-2).

All Cherokee and Wagoneer models have optional four-speaker systems, one speaker in each front door with rear speakers mounted in the rear trim panels.

The radio has external fader and balance controls (fig. 3V-2). An indicator light will come on whenever the radio is receiving a stereo signal.

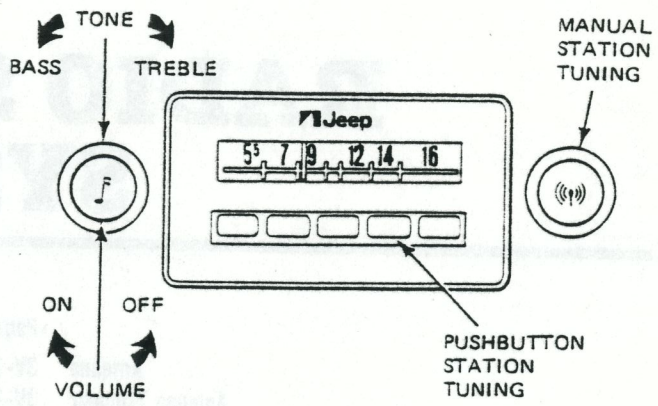

Fig. 3V-1 AM Radio Controls

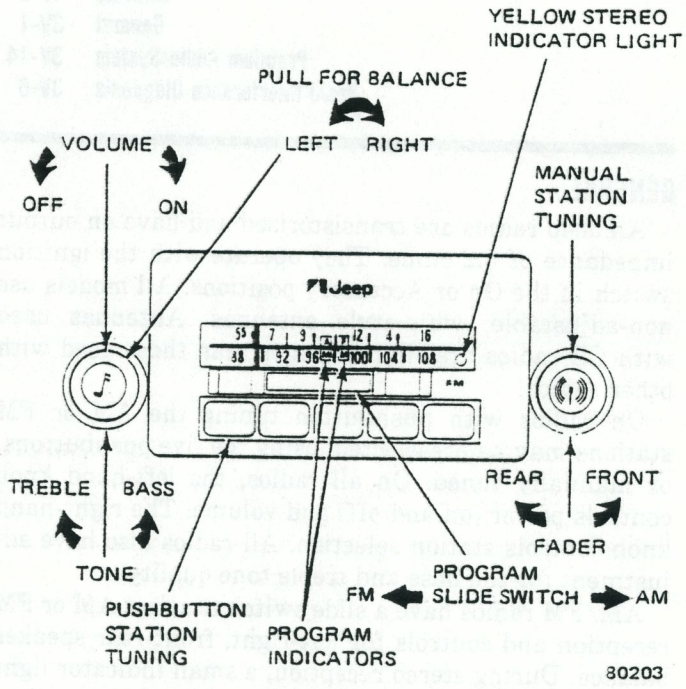

Fig. 3V-2 AM/FM/ Stereo Radio Controls

AM/FM Multiplex Tape Radio

The AM/FM multiplex radio has a built-in, 8-track stereo tape player (fig. 3V-3). AM or FM program selection is made by moving the slide switch (located on the right of the dial face) up or down for the desired programming. Left to right balance has been preset for equal balance and should not require any adjustment. However, should it become necessary to adjust for left-to-right balance, the balance control is located in the tape cartridge slot and is adjustable with a small standard screwdriver (fig. 3V-4).

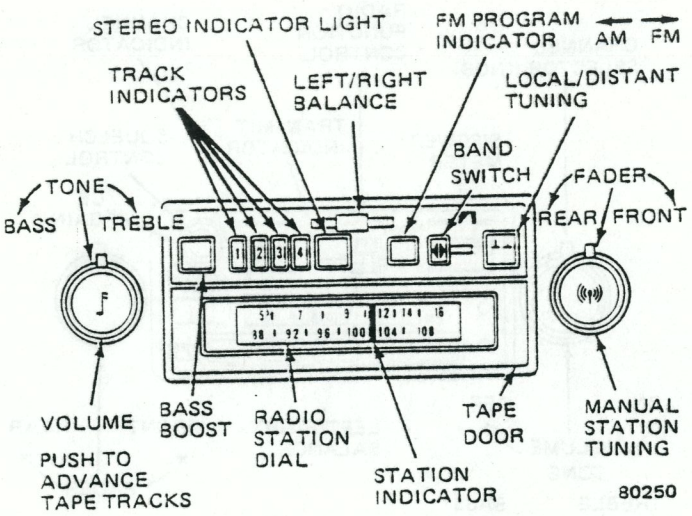

Fig. 3V-3 AM/FM Multiplex Tape Radio

Tape Player Operation

To operate the tape player, place the tape cartridge, open tape end first and labeled side up, in the slot and push in until it is firmly seated. The unit will play the selection on the inserted tape.

To manually change selections, push in and release the left-hand volume control. Each program track will automatically change and play in succession without pushing control.

To turn the tape player off, pull the tape cartridge out approximately one inch.

Stereo Test Tape

A Stereo Test Tape Cartridge, J-22683-01, is available for checking the operation of the tape player. This tape provides a means of checking the player for proper tape speed, crosstalk and sound. Follow the instructions on the tape cartridge.

Tape Head and Capstan Cleaning

One major cause of improper tape player operation is oxide buildup on the head. During normal operation, iron oxide particles are loosened from the tape and built up on the head. This accumulation of oxide can cause poor playback and some up and down tape travel. The head and drive capstan should be cleaned whenever the unit is serviced, or when poor playback or tape travel is noted.

Cleaning may be done either in the vehicle or on a service bench. To clean the head, use a cotton swab moistened with commercially available tape head cleaner or isopropyl alcohol. Wipe capstan and tape head dry (fig. 3V-4). If a commercial tape head cleaner is used, follow the manufacturer's recommended cleaning procedure.

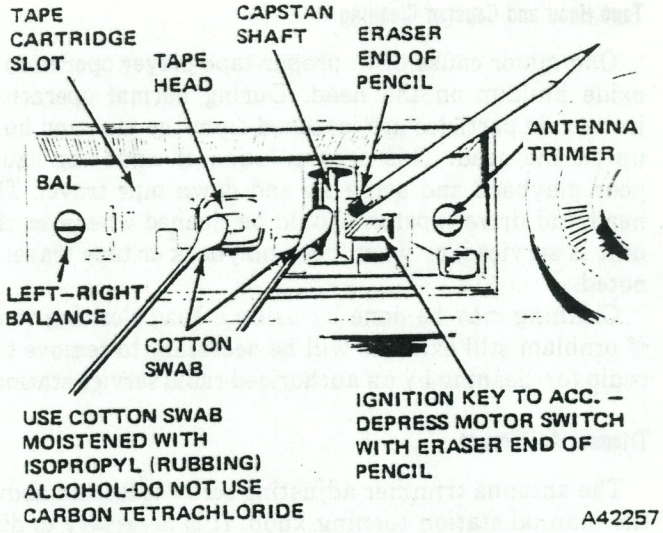

Fig. 3V-4 Tape Head and Capstan Cleaning Procedure

AM/FM/Cassette Stereo Radio

The stereo cassette player (fig. 3V-5) uses cassette cartridges. To operate, insert cartridge into cartridge door. With power on, the cassette will begin playing in the direction of the arrow located on either side of the fast-forward/rewind control. To play the other side of the tape, push the left-hand control knob. The auto-reverse mechanism will automatically begin playing the opposite side of the tape when the first side is completed. To advance or rewind the tape, slide the fast-forward/rewind knob to the desired position. The knob will remain in either position until it is moved back to the center position. To eject a cartridge, push the right-hand control knob. The cartridge will automatically eject when the radio is turned off or the ignition switch is turned off.

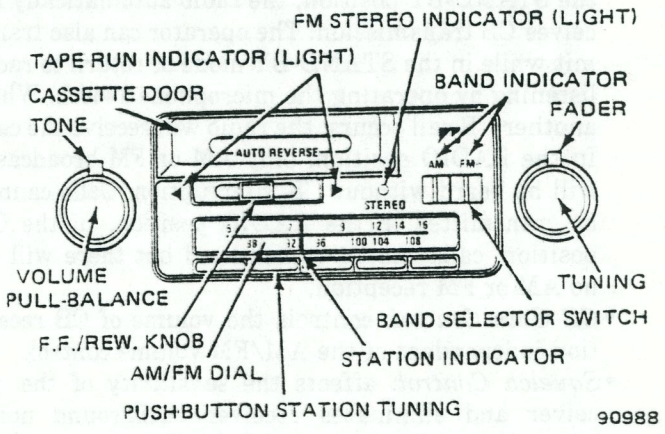

Fig. 3V-5 AM/FM/Cassette Stereo Radio

Bulb Replacement

The radio bulb can be replaced by an authorized radio service station.

Tape Head and Capstan Cleaning

One major cause of improper tape player operation is oxide buildup on the head. During normal operation, iron oxide particles are loosened from the tape and built up on the head. This accumulation of oxide can cause poor playback and some up and down tape travel. The head and drive capstan should be cleaned whenever the unit is serviced, or when poor playback or tape travel is noted.

Cleaning may be done by using a head cleaning tape. If problem still exists it will be necessary to remove the radio for cleaning by an authorized radio service station.

Trimmer Adjustment

The antenna trimmer adjusting screw is located above the manual station turning knob. It is necessary to disconnect the front of the radio and push the radio forward to gain access to the trimmer adjusting screw.

Cassette Test Tape

A cassette test tape J-23724 is available for checking the operation of the cassette player. This tape provides a means of checking the player for proper tape speed. Follow the instructions on the cassette test tape.

CB Radios

CB Radio Controls

Refer to figures 3V-6 and 3V-7.

- *S-RF Meter*: indicates output power when transmitting and the input signal strength when receiving.
- *Stand-By Mode Switch*: permits listening to the AM or FM broadcast band until receiving a CB call. In the STAND-BY position, the radio automatically receives CB transmission. The operator can also transmit while in the STAND-BY mode or return to radio listening by operating the microphone switch. When another CB call occurs, the radio will receive the call. In the RADIO position, only AM or FM broadcasts will be heard without CB interruption. Calls cannot be transmitted in the RADIO position. In the CB position, calls can be transmitted but there will be no AM or FM reception.
- *CB Gain Control*: controls the volume of CB reception independent of the AM/FM volume control.
- *Squelch Control*: affects the sensitivity of the receiver and eliminates receiver background noise when no signal or a weak signal is being received.

CB Operation—To Receive

(1) Center speaker balance control.
(2) Rotate squelch control fully counterclockwise.
(3) Set Radio/CB selector switch to CB position.

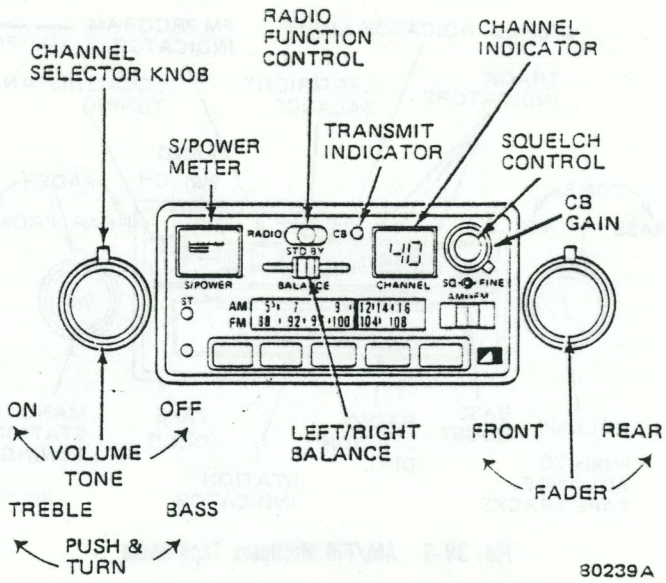

Fig. 3V-6 AM/FM/CB Radio—CB Controls

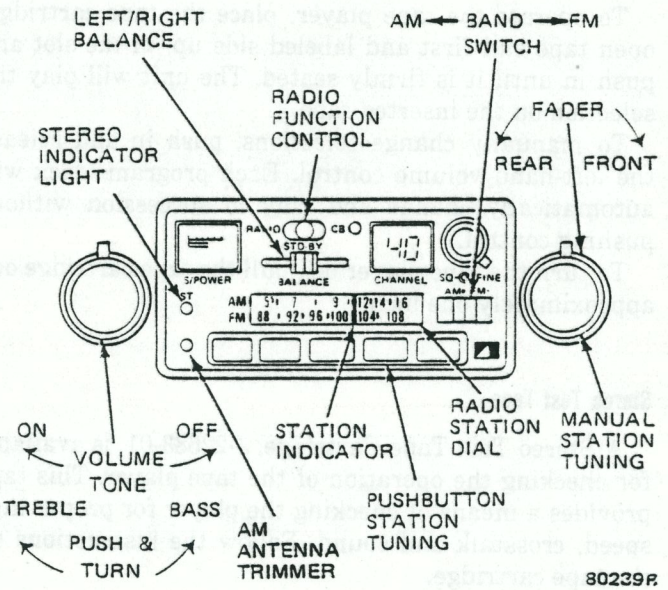

Fig. 3V-7 AM/FM/CB Radio—AM/FM/Controls

(4) Rotate On-Off switch clockwise until noise or signal is heard in speaker.
(5) Check to see that CB Channel indicator light is illuminated.
(6) Select desired channel.
(7) Rotate CB squelch control slowly clockwise until background noise just disappears. Do not advance control too far as weaker signals will not be heard.

CB Operation—To Transmit

(1) Select desired channel for transmitting.
(2) Depress microphone button and speak in a normal voice.
(3) Check relative output power on S-RF meter.
(4) To receive, release microphone button.

Premium Audio System

The premium audio system is used in conjunction with the AM/FM/CB, AM/FM/8-Track Tape Stereo or AM/FM/Cassette Stereo Radios.

The premium sound system provides an improved treble and bass range along with increased volume. The system is turned on and off by the ON/OFF/FADER switch located on the instrument panel. The amplifier is located on the passenger side of the vehicle above the air conditioning housing. When the system is On, the indicator lamp next to the switch will illuminate. To control the front to rear speaker balance, rotate the ON/OFF/FADER switch.

Refer to Wiring Diagrams at the end of this manual for circuit details.

RADIO RECEPTION CHARACTERISTICS

Definitions of Frequently Used Terms

AM (Amplitude Modulation): Common system of radio broadcasting (520 to 1610 kHz)..
Antenna: Device used for transmitting and receiving radio signals..
Circular Polarization: A technique of transmitting radio signals to minimize the affects of fading.
Distortion: False reproduction of the original transmitted signal.
FM (Frequency Modulation): System of radio broadcasting (88 to 108 mHz) with the added advantage of wider audio frequency response.
Fading: Variation of intensity of received radio signals.
Flutter: Momentary loss of received radio station, sometimes referred to as *picket-fencing*.
Hertz: Cycles per second.
Ignition Noise: Undesirable radio signals or noises transmitted from the automobile or an adjacent automobile that interfere with the reception of desired radio signal.
Monaural: A system utilizing a single signal on a single radio frequency (station) as distinguished from a dual channel system (FM stereo).
Multipath Reception: Signal loss or reduction due to a direct signal and a reflected signal arriving at the antenna simultaneously.
Selectivity: The ability of a radio receiver to accept the signal of one station while rejecting signals of undesireable adjacent stations.
Sensitivity: The ability of the radio receiver to receive weak stations.

AM and FM Reception

The following is a brief explanation of AM and FM reception characteristics.

Signal Transmission

The range of normal hearing is approximately 30 Hz (cyles per second) to 14,000 Hz. AM has a range of 50 to 5000 Hz. While FM, covers the entire range of normal hearing. Both AM and FM are received on a regular radio as a monaural signal.

FM Stereo receivers are capable of receiving both monaural and FM stereophonic broadcasts. These stereo broadcasts are sometimes referred to as multiplex.

Fading—Fading is not usually a problem with AM because of its long distance reception capability (fig. 3V-8). FM, on the other hand, is limited to line-of-sight reception (25 to 40 miles) under average conditions of terrain and transmitted power (fig. 3V-9). The area of good FM Stereo reception may even be slightly less than that of regular FM because of stronger signal requirements. Figure 3V-10 illustrates fading of an FM signal due to differences in terrain. Reception behind hills may be noisy (hissing or popping). This noisy reception is sometimes referred to as flutter or picket fencing.

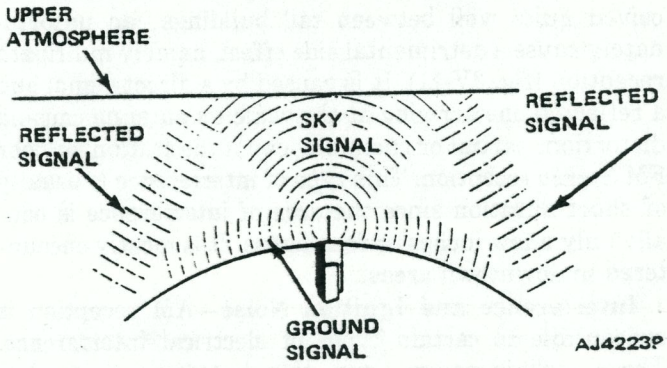

Fig. 3V-8 AM Reception—Long Distance: Follows Curvature of Earth: Reflected by Upper Atmosphere

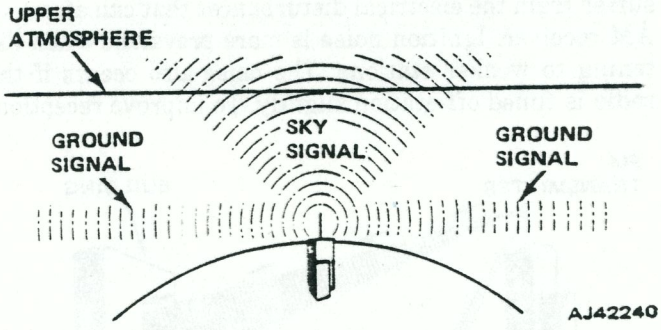

Fig. 3V-9 FM Reception—Shorter Distance: Does Not Follow Curvature of Earth: Not Reflected by Upper Atmosphere

Flutter is produced in the fringe area when objects come between the station and the receiver. The signal will be lost momentarily, then it will return. The rate which the flutter occurs is dependent upon the vehicle's speed in passing objects. The effect is very similar to the way a television set flutters in the fringe area when an airplane passes between it and the station.

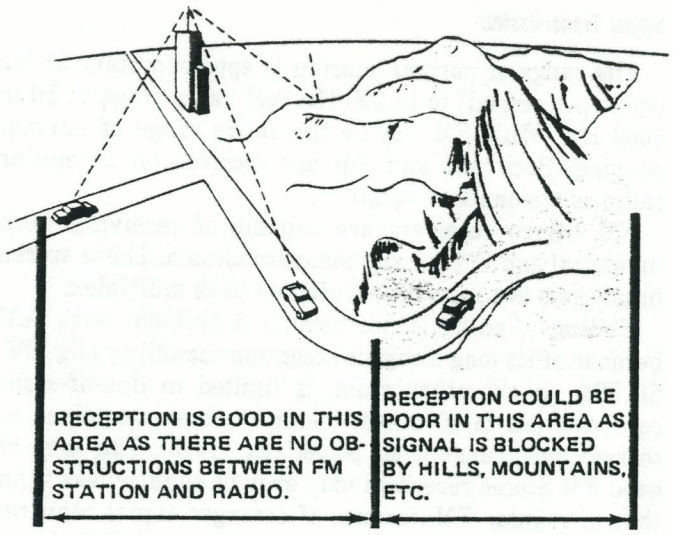

Fig. 3V-10 FM Fading

Multipath Reception—The fact that FM can be received quite well between tall buildings can unfortunately cause a detrimental side effect, namely multipath reception (fig. 3V-11). It is caused by a direct signal and a reflected one arriving at the vehicle's antenna causing distortion, partial or complete loss of the station, or poor FM Stereo reception. This type of interference is usually of short duration since the area of interference is usually only a few inches or feet across. It is mostly encountered in downtown areas.

Interference and Ignition Noise—AM reception is susceptible to certain types of electrical interference. These include power lines, thunderstorms, and other situations where electrical charges in the air cause disturbances resulting in buzzing and static.

Ignition Noise Interference—FM does not usually suffer from the electrical disturbances that can affect an AM receiver. Ignition noise is more prevalent when listening to weaker stations. The noise also occurs if the radio is tuned off-station slightly. To improve reception, make sure the radio is tuned exactly to the station or tune to a station with a strong signal. This increases station signal strength, the FM circuit rejects the noise, and it disappears. Noise will not be noticed in metropolitan areas or within approximately 25 miles of the station.

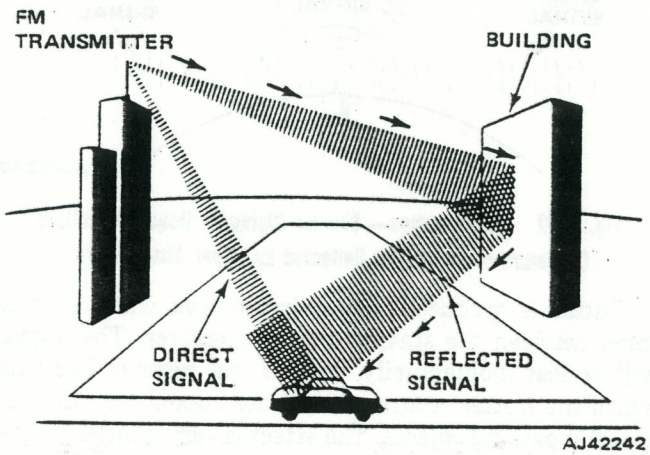

Fig. 3V-11 Multipath Reception

Other FM Interference—Occasionally, when listening to a station while driving in the vicinity of another station (especially one with a strong signal), the possibility of receiving both stations simultaneously can exist. The phenomenon is called adjacent channel interference or cross-modulation.

Using Control Effectively—Proper use of radio controls will enhance listening pleasure.

(1) Always fine-tune radio manually for clearest sound and minimum noise.

(2) Weak FM Stereo signals are inherently noisier than monaural ones when received on an FM stereo radio. To prevent this type of noise from being heard, the FM Stereo radio automatically switches from stereo to the monaural mode. The Stereo-Indicator light goes out, both speakers still operate, but without the stereo effect. When the signal strength increases to a noise-free level, the receiver switches back to the stereo mode. This action is automatic and requires no adjustment.

(3) Occasionally, conditions will be such that noise-free reception simply cannot be attained. If this occurs, set the tone control to the bass (counterclockwise) position to reduce the noise level. When out of the noisy area, set the tone control back to its normal position.

CB Radio Reception

The range of CB broadcasts and reception depends on weather conditions, amount of air traffic, strength and condition of transmitter and receiver, and the adjustment of antenna and splitter box. Range also depends on the movement between the transmitter and receiver. Reception will be clearer in open spaces with little air traffic than in congested metropolitan areas. Hilly terrain may also affect operation. Electrical interference affects reception similar to AM broadcasts.

Reception should not be fuzzy or screechy unless the network is congested.

RADIO INTERFERENCE DIAGNOSIS

General

The object of this diagnosis is to present a systematic approach to troubleshooting interference (noise) problems. First, determine if the noise is normal by referring to Radio Reception Characteristics. If the noise is abnormal, the following procedures outline methods of determining interference point of entry and elimination.

There are two major ways interference enters the radio—the antenna and the A-line or power feed wire to the radio.

Interference Entry—Antenna

Disconnect the antenna. If this causes the noise to stop, the problem is reduced to three possibilities:

- A defective antenna; refer to Radio Antenna Ohmmeter Tests
- Noise radiated upward from the dash
- Noise radiated from the engine compartment

Noise Radiated Upward from Dash

This noise can be determined by fabricating a tool out of a piece of aluminum or copper screen approximately 36 inches by 12 inches (fig. 3V-12).

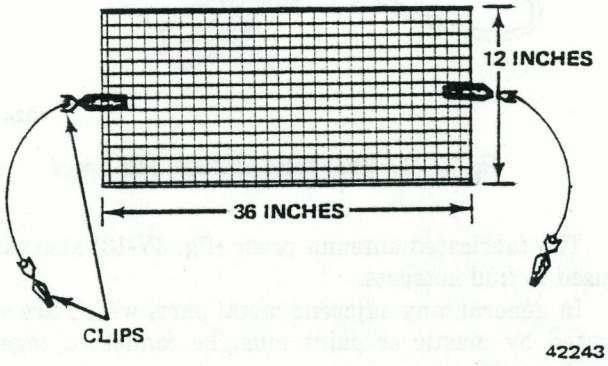

Fig. 3V-12 Improvised Noise Suppression Tool

Lay the screen across the top of the dash and attach the clips to body grounds. If the noise is diminished or disappears, the noise is being radiated up through the dash.

To determine exactly where the noise source is, a useful noise probe can be improvised from an antenna lead-in cable.

To make the probe, cut or remove the lead-in from the antenna at the antenna, remove approximately 2 inches of the outer plastic covering and the woven wire shield (fig. 3V-13).

(1) Disconnect original antenna lead-in and plug in noise probe.

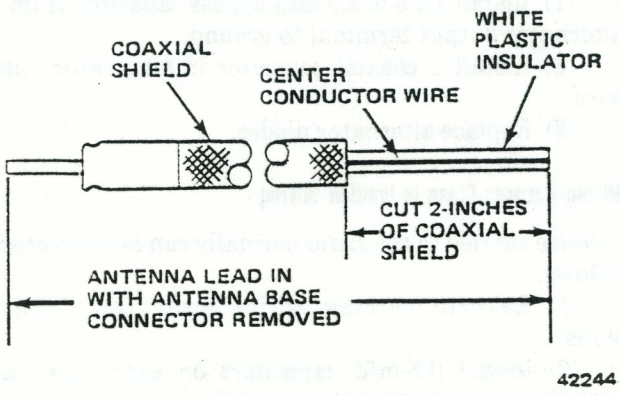

Fig. 3V-13 Noise Probe Fabrication

(2) Turn radio on and use probe to discover hotspot or source of noise. Do not touch the end of the probe with your hand as this would give an incorrect indication. As the probe comes closer to the noise source, the loudness of the noise will increase.

(3) If the source is found to be a switch, connect a 0.5-mfd capacitor from the power feed side of the switch to a good chassis ground.

(4) Gauges and sender units generally can be silenced by installing 0.5-mfd capacitors at their terminals. Install a 0.5-mfd capacitor at the battery terminal of the CVR or a 0.1-mfd, radio-type capacitor directly across the CVR terminals.

(5) If the source is found to be a wire, reroute the wire, or wrap a piece of screen around the wire or wire harness and attach one or more ground leads to the wire screen. It also may be possible to screen off the area found to be radiating noise. Be sure to ground the screen.

(6) If the noise is found to be an electric motor, install a 0.25-mfd coaxial (feed-through) capacitor in series with the motor.

Noise Radiated from the Engine Compartment

These noises can be separated into three areas:

- Primary Ignition Noise
- Secondary Ignition Noise
- Alternator Whine (Antenna)

Primary Ignition Noise

This type of noise generally affects the AM band. The noise usually appears as:

- Frequency varying with engine rpm
- Loudness varying with engine rpm
- Stops instantly when the ignition is turned to the Off position and turned to Accessory position

The first two classifications are usually the result of poor grounds on the coil capacitors or a wire routing problem. Cleaning the grounds or rerouting the wires may solve the problem.

An extra long antenna lead-in may be prepared as shown in figure 3V-12, and used as a hotspot probe.

Remove the ignition coil and its mounting bracket. Clean the paint off the bracket and the engine block, then assemble tightly. In many cases, this helps reduce the amount of interference radiated from the ignition system. Also, the installation of a hood bonding strap or device will help reduce interference radiated from the ignition system. Be sure to check the coil polarity.

In some rare cases, extra suppression may be required if the vehicle is operating in fringe areas. For those special cases perform the following steps:

(1) Install a 0.1-mfd coaxial capacitor as close as possible to the coil battery terminal, not the distributor terminal. Do not use an ordinary bypass capacitor.

(2) Install a 0.005-mfd, 1000-volt ceramic disc capacitor at the coil distributor terminal.

(3) Install a 0.5-mfd coaxial capacitor at the alternator output terminal. Be sure it is rated to handle the maximum alternator voltage.

Secondary Ignition Noise

Secondary ignition noise will always affect FM and, if severe enough, may also affect AM. Normally one of two conditions will be found in the radio.

- Ignition noise all across FM band (and possible on AM)
- Ignition noise (loud) in between stations but not on a strong station

When these conditions exist in the radio, the problem is more than likely the result of:

- Distributor cap carbon ball eroded, or cracked or loose cap
- Rotor with a burned carbon contact spot
- Secondary wire not seated in the coil or distributor
- Defective coil
- An oil film on some of the lead terminals
- Copper core secondary wiring
- Defective or improper spark plugs

If a wire was found not seated, remove the wire and check for carboned end. It is not advisable to repair an end terminal on carbon core wire; replace the entire cable.

If the noise in question sounds like one or two cylinders and definitely not all of them, then the problem is after the coil. Using the fabricated noise probe, which plugs into the radio, have someone sit in the vehicle and listen to the radio. Move the probe from plug to plug. The person in the vehicle should notice an appreciable increase in the plug noise when the defective plug is reached.

It is a good idea to install resistor spark plugs when experiencing spark plug noise. If the vehicle has copper core secondary wiring, these wires should be replaced with original equipment, carbon core resistor wires.

Alternator Whine (Antenna)

Alternator whine can be described as an annoying, high-pitched whistle, or a siren-type sound that increases and decreases with engine rpm.

Methods of eliminating alternator whine and engine interference noise:

(1) Install front fender ground straps.

(2) Install hood bonding strap or device.

(3) Run offending wire through a shielded (grounded) cable.

(4) Clean slip rings and be sure the brushes are making good contact.

A-Line (Power Feed Wire to Radio)

If disconnecting the antenna did not eliminate radio noise, the noise is probably on the A-line.

Motor noise on the A-line is usually the result of voltage spikes on this line being so large that the input filter circuit in the radio cannot handle them. There are two ways to handle this problem:

(1) Locate the cause of line noise and eliminate it.

(2) Add external filters to reduce the spikes to a point where the radio filter can handle the spikes.

A grounded capacitor touched to all hot electrical connections will often identify the offenders (fig. 3V-14).

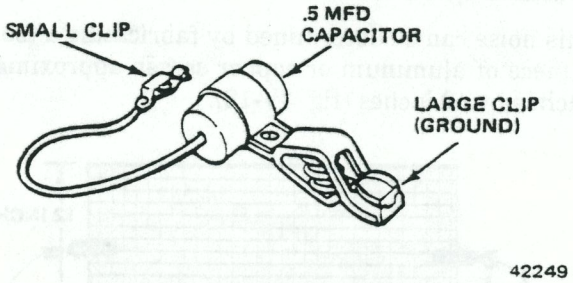

Fig. 3V-14 Interference Eliminator Test Device

The fabricated antenna probe (fig. 3V-13) also can be used to find hotspots.

In general, any adjacent metal parts which are separated by mastic or paint must be connected together electrically.

Effective bonding requires more than physically clean surfaces and self-tapping screws. Tooth-type lockwashers must be used to cut into the surface layers of metal. Grounding straps must be as short and as heavy as possible.

A-line noise is normally the result of:

- Alternator whine (A-line)
- Wiring harness too close to ignition wiring
- Radio noise suppressor
- Poor radio grounding

Alternator Whine (A-Line)

Alternator whine does not stop instantly when the key is turned quickly to the accessory position at fast idle. It is a high pitched whine which increases with rpm. Correct alternator whine as follows:

(1) Install a 0.5 to 2.0 mfd bypass capacitor from the alternator output terminal to ground.

(2) Install a coaxial capacitor in alternator output wire.

(3) Replace alternator diodes.

Wiring Harness Close to Ignition Wiring

Noise carried to the radio normally can be corrected as follows:

(1) Relocate harness wiring away from ignition wires.

(2) Install 0.5-mfd capacitors on each fuse panel lead. Be sure capacitor is grounded.

Instrument Cluster Radio Noise Suppressor

A noise suppressor is installed on Cherokee, Wagoneer and Truck models equipped with a radio. This suppressor (choke) is plugged into the back of the cluster on a printed circuit board. Be sure the choke has not been installed over the copper strip installed on vehicles not originally equipped with a radio.

Tap on the instrument panel with the ignition in the ON position and the ACC position to activate the CVR point movement. If noise only occurs in the ON position, repair noise suppressor as follows:

(1) Remove radio choke.

(2) Remove plastic covering.

(3) Unsolder one end of coil wire and remove approxiately 6-1/2 inches of wire.

(4) Resolder wire end.

(5) Wrap coil with several turns of plastic electrical tape and install choke.

Poor Radio Ground

To check for a poor ground, attach a jumper wire to the radio case and connect to a good chassis ground. If there is no change in radio noise, the radio has a good ground.

If noise changed, check for loose mounting screws and a poor ground.

Other Sources of Interference

Speaker Leads

To determine if speaker leads are inducing or picking up noise, lay the wires on top of the carpet with the wires separated. If the noise is gone, the harness is at fault. Perform one or more of the following:

(1) Separate coil wires by installing a loom over each of the wires.

(2) Install a 0.001-mfd, thumbnail-type capacitor across each speaker.

(3) Remove ground wire from harness and ground each rear speaker at the rear of vehicle.

Speaker-induced noise will normally not occur on front-mounted instrument panel speaker systems. It is more apt to occur on four-speaker systems and when the fader control is in the mid-position.

Defective Radio

Exchange with a known good radio to determine if the radio is defective.

Direct Entry into the Radio

(1) Be sure radio has a good ground.

(2) Tighten all radio chassis screws.

Wheel and Tire Static

Wheel static is another source of interference. This is a running noise most likely to be encountered when the vehicle is in motion on a hard, dry-surfaced road. The noise will remain when the vehicle is coasting with the engine and all electrical equipment turned off. The static occurs in the front wheels due to insulating film produced by the lubricant in the wheel bearings.

In some instances, static discharges take place between the tire and the road surface. An anti-static powder kit is available from radio supply houses which applies conducting material to the inside surface of the tire to eliminate noise from this source. Tire static can be checked by washing the tire with water. The water provides a conduction path to ground for the discharges. Tire static is most likely to be encountered during hot, dry seasons.

Turn and Stop Signals

The flasher in the turn signals and the switch in the stop signal may cause popping noises in the radio. In most cases, the noises are interference due to arcing in the contacts. The correction is a 0.5-mfd bypass capacitor installed at the battery connection of the switch or the flasher. It is less likely, but possible, that the low frequency components of the interruptions are reaching audio stages of the radio. The test is to check if the noise is present with the volume control turned down. If so, install a 1,000-mfd condenser.

Horn Noise

The diagnosis and cure for a growling noise in the radio when the horn is operated is the same as for Turn and Stop Signals detailed above. The suppressor capacitors are installed at the point where the battery lead feeds the horn relay.

Be sure the horn relay cover is not loose.

Accessories

Electric windshield wipers, blower motors, window regulator motors, or any brush-type motors, generally can be suppressed by installing 0.25-mfd capacitors at the terminals.

CB RADIO DIAGNOSIS

For possible CB radio problems, refer to *CB Radio Reception* to determine if the condition is normal. If problem still exists, use CB Radio test instruments (fig. 3V-15) to diagnose trouble.

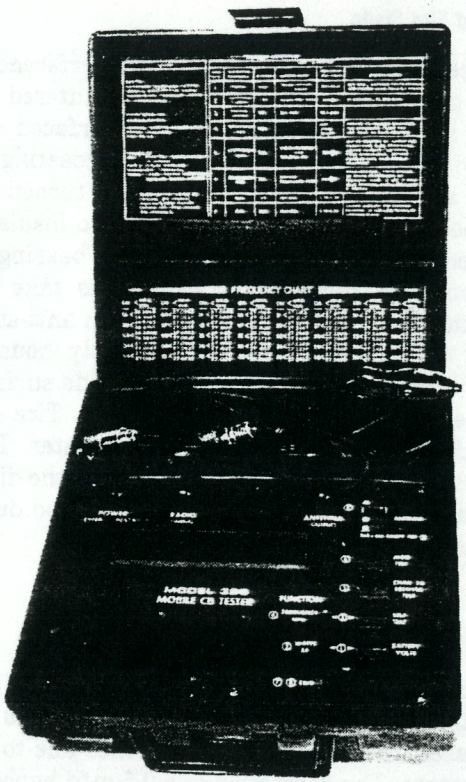

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Fig. 3V-15 Amserv AMX 386S Mobile CB Tester

RADIO REPLACEMENT

CJ Models

NOTE: *If equipped with air conditioning, remove screws attaching evaporator assembly to instrument panel and lower evaporator assembly.*

(1) Disconnect battery negative cable.
(2) Remove radio control knobs, attaching nuts, and bezel.
(3) Disconnect radio support bracket from instrument panel.
(4) Remove radio by tilting it downward and toward steering wheel.
(5) Disconnect antenna lead, speaker wires, and feed wire.
(6) Remove bracket from radio and install on replacement radio.
(7) Connect antenna lead, speaker wires, and feed wire to replacement radio.
(8) Install radio in instrument panel.
(9) Connect radio support bracket to instrument panel.
(10) Install radio bezel, attaching nuts, and control knobs.
(11) Connect battery negative cable.

Cherokee-Wagoneer-Truck Models

(1) Open glove box door and remove glove box liner and lock striker.
(2) Disconnect microphone lead from radio, if equipped.
(3) Disconnect antenna lead(s).
(4) Disconnect feed wire from fuse panel.
(5) Disconnect speaker leads from radio.
(6) Disconnect rear support bracket from radio.
(7) Remove radio control knobs and attaching nuts.
(8) Push radio back to clear instrument panel and remove it through glove box opening.
(9) Install radio in instrument panel.
(10) Install radio attaching nuts and control knobs.
(11) Connect rear support bracket.
(12) Connect feed wire to fuse panel.
(13) Connect speaker leads to radio.
(14) Connect antenna lead(s).
(15) Connect microphone lead to radio, if equipped.
(16) Install glove box liner and lock striker.

BULB REPLACEMENT

All Models

NOTE: *AM/FM/CB radio bulb replacement is accomplished by exchanging the radio.*

(1) Remove radio.
(2) Remove radio dial cover retainers and cover.
(3) Rotate manual tuning control to move pointer to extreme left or right.
(4) Remove dial light reflector clips and deflector.
(5) Remove bulb and bulb diffuser.
(6) Install diffuser on bulb and install bulb.
(7) Install dial light deflector.
(8) Install dial cover.
(9) Install radio.

ANTENNA

AM and AM/FM Models

All antennas must have good ground to eliminate static noises. The mast of the antenna is not grounded except through the radio. The base of the antenna is grounded to the vehicle sheet metal. The coaxial shield (the wire mesh) surrounding the center conductor wire of the antenna lead-in cable is grounded to the radio and the antenna base.

Tests

There are three antenna tests to be made with the use of an ohmmeter:

- Mast to ground
- Tip of mast to tip of conductor
- Body ground to battery ground

Refer to figure 3V-17.

Operating Instructions for Amserv AMX 386S Mobile CB Tester

NOTES

CAUTION:

Do not key microphone without antenna connected or antenna button in int. position if antenna is not connected.

RADIO UNDER TEST CONTROL SETTINGS

Squelch – Minimum (audible noise)
Volume – Mid-Range
Channel – 2

FAILURE OF –

Test 1 – Probable Faulty Battery or Harness
Test 2,7 – Faulty Model 386S
Tests 3 to 6 – Faulty CB
Test 8 – After antenna adjustment indicates faulty antenna.

*Limits set for typical CB systems. See specific manufacturers specifications for other radio's and antenna's.

TEST PROCEDURE

Test Step	Function Setting	Antenna	Instructions	*Readings Min.-Max.	Special Notes
1	Watts	Int.	Press-Battery Volts	12.0-16.0	Key mic., battery volts should not change more than 0.5 volts.
2	Frequency MHZ	Int.	Press-Self Test	→	27.2035 min., 27.2065 max.
3	Watts RF	Int.	Key Mic.	03.0 Min.	
4	Frequency MHZ	Int.	Key Mic.	See Freq. Chart	Rotate CB channel selector. See frequency chart for min./max. on each channel.
5	Frequency MHZ	Int.	Press-Receiver Test (Channel 20)	→	Set to channel 20. Listen for clear tone (1kHz) from radio. Adjust squelch clockwise, tone should reappear.
6	Frequency MHZ	Int.	Key Mic. Press-Mod. Test	→	Talk into mic., voice should be heard from Model 386 speaker. Note - if mic. is held near speaker, squealing sound is normal.
7	SWR	Int.	Key Mic.	1.00-1.20	
8	SWR	Ext.	Key Mic.	1.00-3.50	Adjust antenna for minimum reading.

80699

CB RADIO FREQUENCY CHART

CH. < MAX. / MIN.	CH. < MAX. / MIN.	CH. < MAX. / MIN.	CH. < MAX. / MIN.	CH. < MAX. / MIN.	CH. < MAX. / MIN.	CH. < MAX. / MIN.	CH. < MAX. / MIN.
01 < 26.9663 / 26.9637	06 < 27.0263 / 27.0237	11 < 27.0863 / 27.0837	16 < 27.1563 / 27.1537	21 < 27.2163 / 27.2137	26 < 27.2663 / 27.2637	31 < 27.3163 / 27.3137	36 < 27.3663 / 27.3637
02 < 26.9763 / 26.9747	07 < 27.0363 / 27.0337	12 < 27.1063 / 27.1037	17 < 27.1663 / 27.1637	22 < 27.2263 / 27.2237	27 < 27.2763 / 27.2737	32 < 27.3263 / 27.3237	37 < 27.3763 / 27.3737
03 < 26.9863 / 26.9837	08 < 27.0563 / 27.0537	13 < 27.1163 / 27.1137	18 < 27.1763 / 27.1737	23 < 27.2363 / 27.2337	28 < 27.2863 / 27.2837	33 < 27.3363 / 27.3337	38 < 27.3863 / 27.3837
04 < 27.0063 / 27.0037	09 < 27.0663 / 27.0637	14 < 27.1263 / 27.1237	19 < 27.1863 / 27.1837	24 < 27.2463 / 27.2437	29 < 27.2963 / 27.2937	34 < 27.3463 / 27.3437	39 < 27.3963 / 27.3937
05 < 27.0163 / 27.0137	10 < 27.0763 / 27.0737	15 < 27.1363 / 27.1337	20 < 27.2063 / 27.2037	25 < 27.2563 / 27.2537	30 < 27.3063 / 27.3037	35 < 27.3563 / 27.3537	40 < 27.4063 / 27.4037

80700

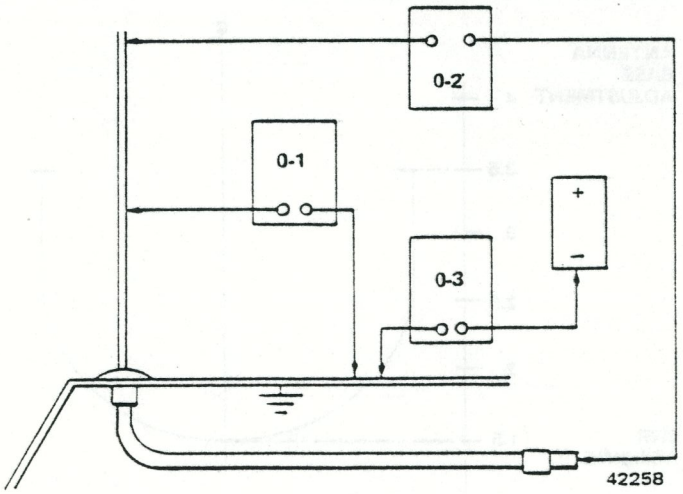


Fig. 3V-16 Antenna Ohmmeter Test

Mast-to-Ground Test

This test verifies that the antenna is making electrical contact with the radio and that the mast is insulated from the base.

(1) Touch one ohmmeter prod to tip of antenna mast and other prod to antenna base (0-1). With antenna installed in radio, there should be continuity (approximately 15 ohms).

(2) Disconnect antenna from radio and repeat step (1). There should not be any continuity with antenna disconnected from radio.

Tip of Mast-to-Tip of Conduct Test

This test verifies that the antenna does not have an open circuit.

(1) Disconnect antenna from radio.

(2) Touch one ohmmeter prod to mast tip and other prod to tip of lead-in (part inserted into the radio) (0-2). There should be continuity (fraction of an ohm).

Body Ground-to-Battery Ground Test

This test verifies that the antenna base has a good ground. Touch one ohmmeter lead to the fender and the remaining prod to the battery negative post (0-3). The resistance should be extremely low (less than one ohm).

AM/FM/CB Radio

VSWR is a measurement of the magnetic fields which reflect back into the antenna. Besides limiting the range of the transmitter, these also cause a heat build-up which can damage the transmitter circuitry. A high VSWR reading indicates a high level of reflected magnetic fields. A reading less than 2.0:1 is excellent. A reading above 3.5:1 is excessive and requires adjustment (see VSWR Reading by CB Channels chart). VSWR readings can vary depending upon atmospheric conditions. VSWR can also vary with respect to surrounding objects that affect reflection and conductivity.

VSWR Reading by CB Channels

CB CHANNELS	VSWR READING
1 thru 5	Less Than 3.5:1
6 thru 10	Less Than 3.0:1
11 thru 15	Less Than 2.5:1
16 thru 25	Less Than 2.0:1
26 thru 30	Less Than 2.5:1
31 thru 35	Less Than 3.0:1
36 thru 40	Less Than 3.5:1

80662

Tuning the CB Antenna/Splitterbox

Tuning the CB antenna or splitterbox involves reducing the SWR level by using a VSWR meter or the Amserv AMX 386S Mobile CB Tester and chart covering operating instructions for Amserv AMX 386S Mobile CB Tester. Trim the antenna/splitterbox as follows:

NOTE: *When checking SWR, vehicle should be located out-of-doors and at least 100 feet from other vehicles, people, or buildings. Doors of test vehicle should be closed.*

(1) Disconnect coaxial cable at inline connection near splitterbox.

(2) Connect transmitter end of coaxial cable to a jumper coaxial cable.

NOTE: *Jumper should not exceed 18 inches.*

(3) Connect jumper coaxial cable to transmitter terminal of test instrument.

(4) Connect splitterbox end of coaxial cable to antenna terminal of test instrument.

NOTE: *If a VSWR meter is used, it is recommended to connect a 50-ohm dummy load to VSWR meter antenna connection. Radio will not transmit with a dummy load.*

(5) With engine running, turn radio on, key mike, and measure SWR on channels 1 and 40 following test instrument manufacturer's instructions.

(a) If SWR reading on test instrument is less than 3.5 between channels 1 and 40 and within 0.5 of one another, no further adjustment is required.

(b) If SWR reading on test instrument is more than 3.5 between channels 1 and 40 adjust splitterbox.

(6) Adjust splitterbox using a 5/64-inch hexagon nonmetallic alignment tool (available at most radio/television repair shops).

NOTE: *If a metal Allen wrench is used for the adjustment, remove the wrench from the splitterbox before reading the test instrument.*

(a) Insert alignment tool into splitterbox adjusting slug.

(b) Turn slug clockwise or counterclockwise, in one quarter turn increments, until SWR reading on test instrument is less than 3.5 between channels 1 and 40 and within 0.5 of one another, no further adjustment is required.

(c) If desired SWR reading cannot be obtained the antenna base slug must be adjusted.

(7) Turn transmitter channel selector to channel 20 and record SWR reading.

(8) Disconnect antenna mast from base and remove protective mylar tape from antenna base.

(9) Adjust antenna base slug using a 5/64-inch Allen wrench at least 3-1/2-inches long.

(a) With antenna mast installed, insert wrench into antenna base slug and turn slug clockwise or counterclockwise, in one quarter turn increments, to obtain lowest possible SWR reading on test instrument.

(b) Readjust splitterbox as outlined above.

Changing the splitterbox adjustment will lower or raise the frequency of the best channel match. Changing the load coil adjustment in the antenna base will raise or lower the SWR curve (fig. 3V-17).

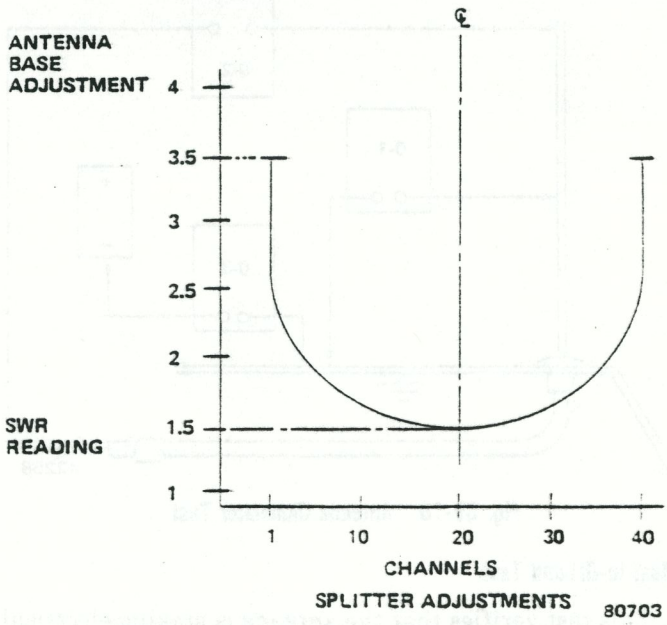


Fig. 3V-17 Typical SWR Curve

NOTE: *Although you are not talking while checking VSWR, a carrier signal is being transmitted which can eliminate another transmission. Try to pick a time when the channel is not in use to check VSWR.*

SPEAKERS

Speakers have an impedance of either 3.2 or 8 ohms. A speaker should be replaced with a speaker having the proper part number. If the exact replacement is not available, select a speaker which matches the ohm value stamped on the radio chassis with a black ink stamp.

AM/FM stereo radios are more critical in the selection of a speaker than are AM radios. A noticeable deterioration in sound will be noticed if the correct speaker is not used.

Stereo speakers are paired together for a truer stereo sound, right front with right rear, left front with left rear.

Speaker Repairs

A speaker, once it has been damaged, is usually not repairable and should be replaced. Defective speakers usually have one or more of the following symptoms:

- Loose mounting.
- Screws or other objects stuck to back of magnet.
- Audio distortion, particularly on the low frequency notes and at high volume.
- Rattles and buzzes caused by foreign material hitting or rubbing against the speaker cone.
- Raspy noises caused by foreign matter inside the speaker restricting free movement of the speaker cone.
- Muffled sound caused by speaker opening obstruction.

Use a light to check the speaker opening(s).

If the entire speaker is not visible through the speaker grille openings, remove the obstruction as follows:

Front Door Speakers

(1) Remove door trim panel lower screws.

(2) Carefully lift the door trim panel away from door to expose speaker.

(3) Cut out excess water dam paper around speaker.

(4) Install door trim panel lower screws.

NOTE: *Be sure the speaker mounting screws are tightened securely.*

Speaker Harness Test

Ground Condition

(1) Disconnect speaker feed wires at radio connector and each individual speaker.

NOTE: *When reconnecting the speaker harness to the radio, be sure the antenna lead-in cable is fully engaged in the radio socket.*

(2) Connect one lead of an ohmmeter to the speaker feed wire and the other lead to a good ground. An infinity reading should be indicated. Check each individual speaker wire in this manner.

(3) If resistance is indicated on the ohmmeter, the wire being checked is grounded.

NOTE: *Grounded speaker harnesses are generally caused by screws piercing wire harness.*

Short Condition

(1) Disconnect speaker feed wires at the radio connector and at each individual speaker.

(2) Connect ohmmeter leads to speaker feed wires at the radio connector.

(3) An infinity reading should be indicated.

(4) If resistance is indicated on ohmmeter, the feed wires being checked are shorted.

Speaker Test

Speakers may be isolated for grounds by testing the impedance with an ohmmeter. Connect ohmmeter between the two speaker leads. The specified value should match the ohm value stamped on the radio chassis.

Speaker Replacement

CJ Models

To remove the AM speaker, remove the four attaching nuts from the mounting studs.

NOTE: *On vehicles equipped with air conditioning, the evaporator must be lowered for removal of the speaker.*

On models equipped with the two-speaker stereo radio system, the speakers can be removed by removing the four retaining nuts from each speaker.

NOTE: *On vehicles equipped with air conditioning the evaporator must be lowered for removal of the passenger side speaker.*

Cherokee-Wagoneer-Truck Models

The AM speaker is located above the radio. To remove the speaker, remove the radio, then remove the four attaching nuts from the speaker mounting studs.

On vehicles equipped with a stereo radio, interior trim panels must be removed for access to the speaker.

PREMIUM AUDIO SYSTEM

Fader Switch

Removal

(1) Disconnect negative battery cable.
(2) Remove screws attaching switch housing to instrument panel or evaporator housing. Lower housing.
(3) Disconnect wires from fader switch.
(4) Disconnect lamp wires.
(5) Remove control knob.
(6) Remove retaining nut from switch.
(7) Remove switch.

Installation

(1) Position fader switch into housing.
(2) Install fader switch retaining nut.
(3) Connect lamp wires.
(4) Connect wires to fader switch.
(5) Position switch housing on instrument panel or evaporator housing and install attaching screws.
(6) Install control knob.
(7) Connect negative battery cable.
(8) Reset clock, if equipped.

Indicator Lamp

Removal

(1) Disconnect negative battery cable.
(2) Remove screws attaching switch housing to instrument panel or evaporator housing. Lower housing.
(3) Disconnect lamp wires.
(4) Remove lamp.

Installation

(1) Install lamp.
(2) Connect lamp wires.
(3) Position switch housing on instrument panel or evaporator housing and install attaching screws.
(4) Connect negative battery cable.
(5) Reset clock, if equipped.

Amplifier

Removal

(1) Disconnect negative battery cable.
(2) Remove evaporator housing attaching screws and lower housing, if equipped.
(3) Disconnect amplifier wiring harness from fader switch.
(4) Remove amplifier attaching hardware.
(5) Remove amplifier assembly using care not to damage wiring harness.

Installation

(1) Position amplifier assembly in vehicle.
(2) Install amplifier attaching hardware.
(3) Route wiring harness to switch and connect.
(4) Position evaporator housing and install attaching screws, if equipped.
(5) Connect negative battery cable.
(6) Reset clock, if equipped.

SPECIFICATIONS

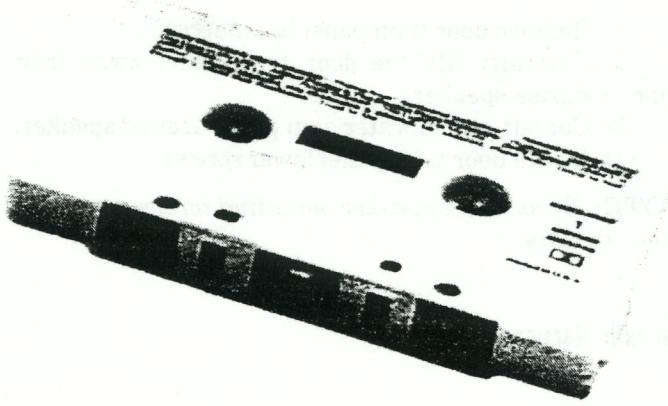
Radio Bulb Chart

	Number of Bulbs/ Bulb Trade Number
CJ	1/1892
Cherokee-Wagoneer-Truck	1/1893

70320

Tools

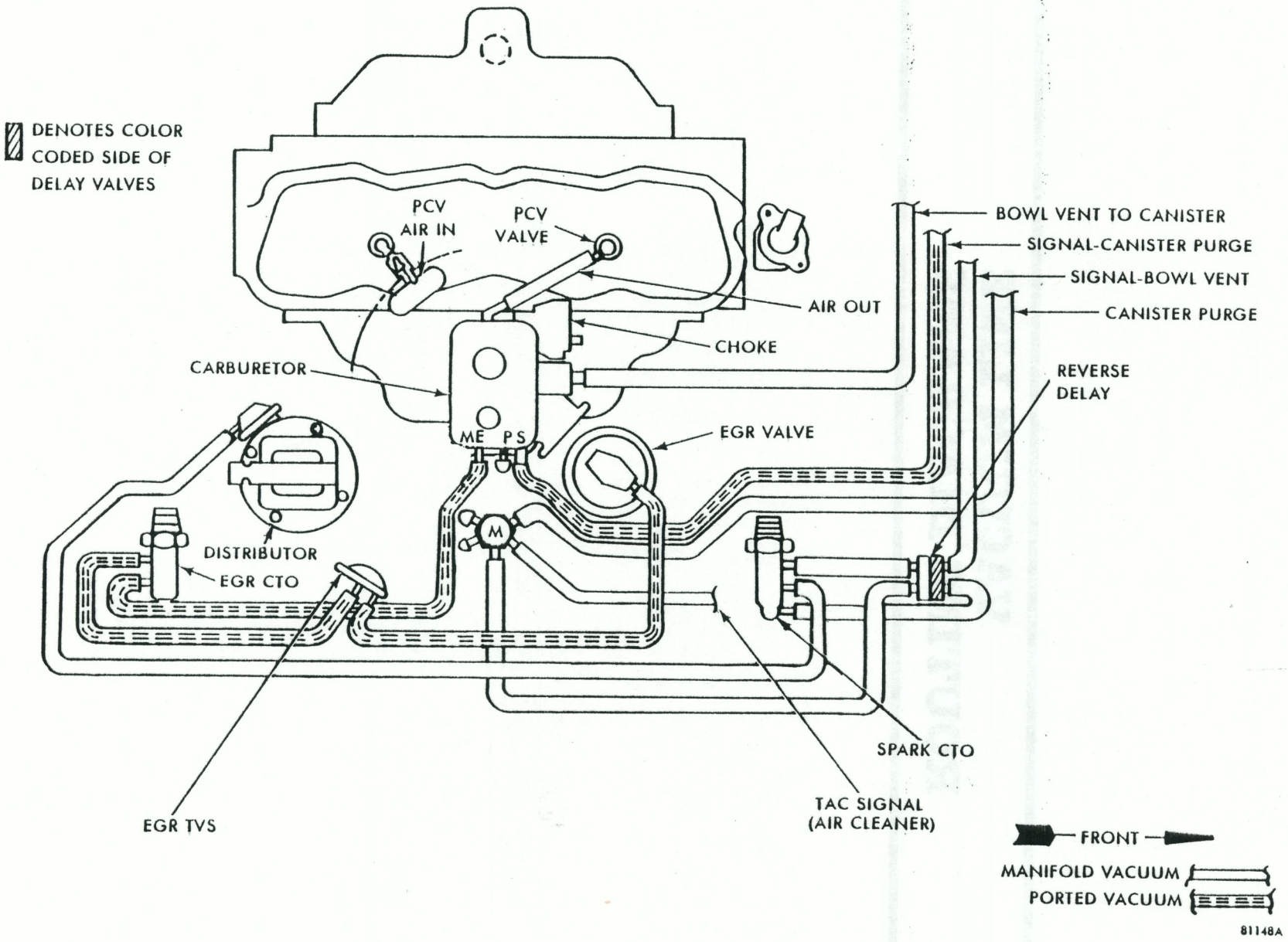
J-22683-01
STEREO TEST TAPE



J-23724
CASSETTE TEST TAPE

70319

VACUUM LINE ROUTING DIAGRAMS



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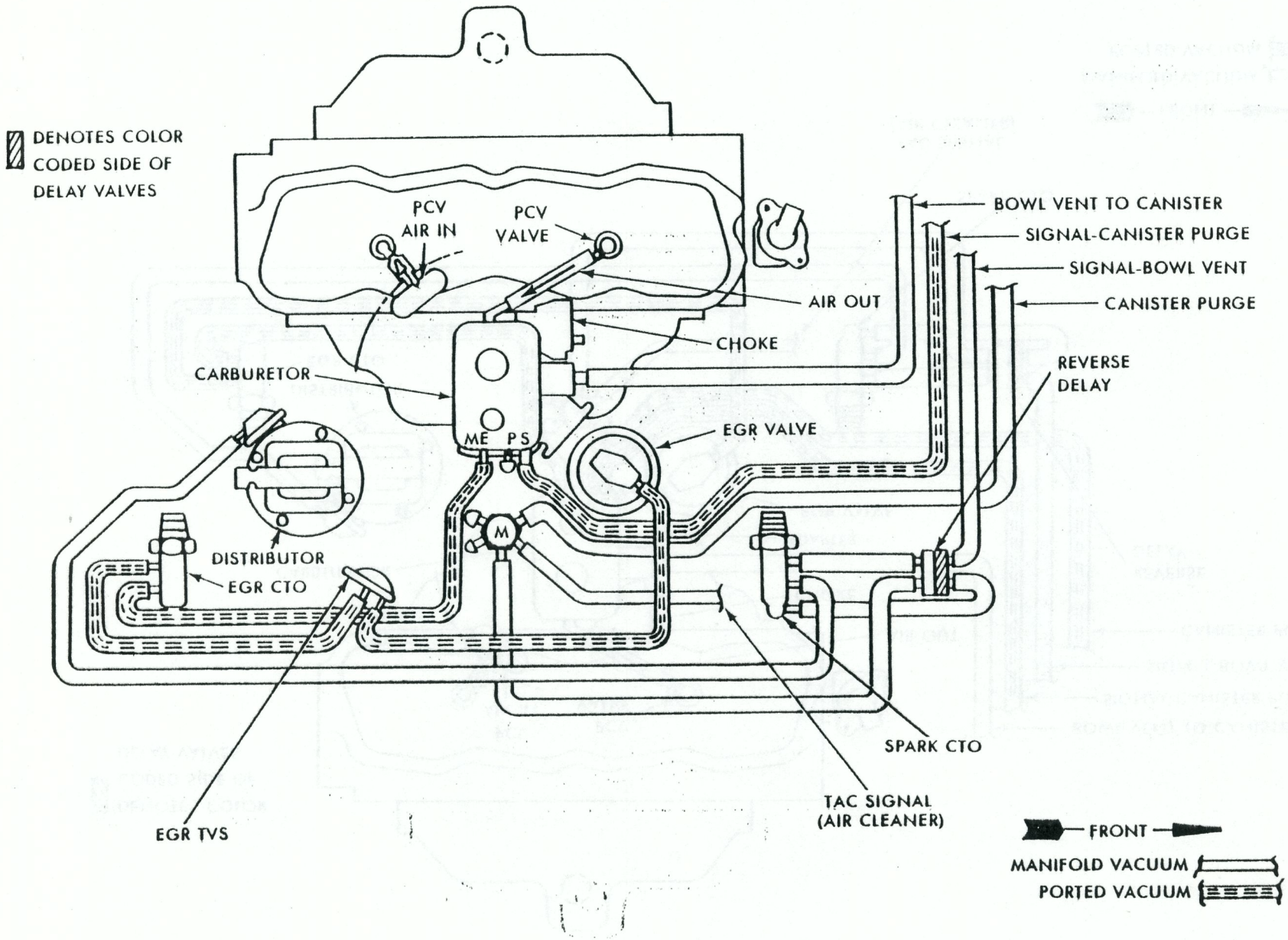

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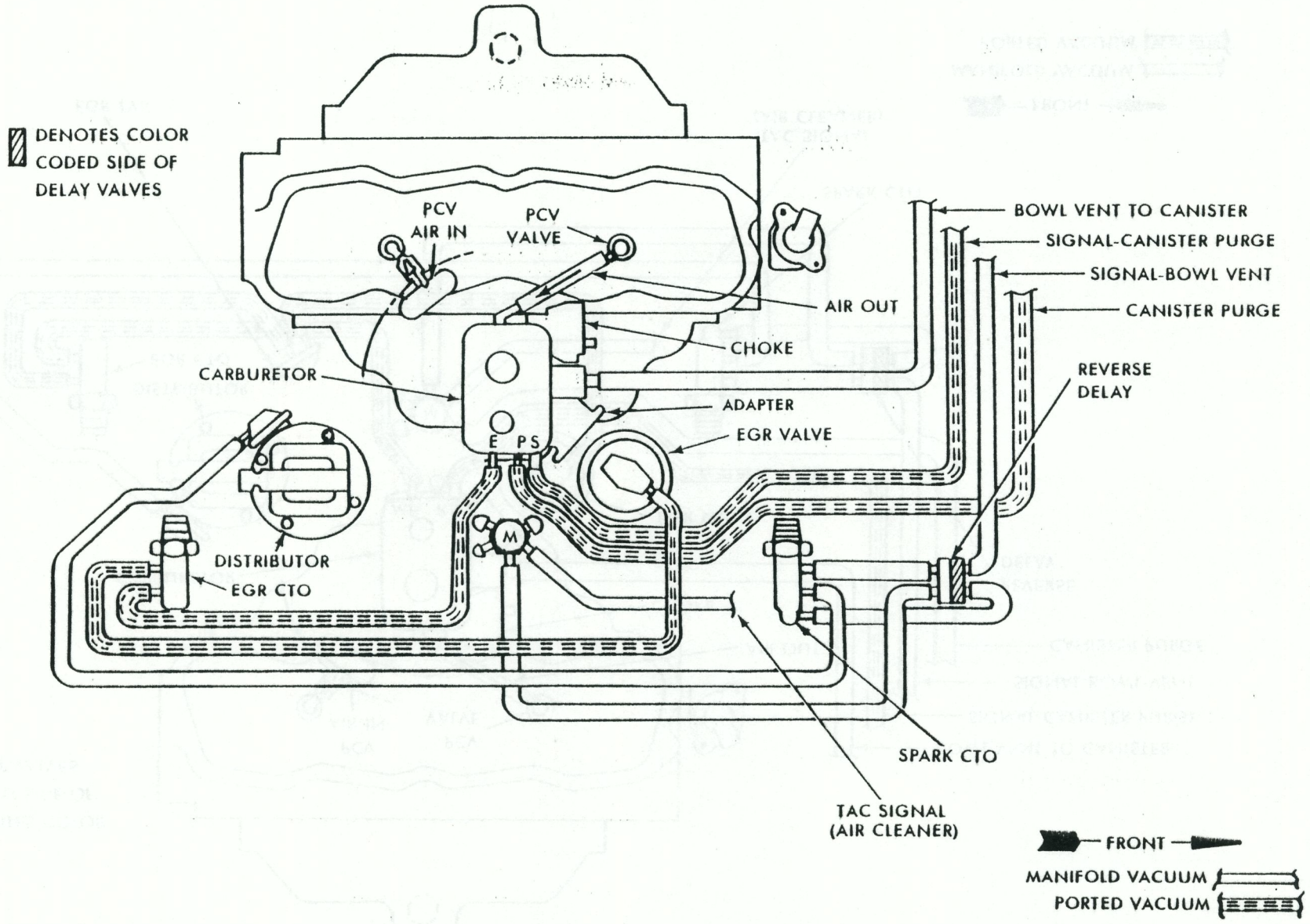

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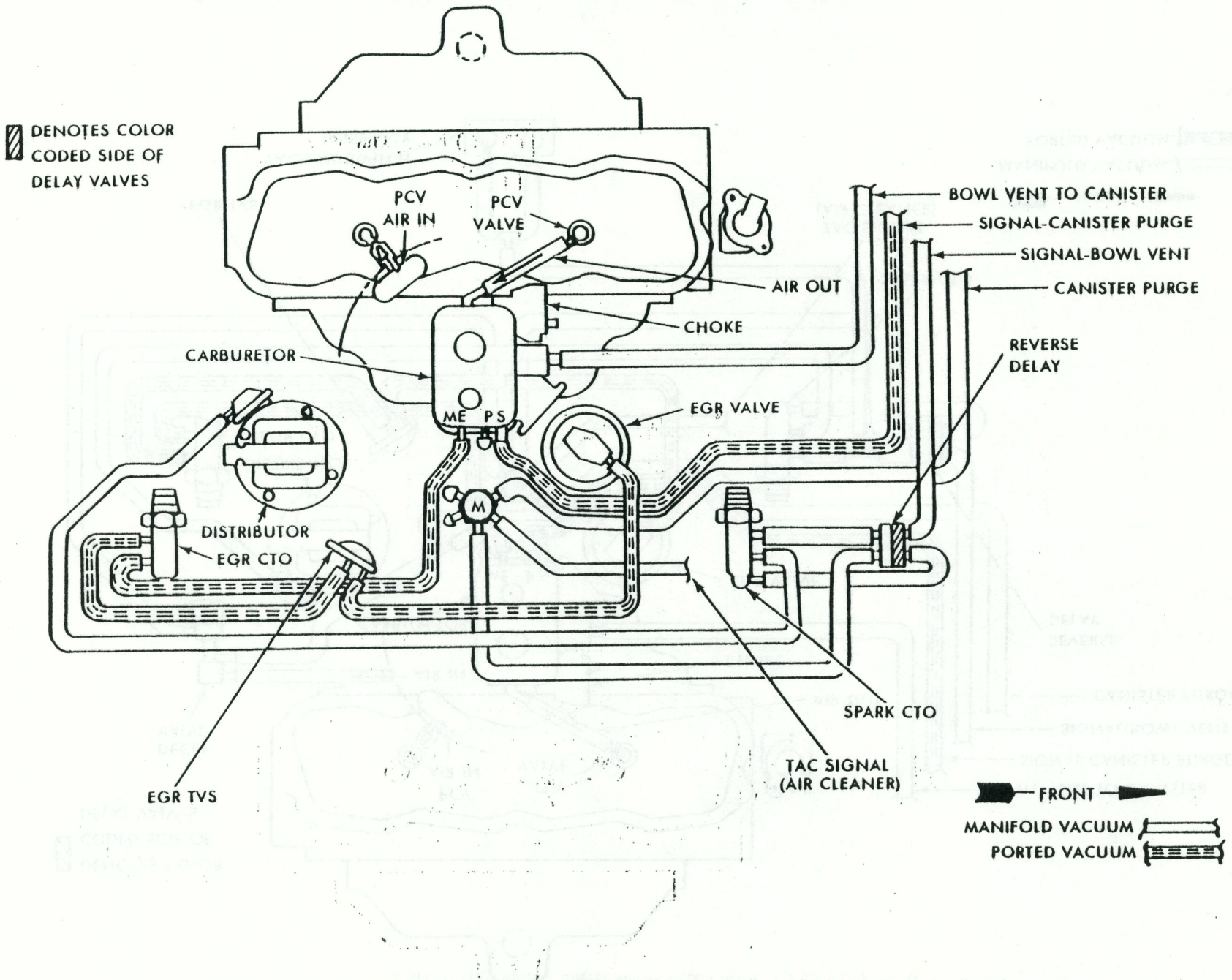

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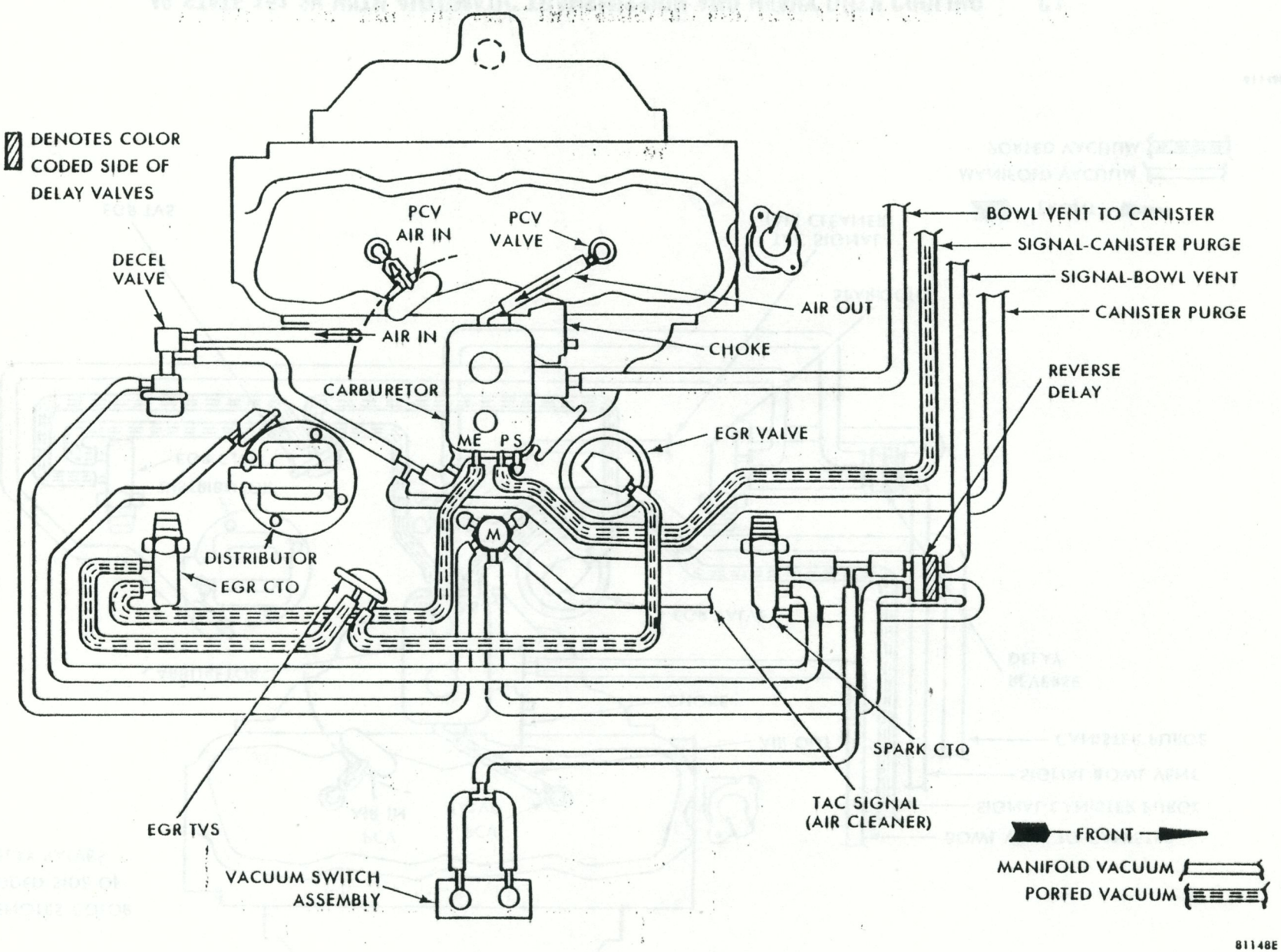

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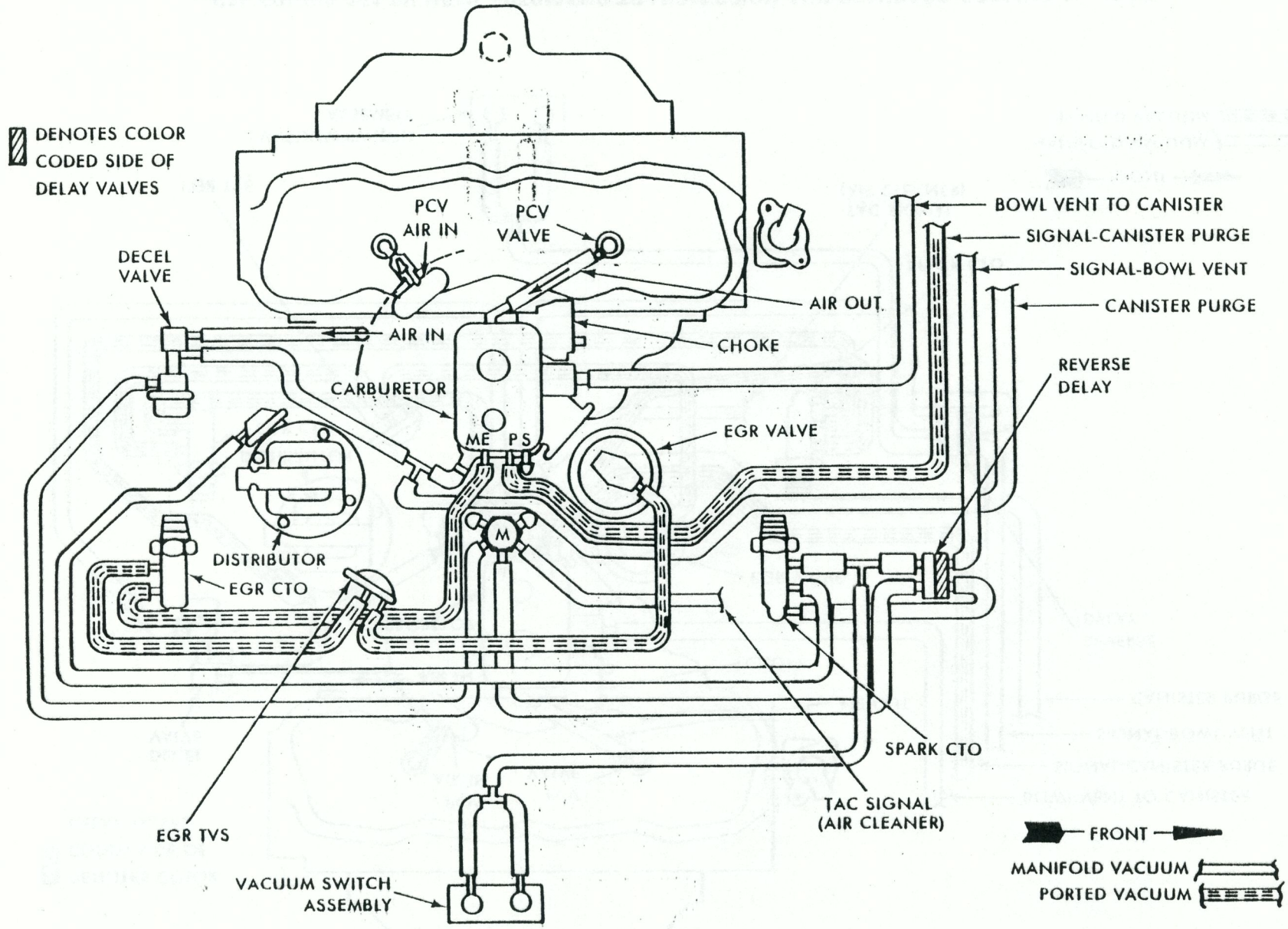

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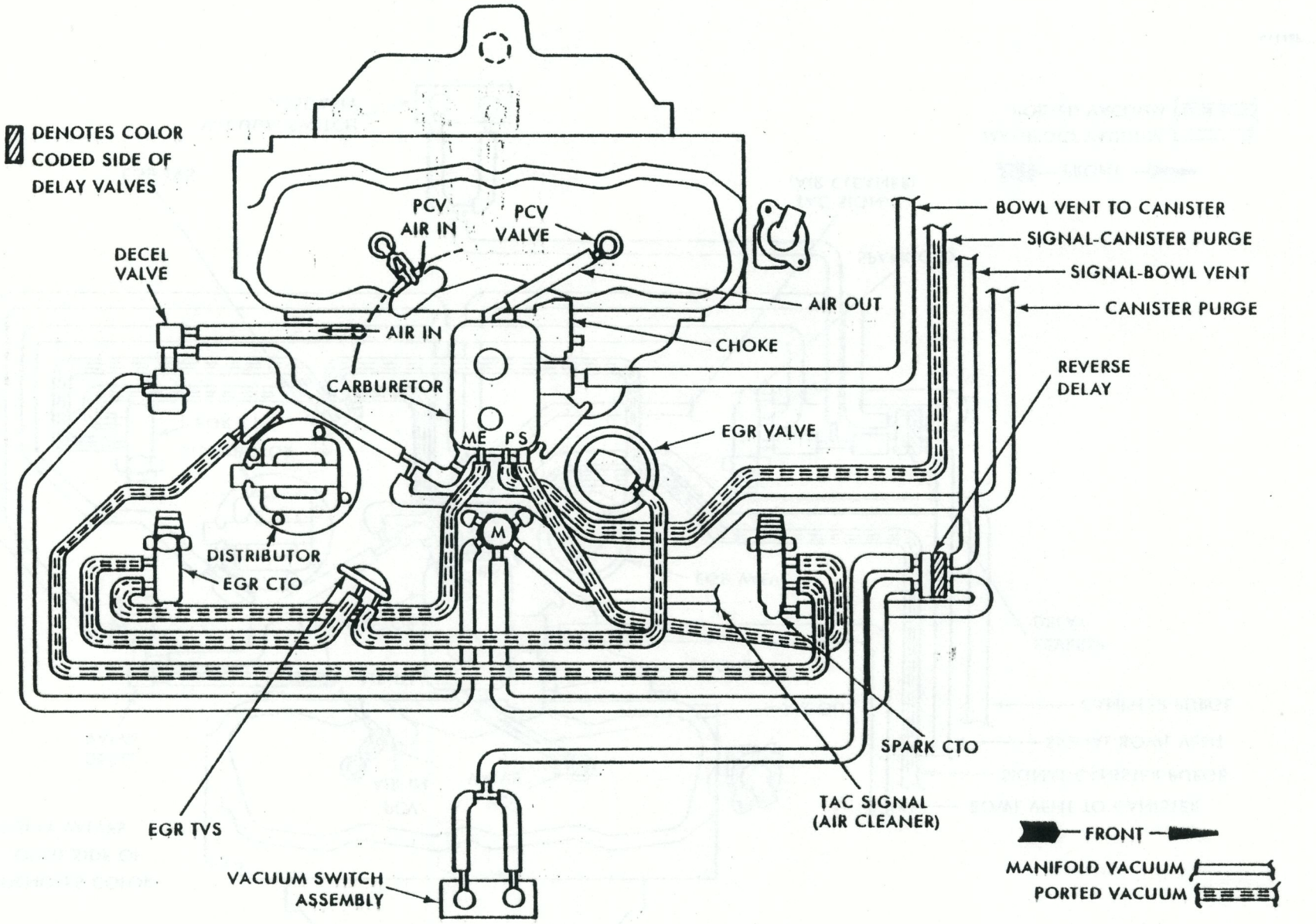

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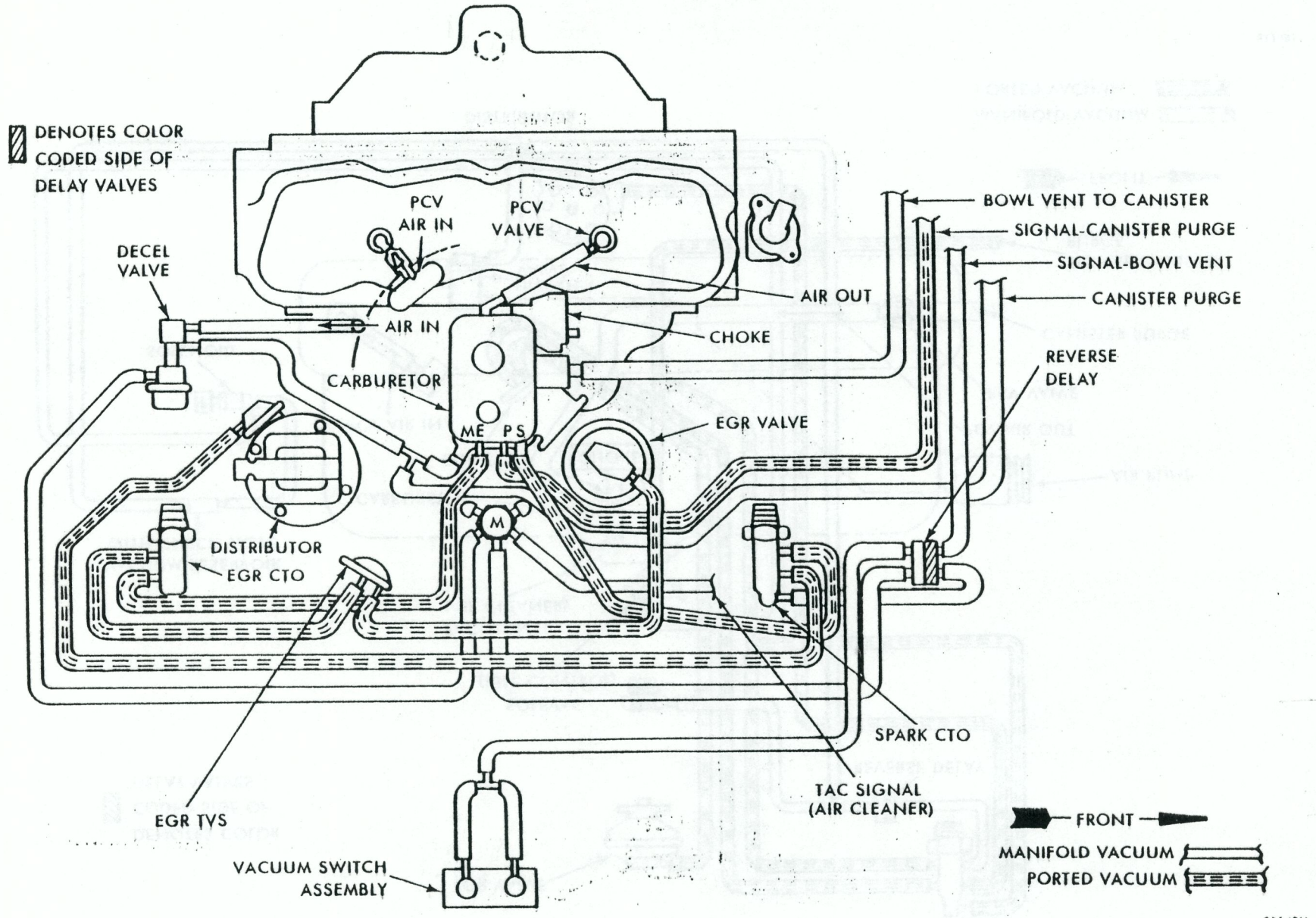

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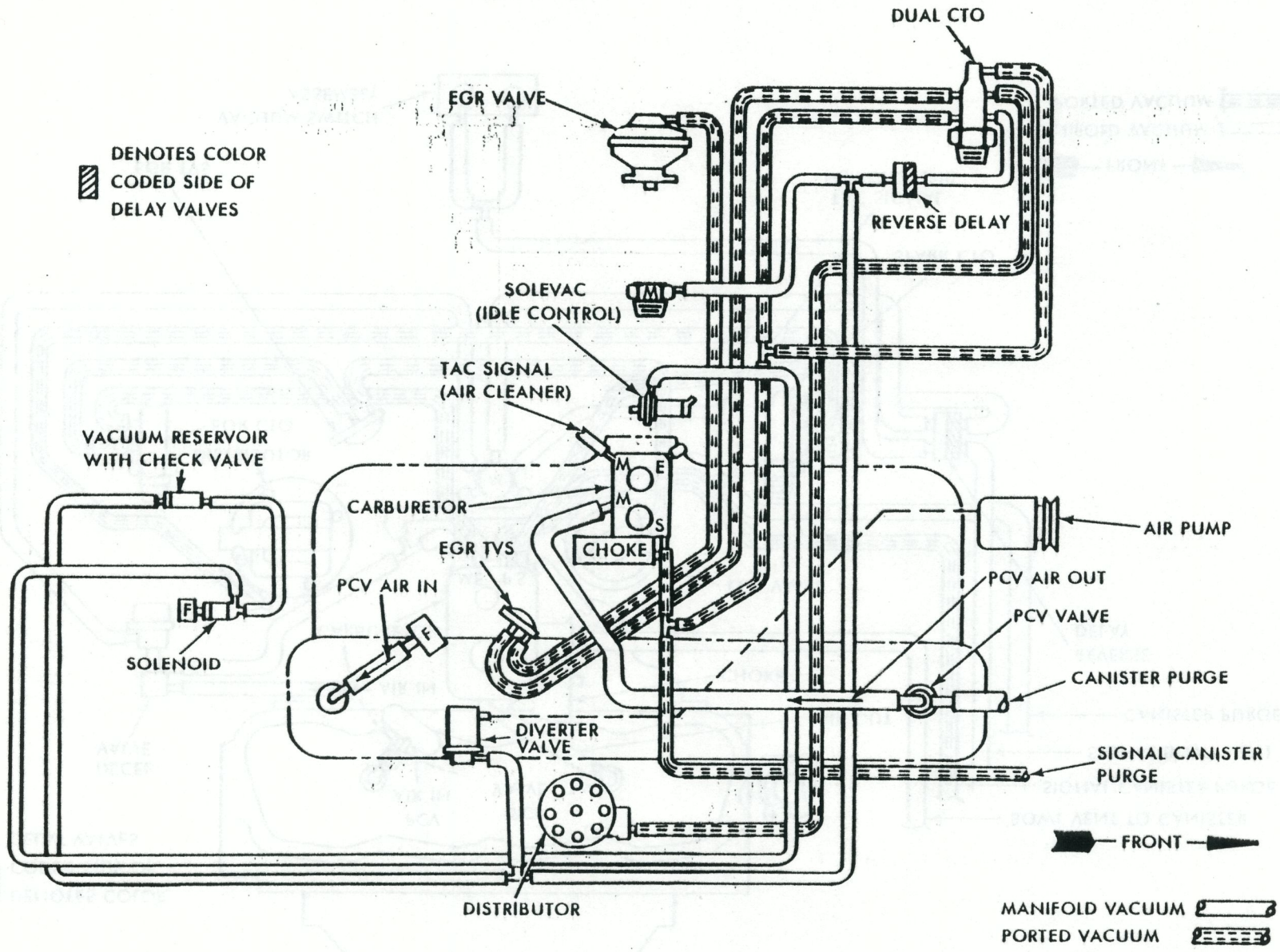

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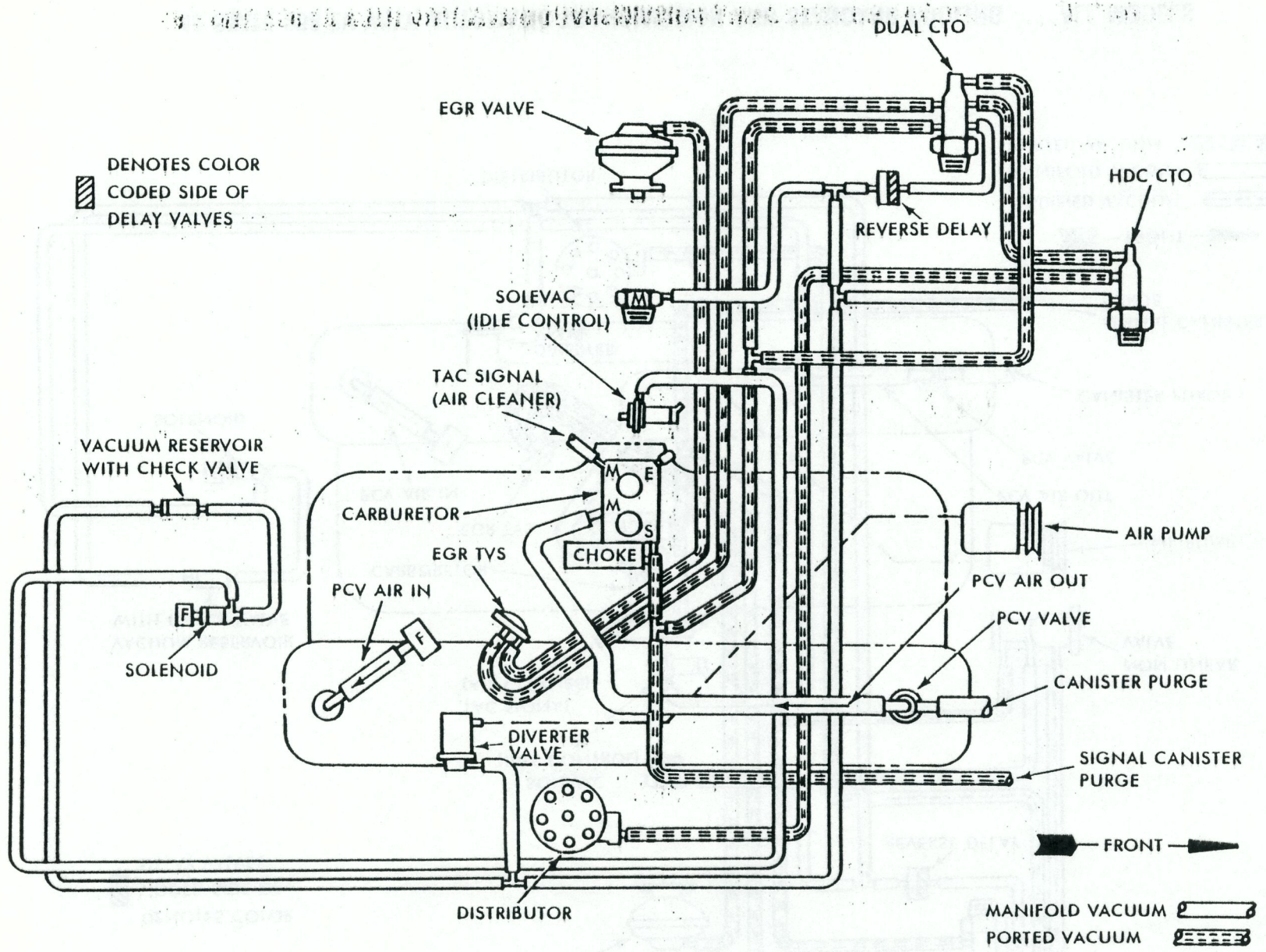

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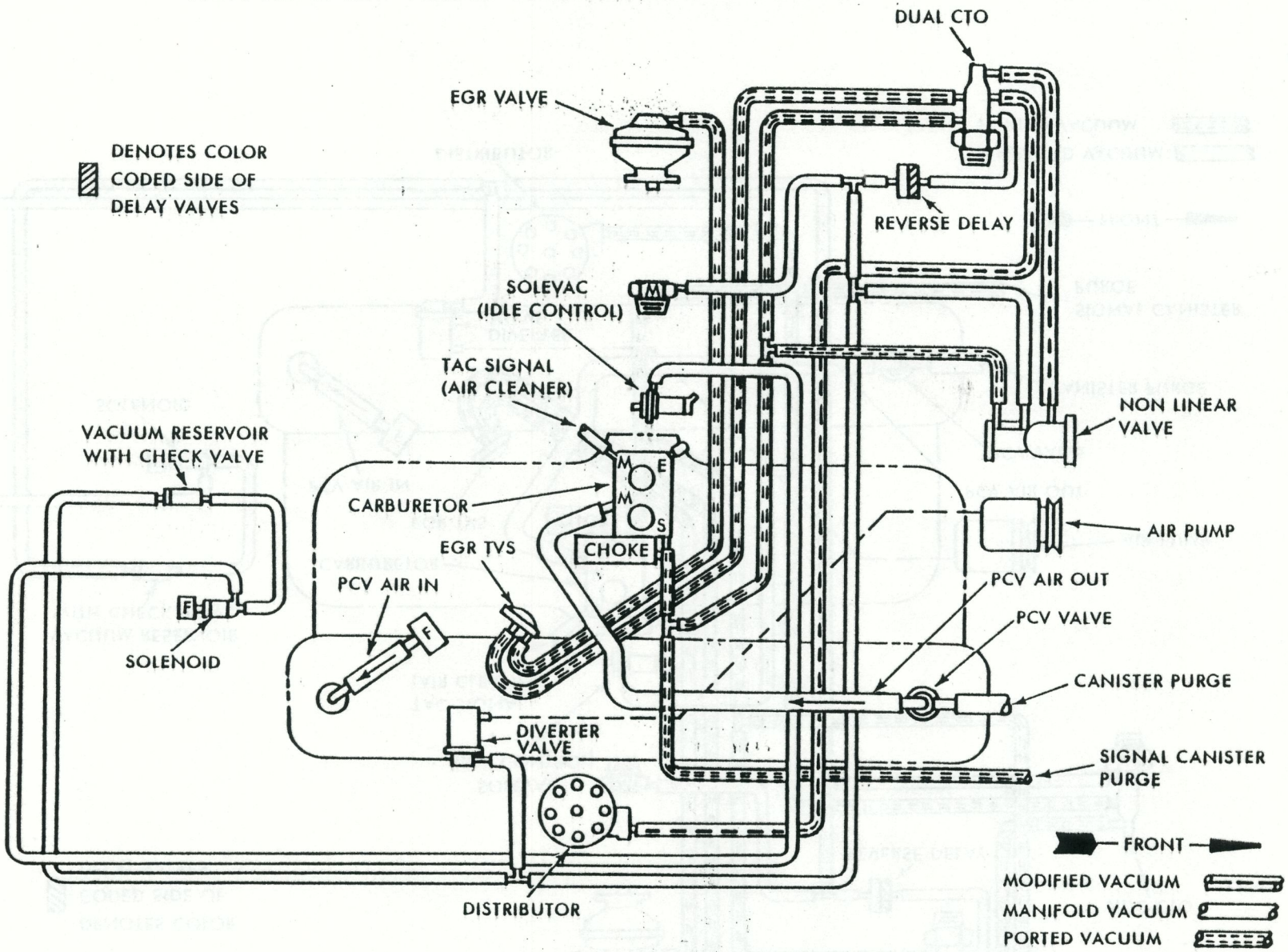

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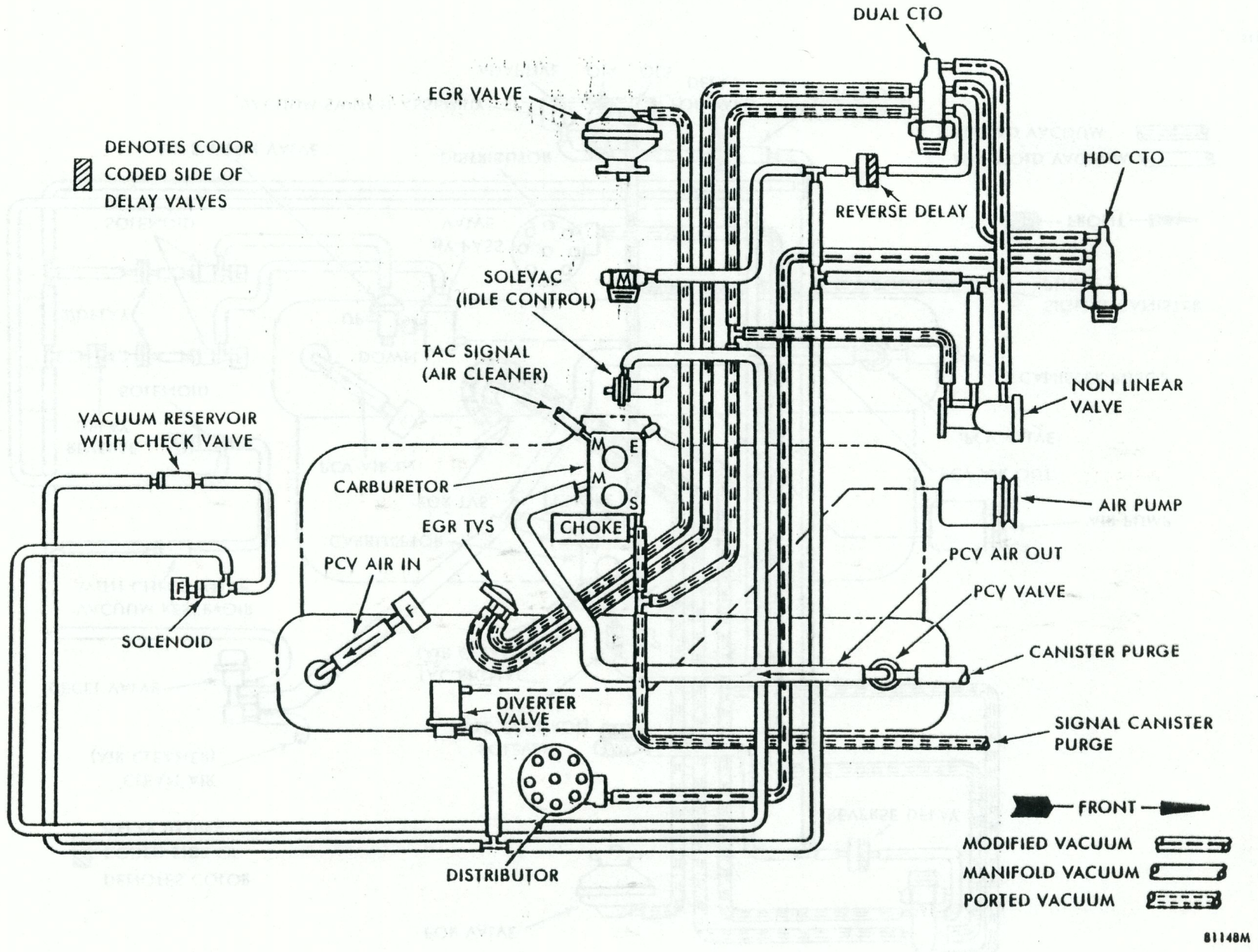

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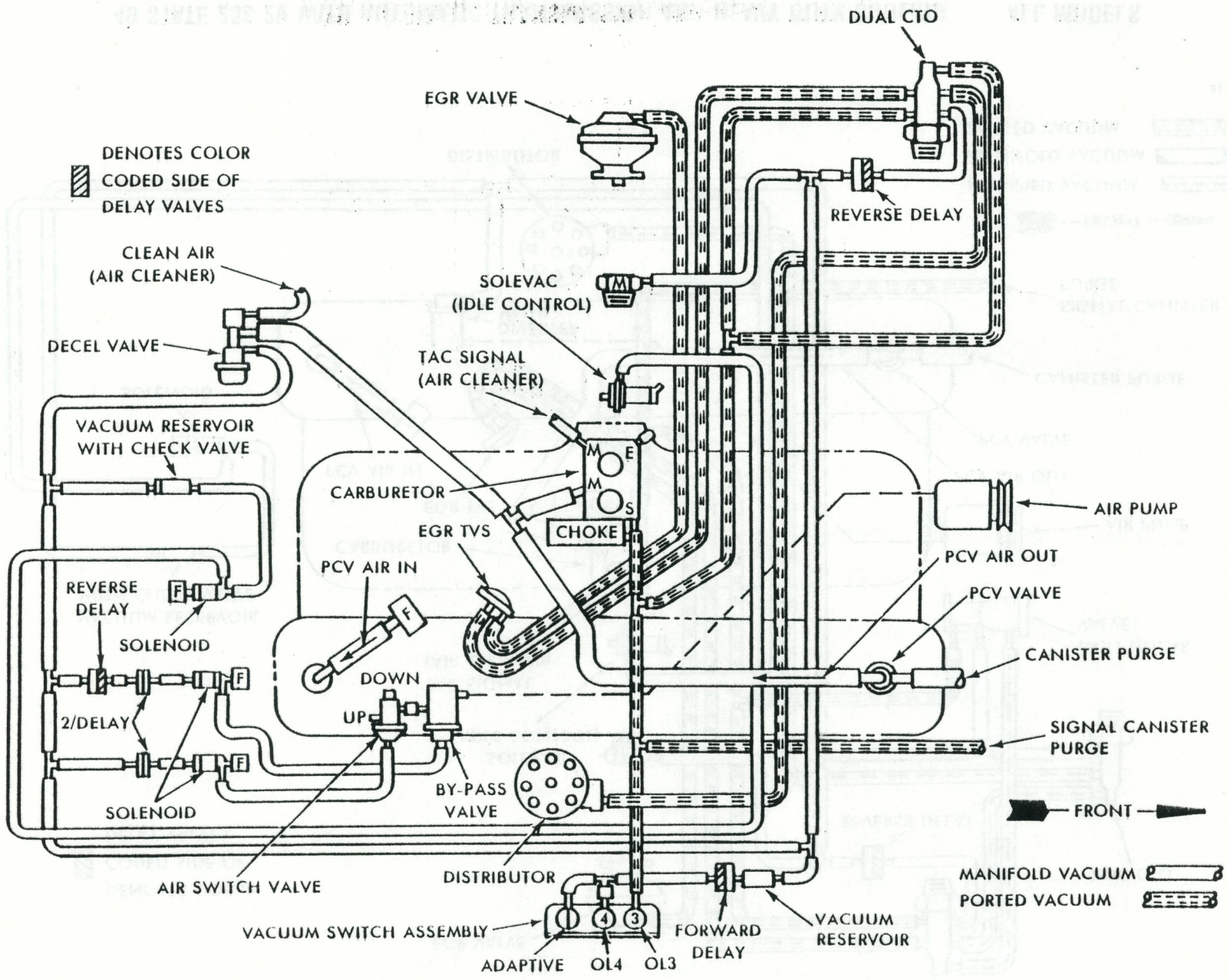

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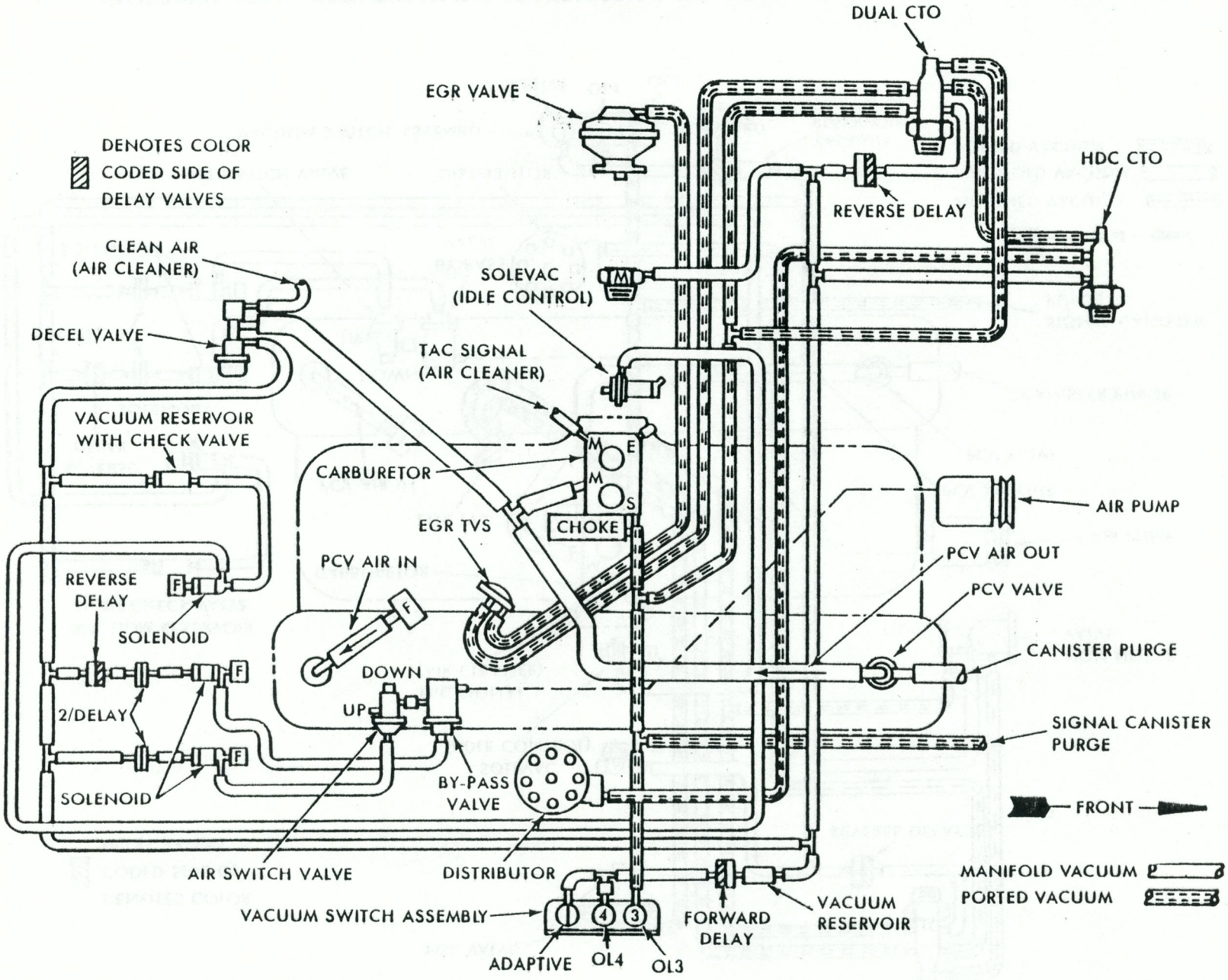

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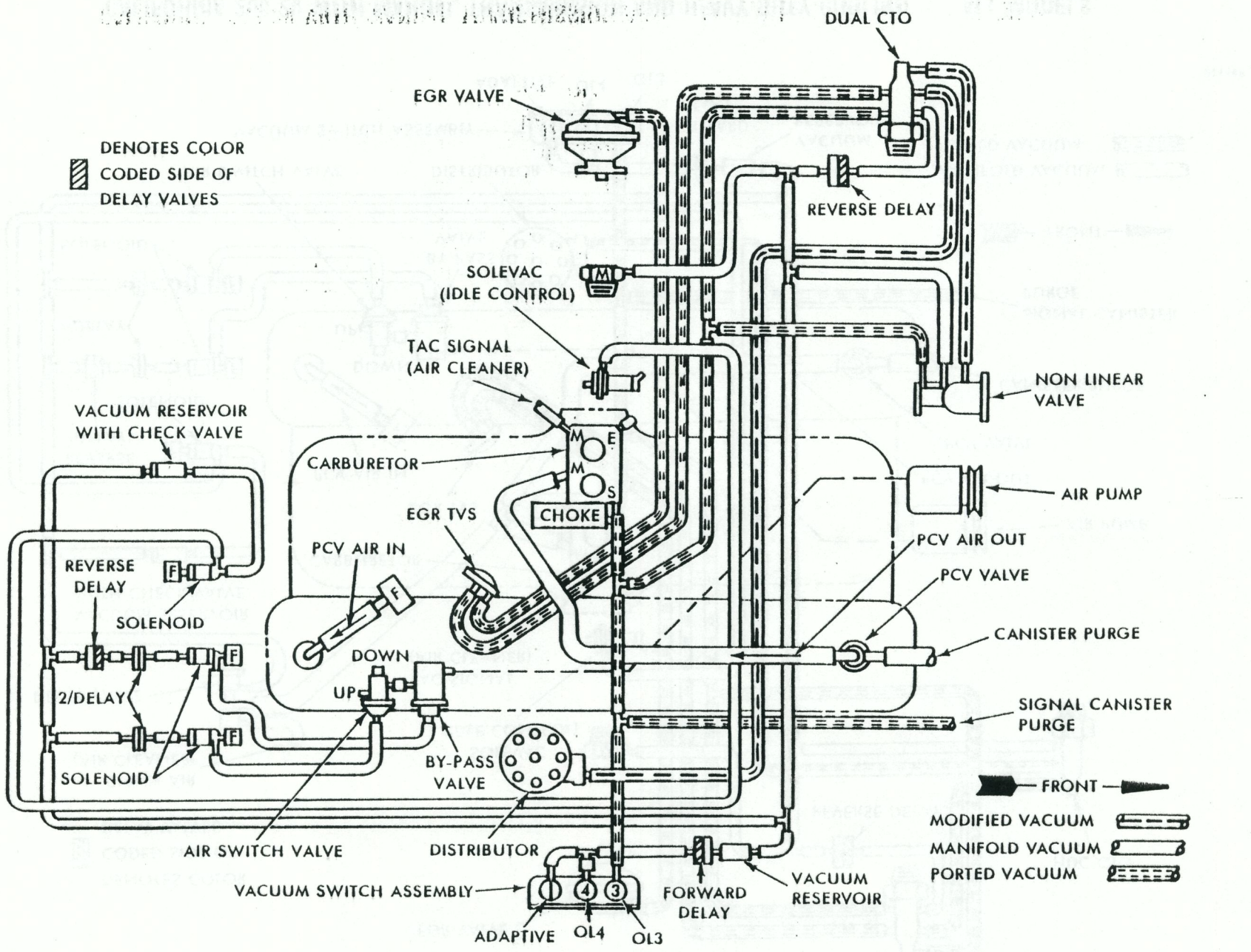

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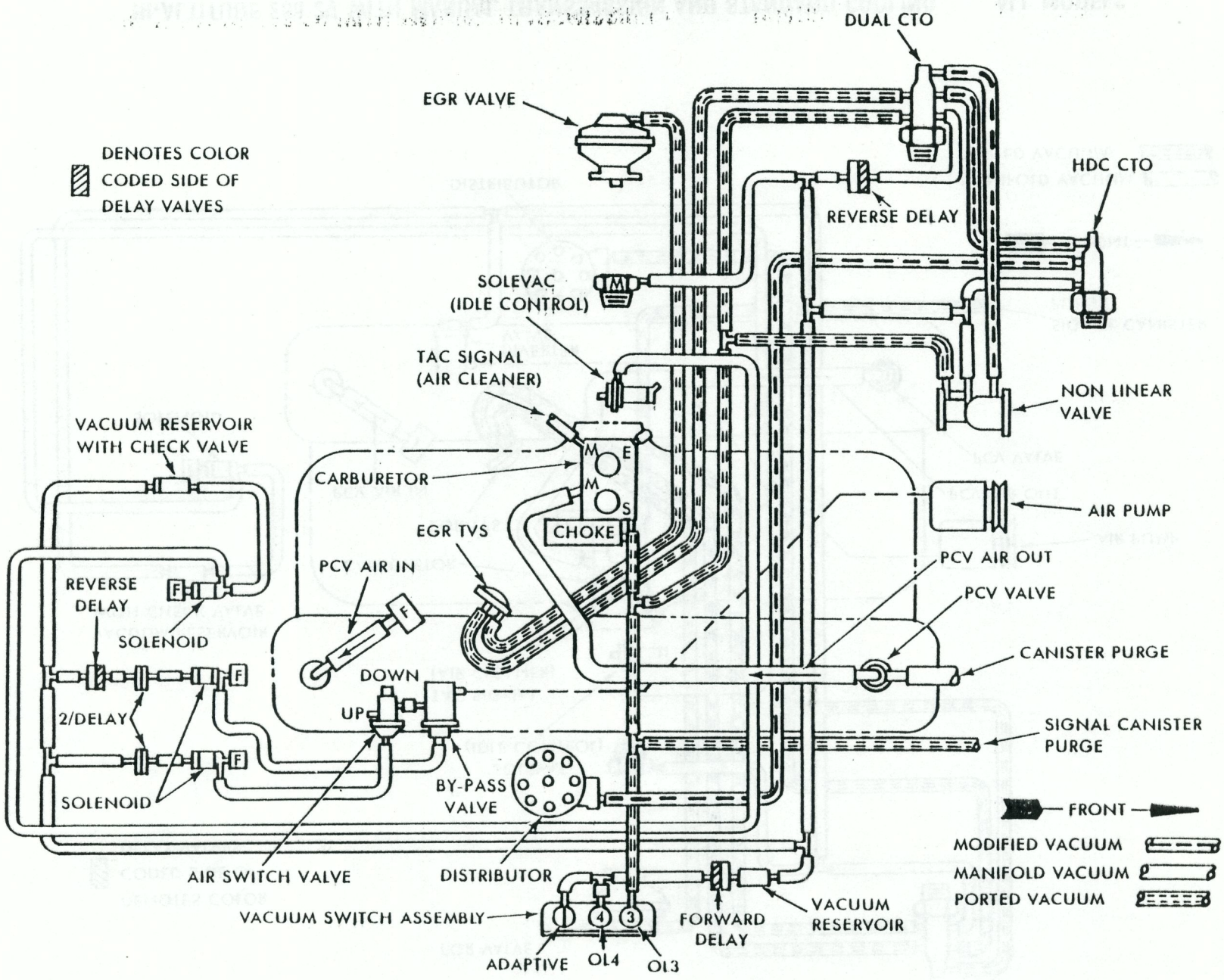

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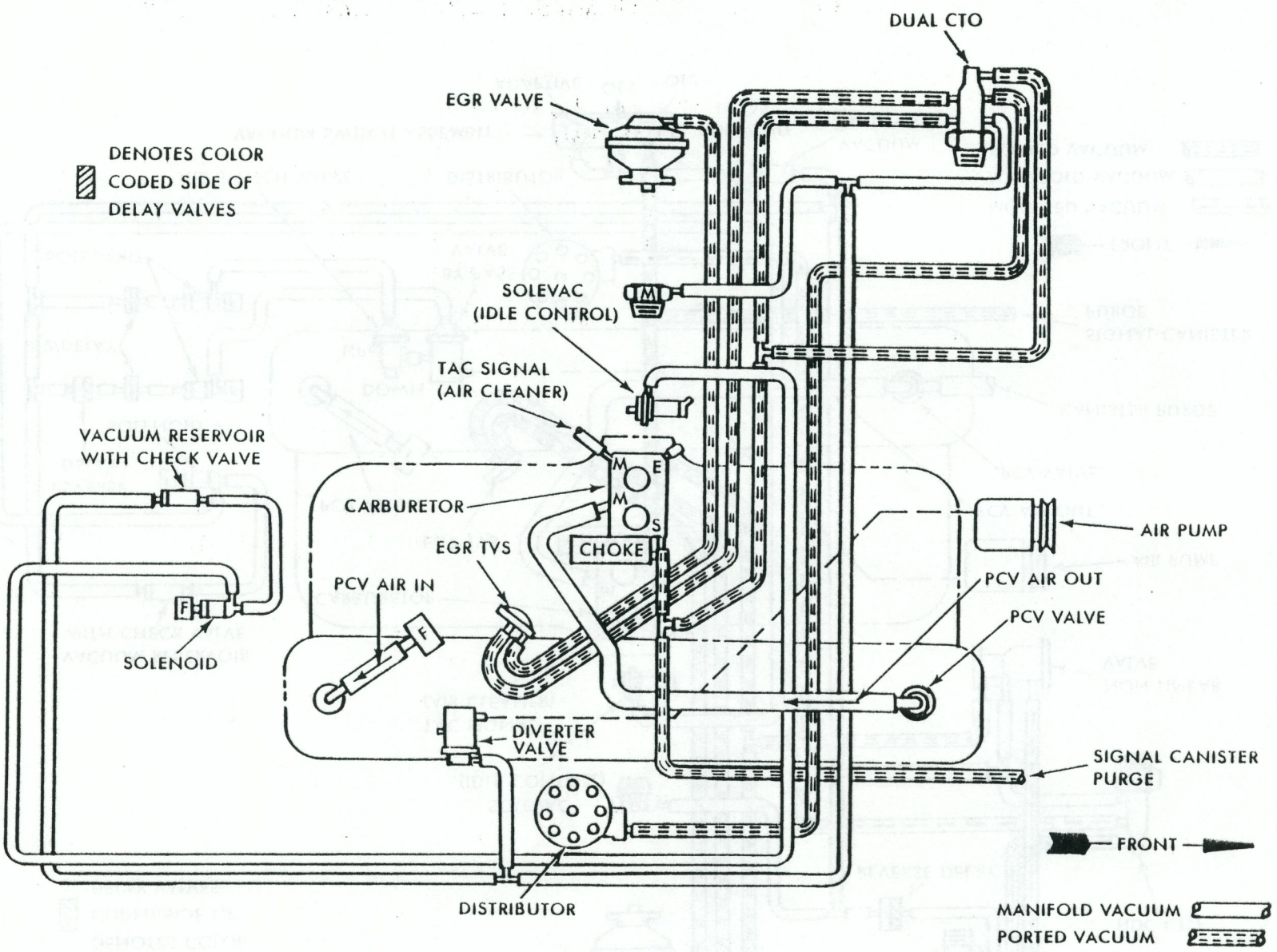

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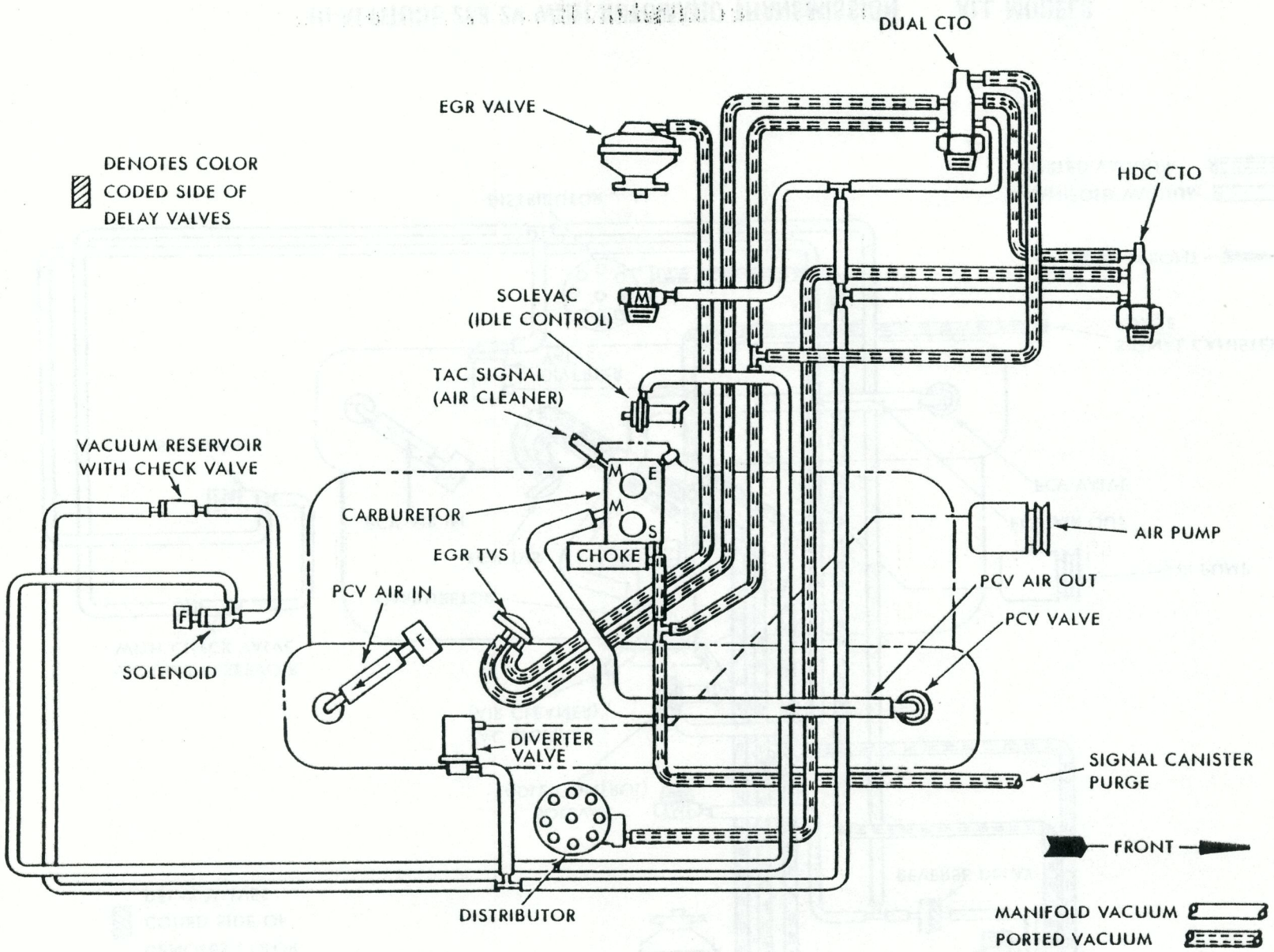

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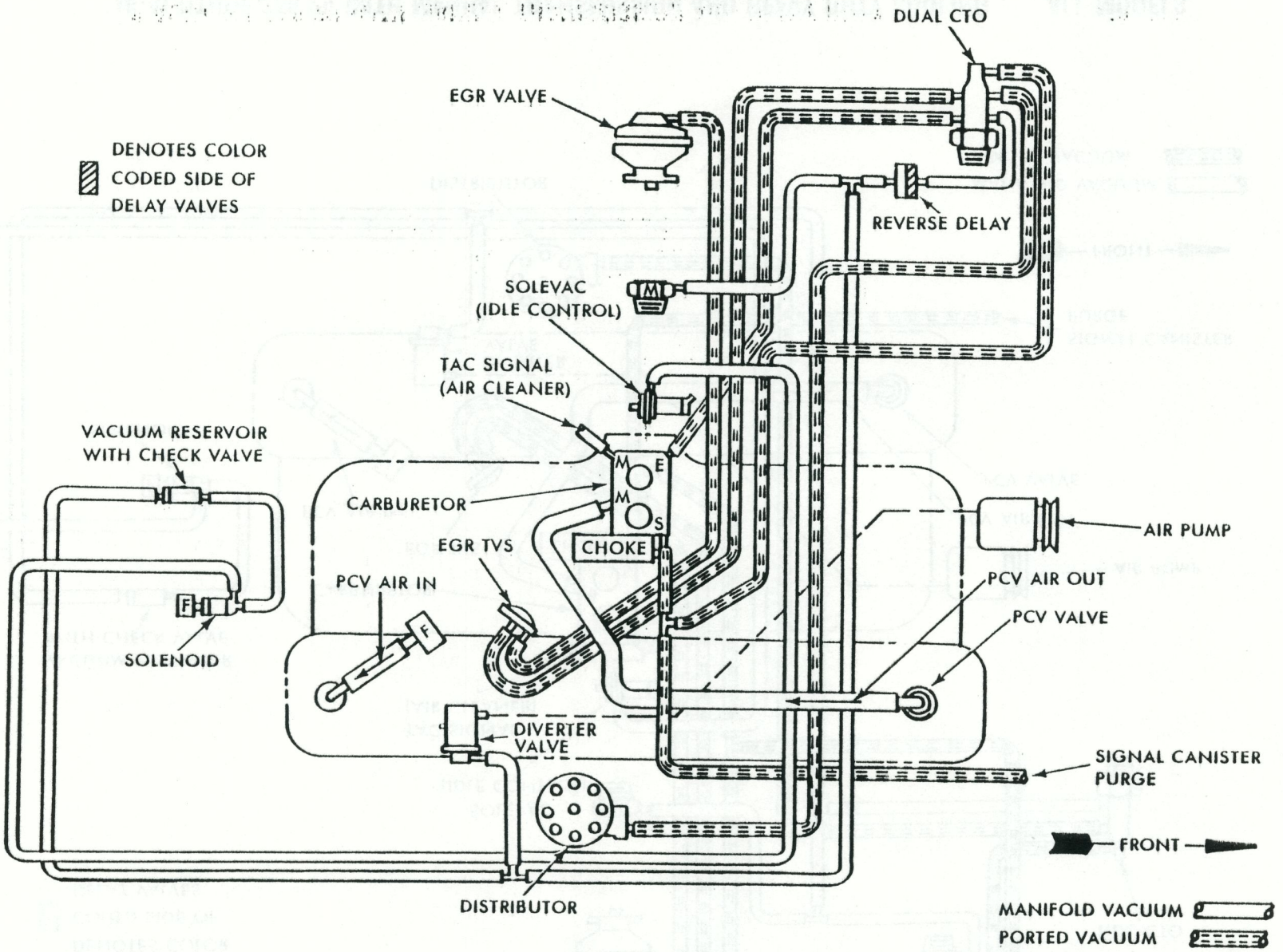

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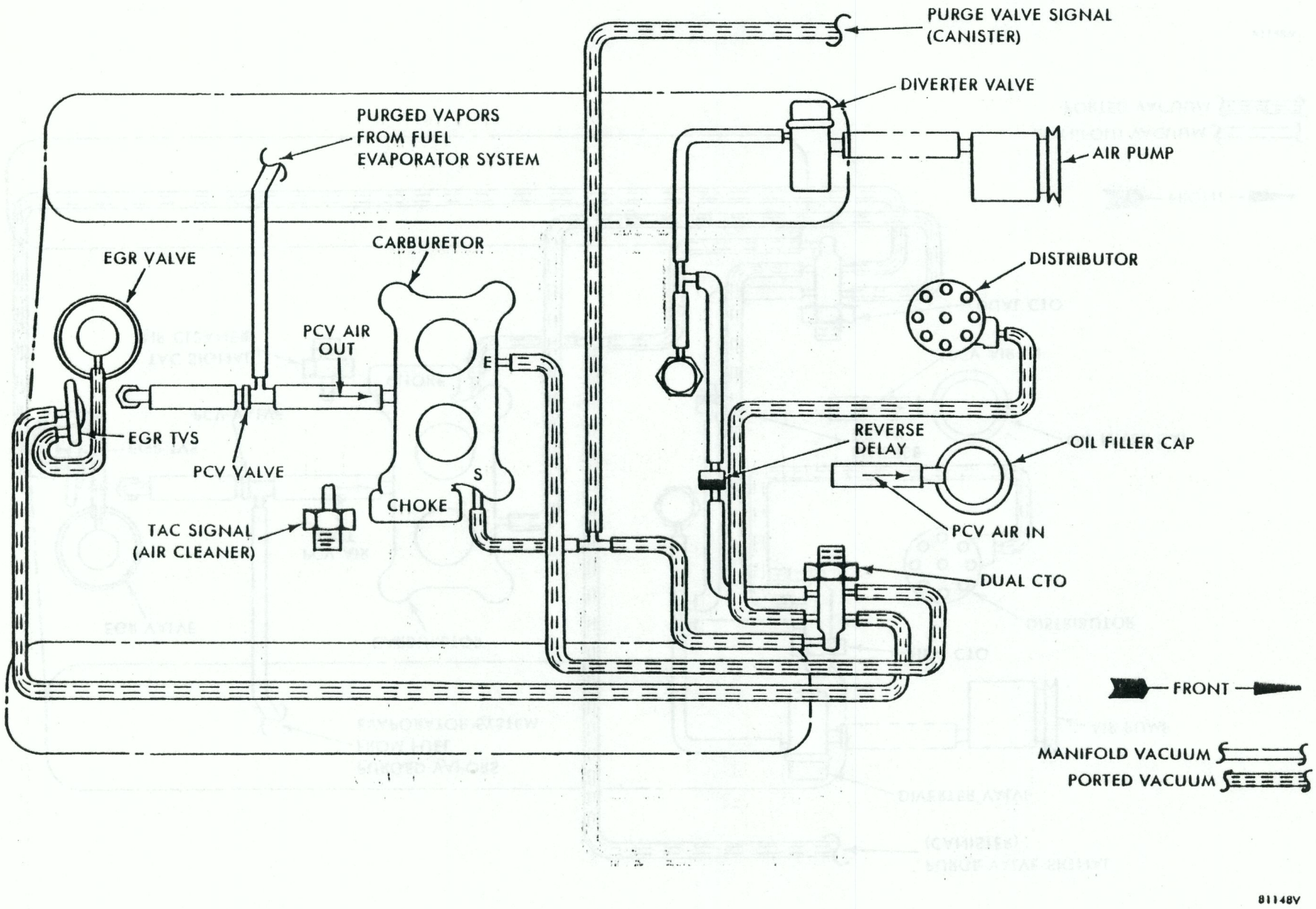

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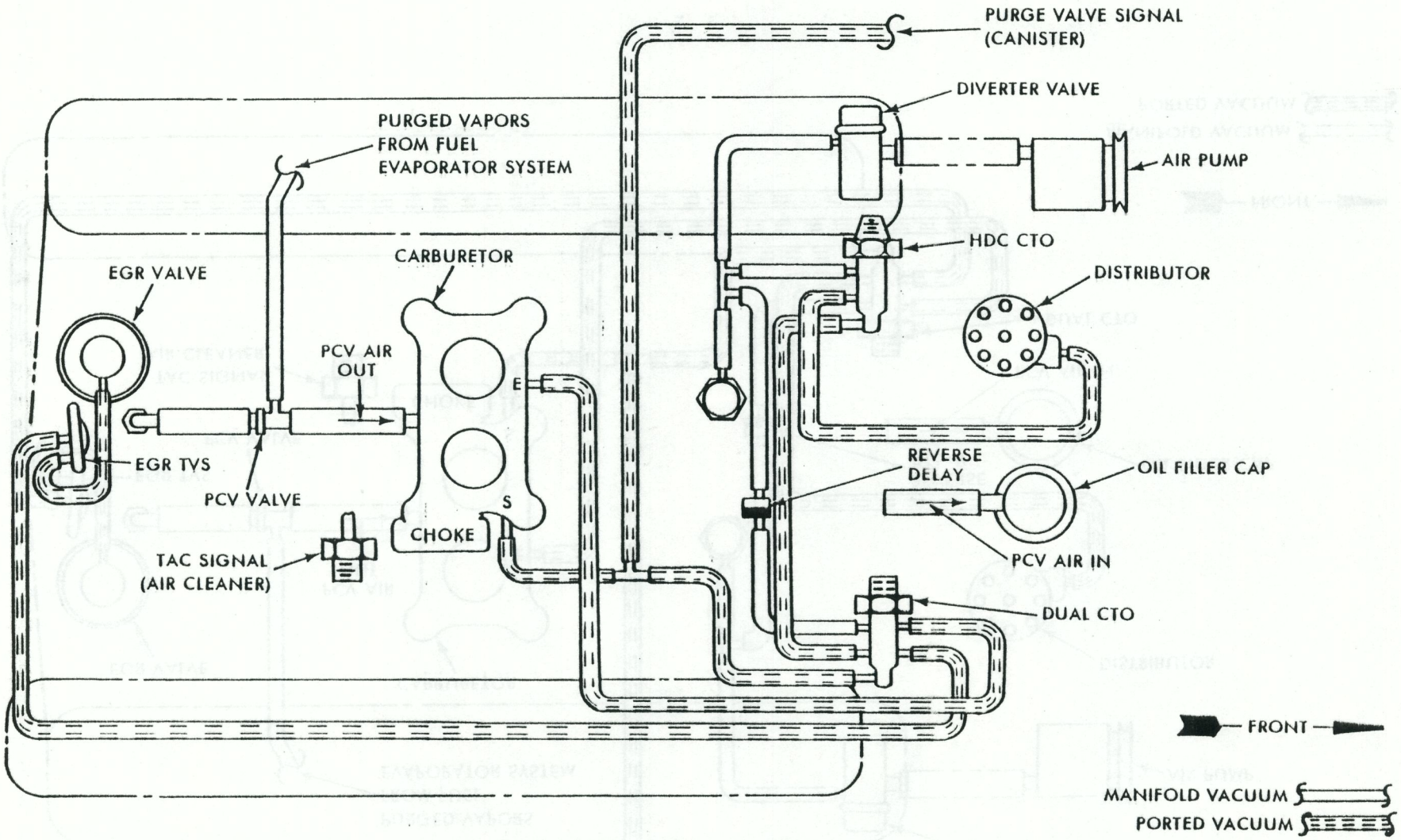

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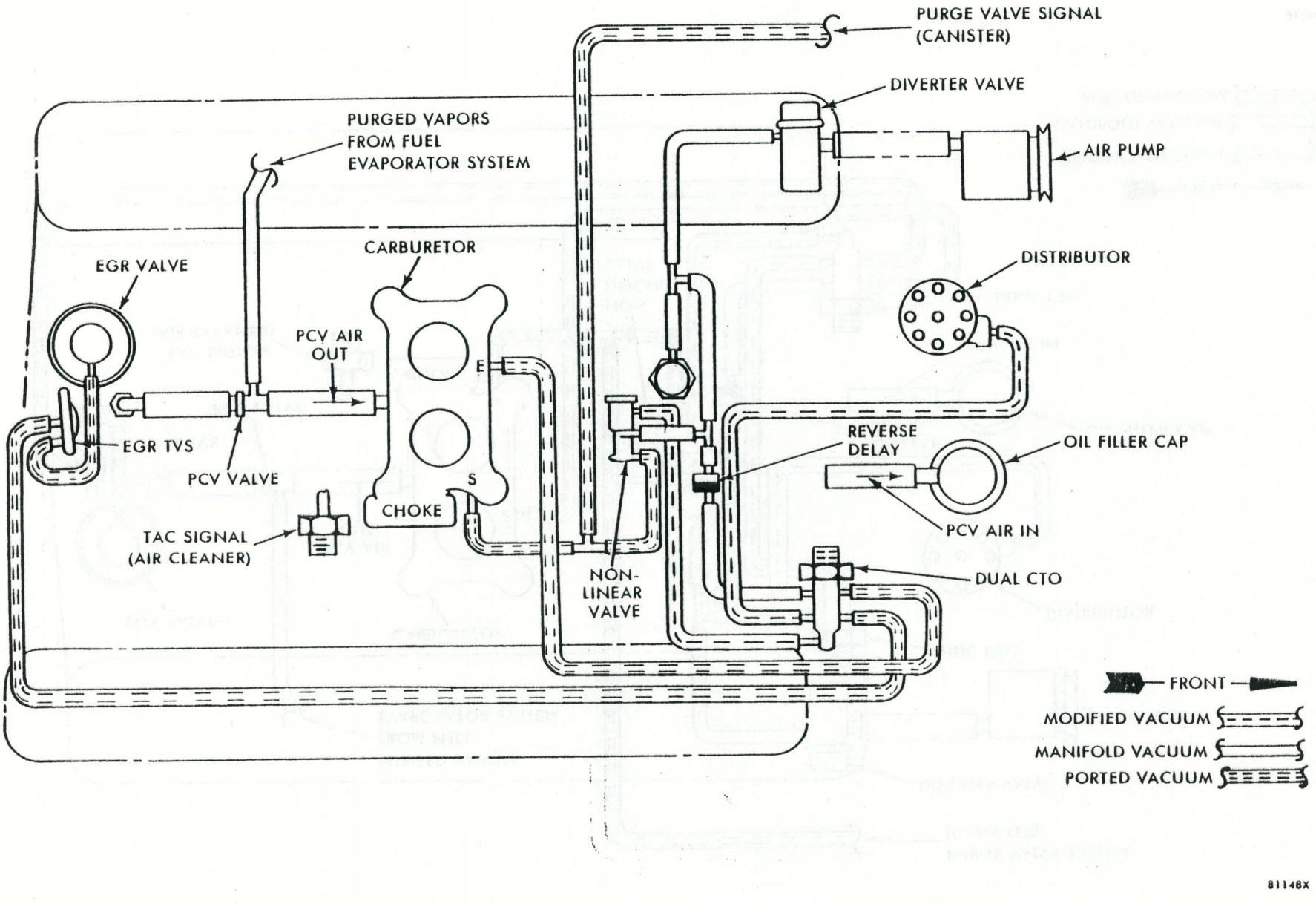

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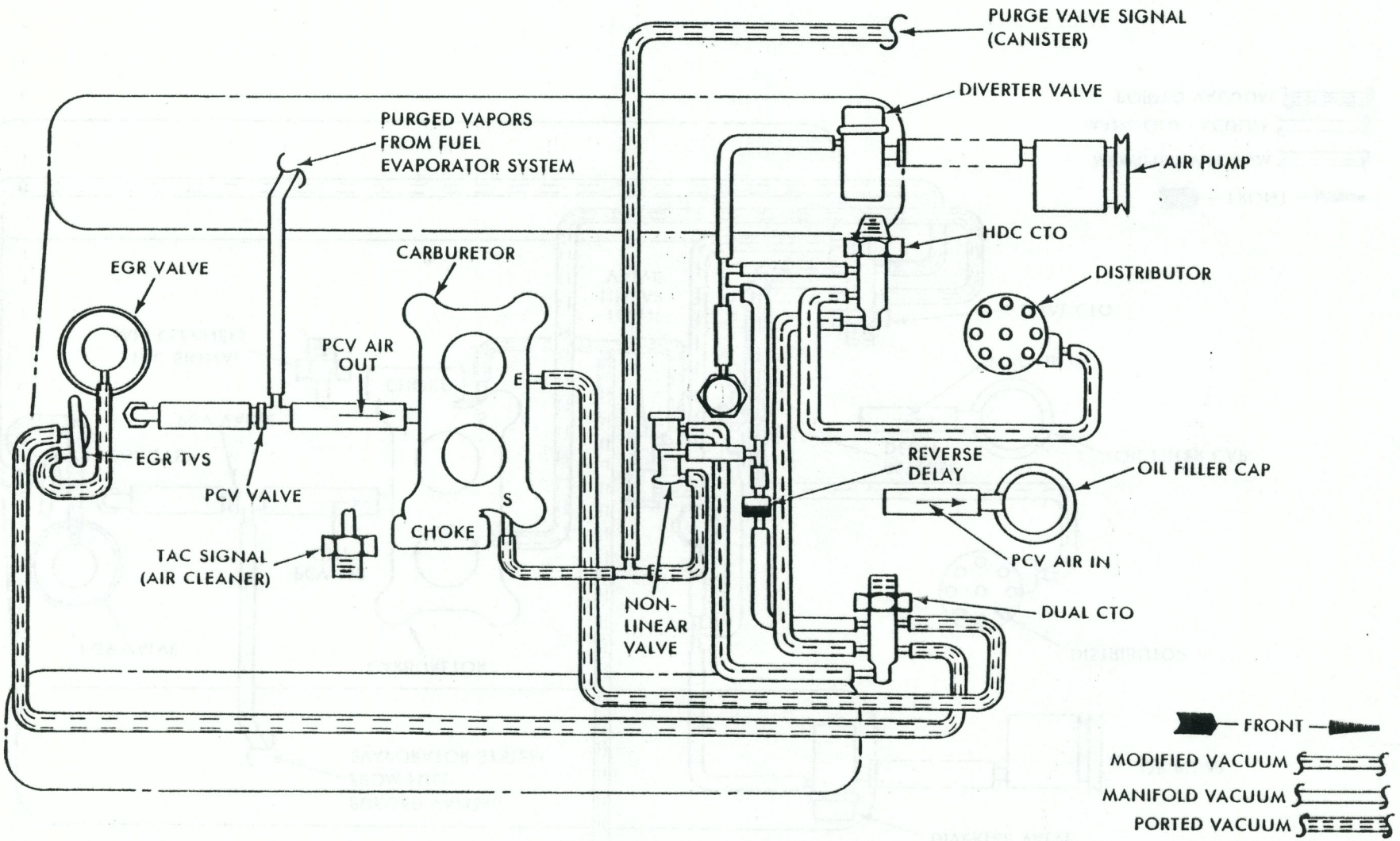

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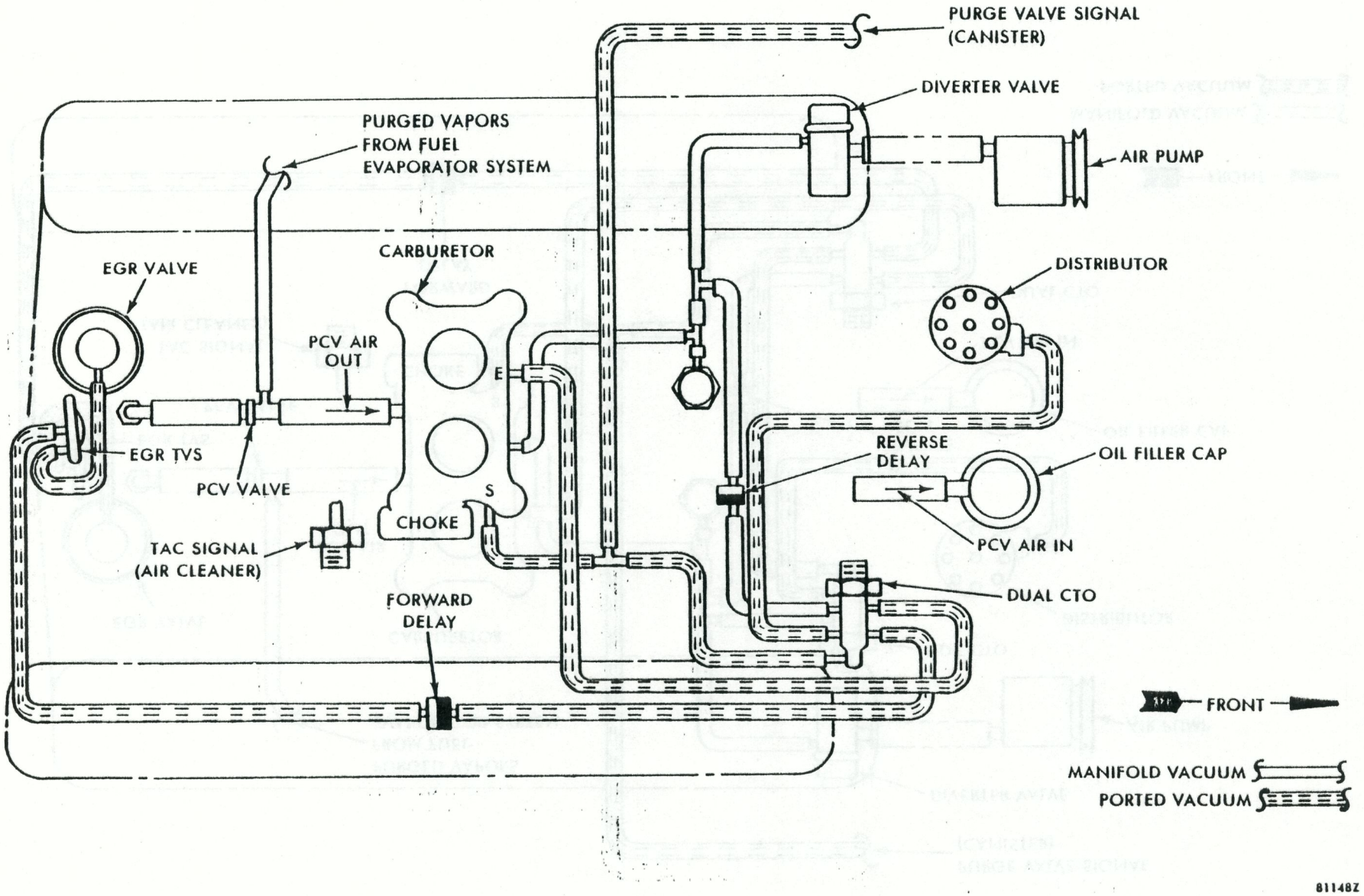
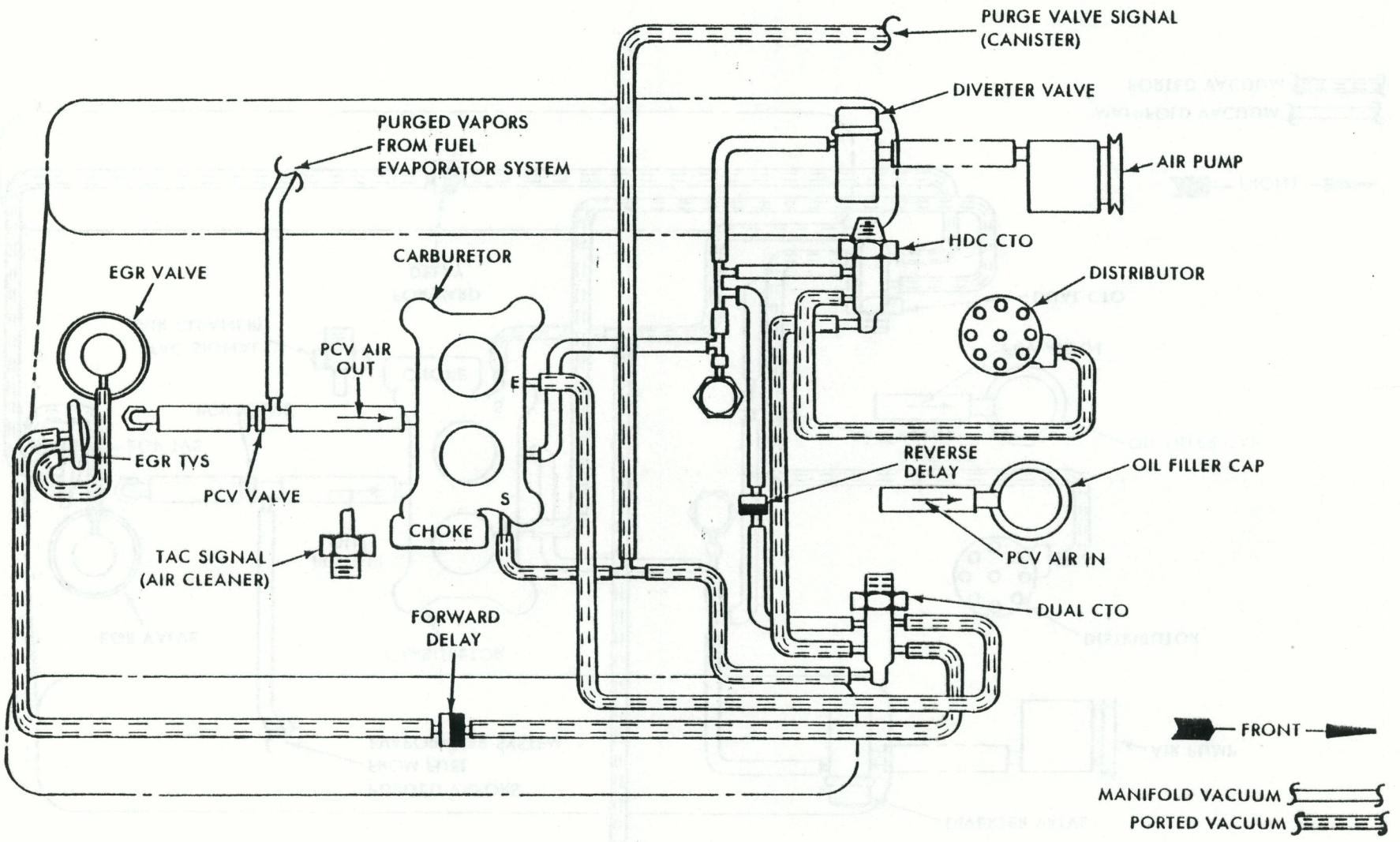
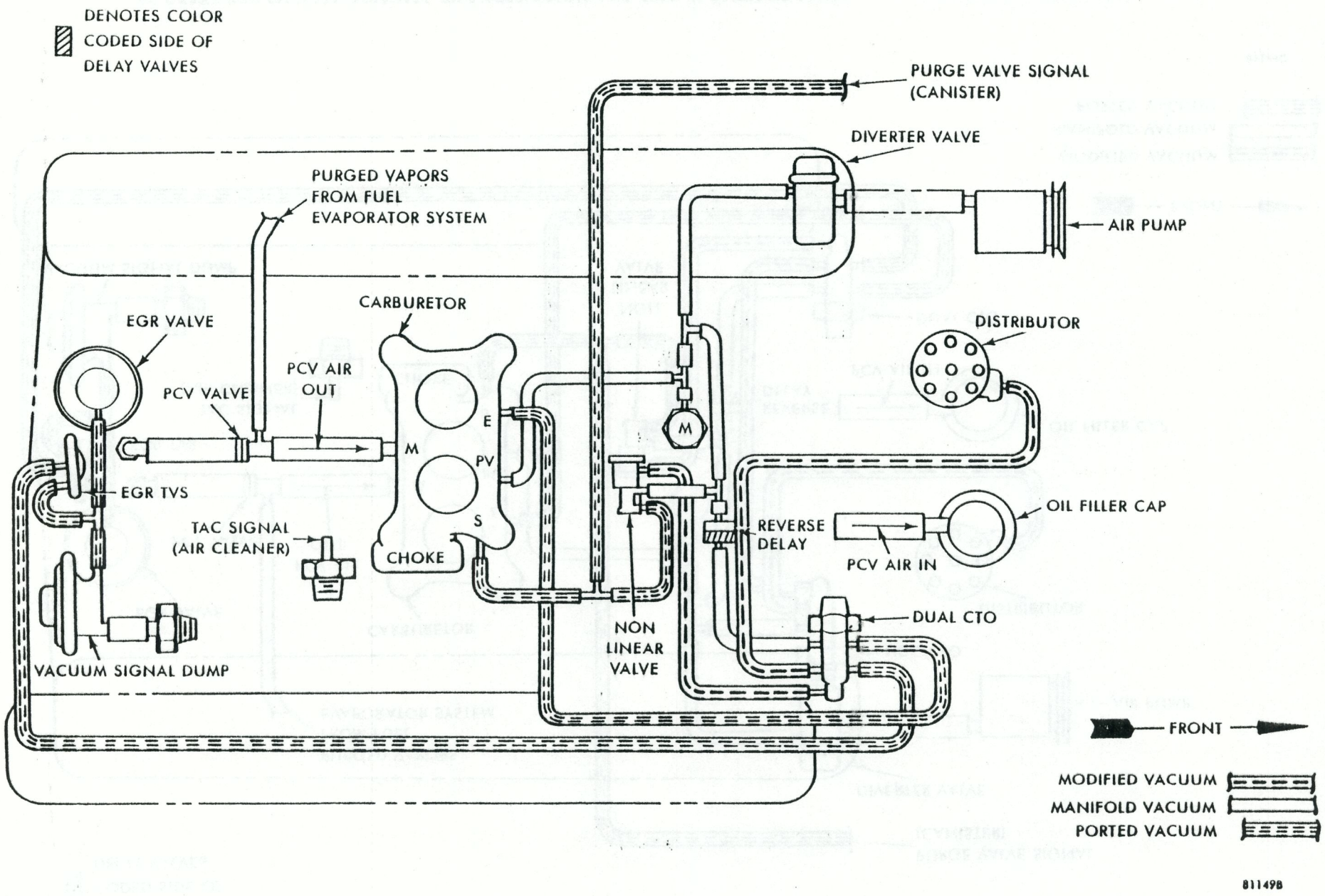


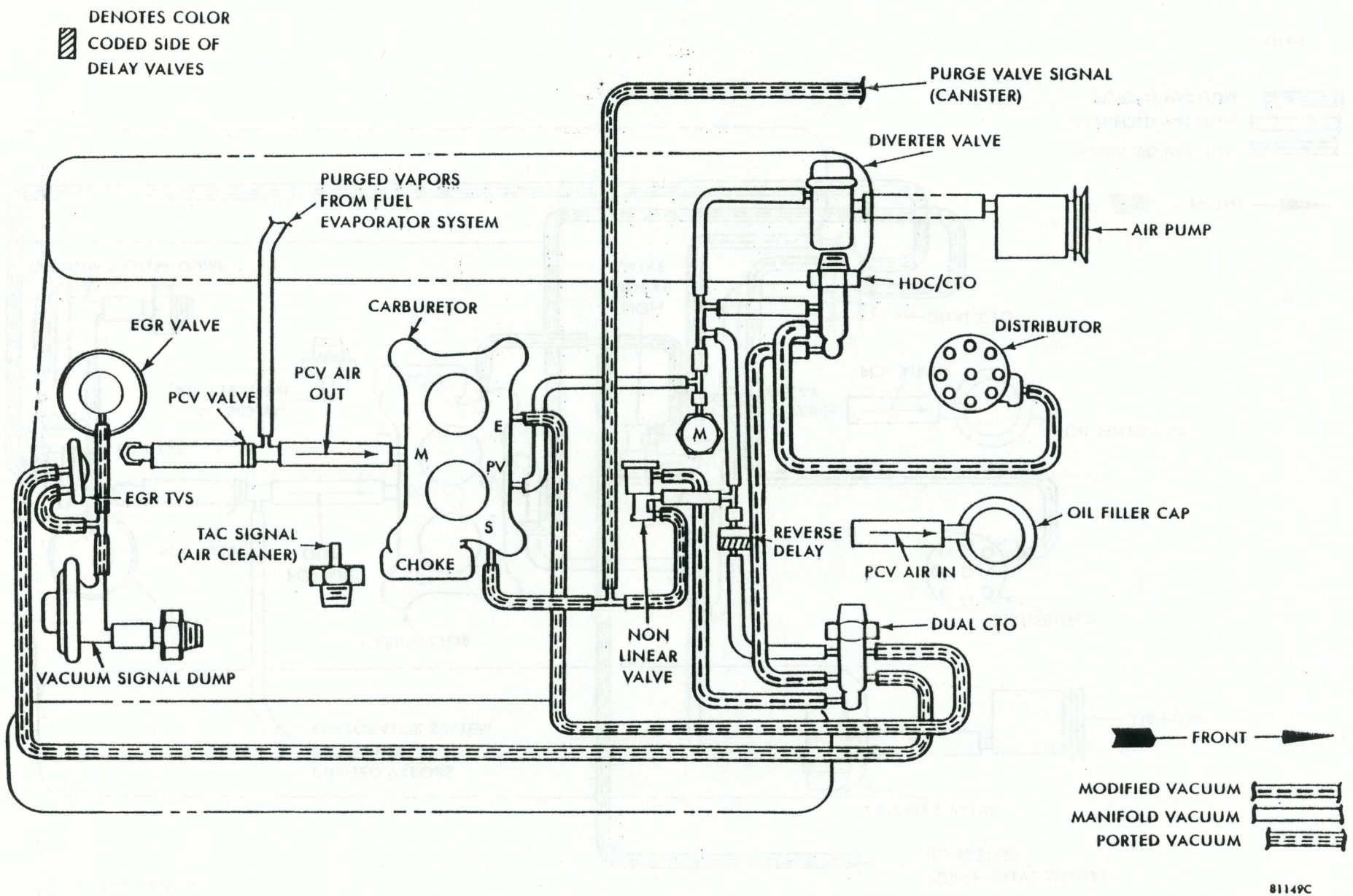
HI-ALTITUDE 304 2V WITH MANUAL TRANSMISSION AND STANDARD COOLING CJ



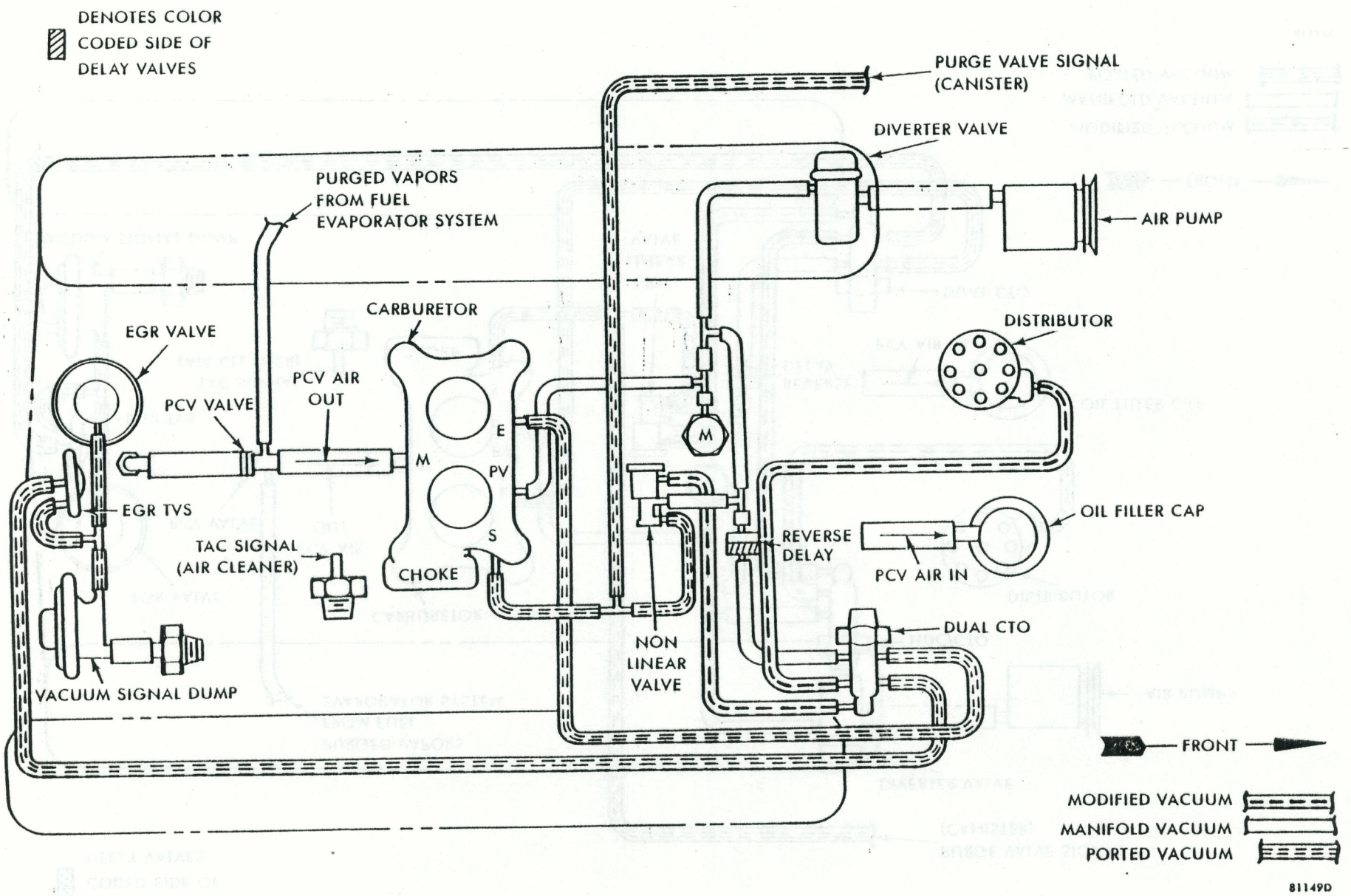
HI-ALTITUDE 304 2V WITH MANUAL TRANSMISSION AND HEAVY DUTY COOLING CJ



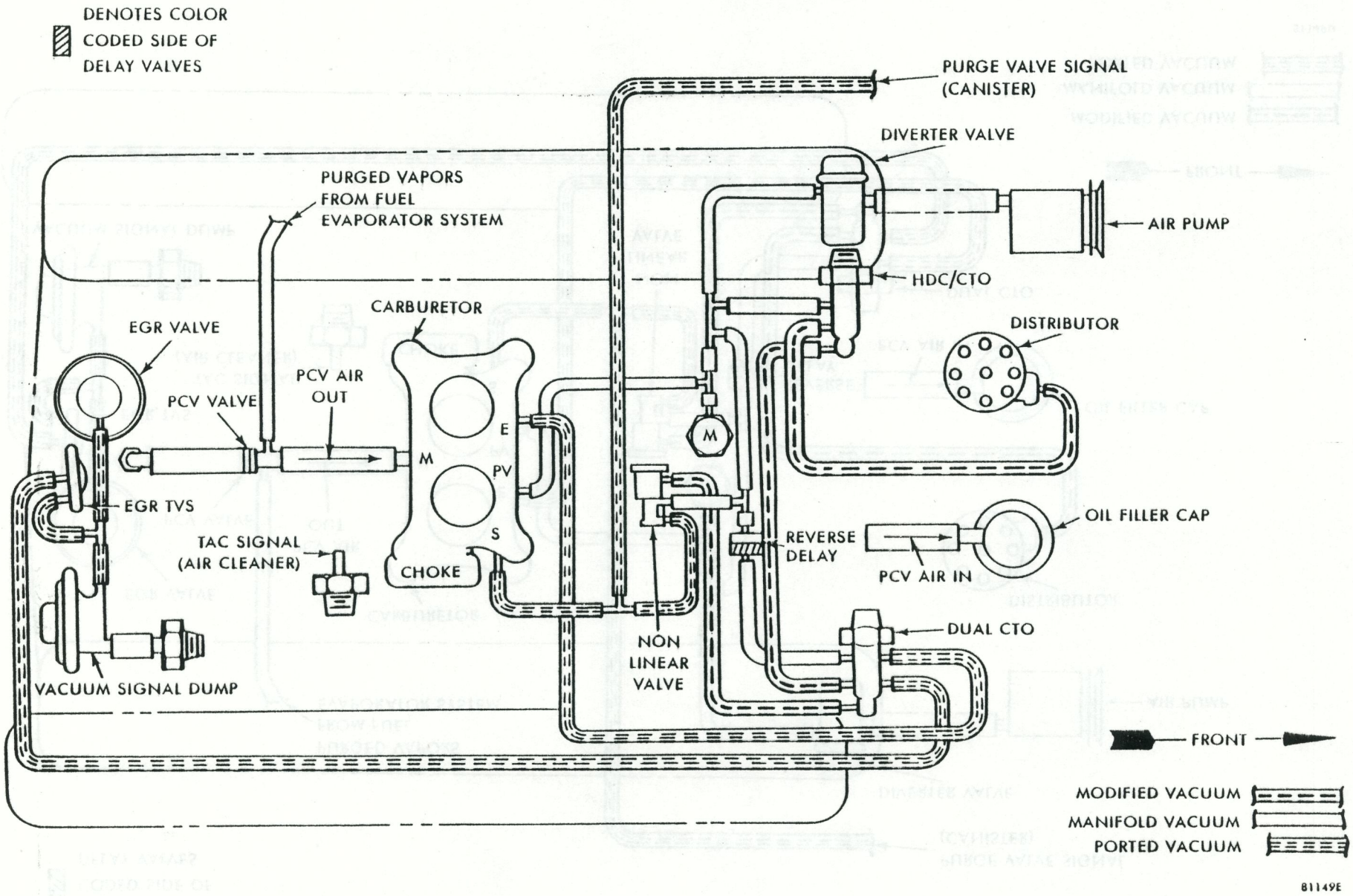
49 STATE 360 2V WITH MANUAL TRANSMISSION AND STANDARD COOLING · CHEROKEE, WAGONEER, TRUCK



49 STATE 360 2V WITH MANUAL TRANSMISSION AND HEAVY DUTY COOLING **CHEROKEE, WAGONEER, TRUCK**



49 STATE 360 2V WITH AUTOMATIC TRANSMISSION AND STANDARD COOLING , CHEROKEE, WAGONEER, TRUCK



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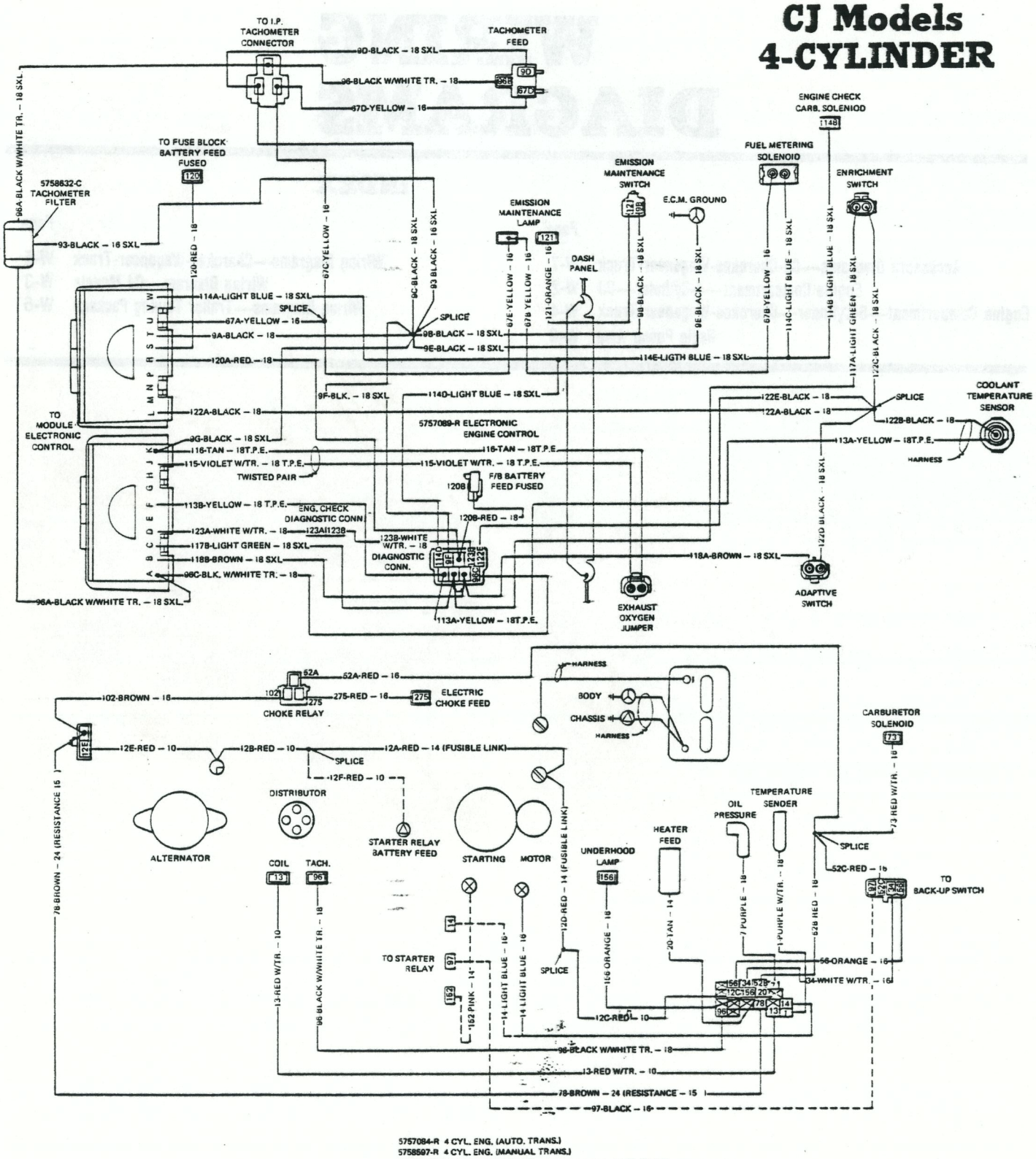


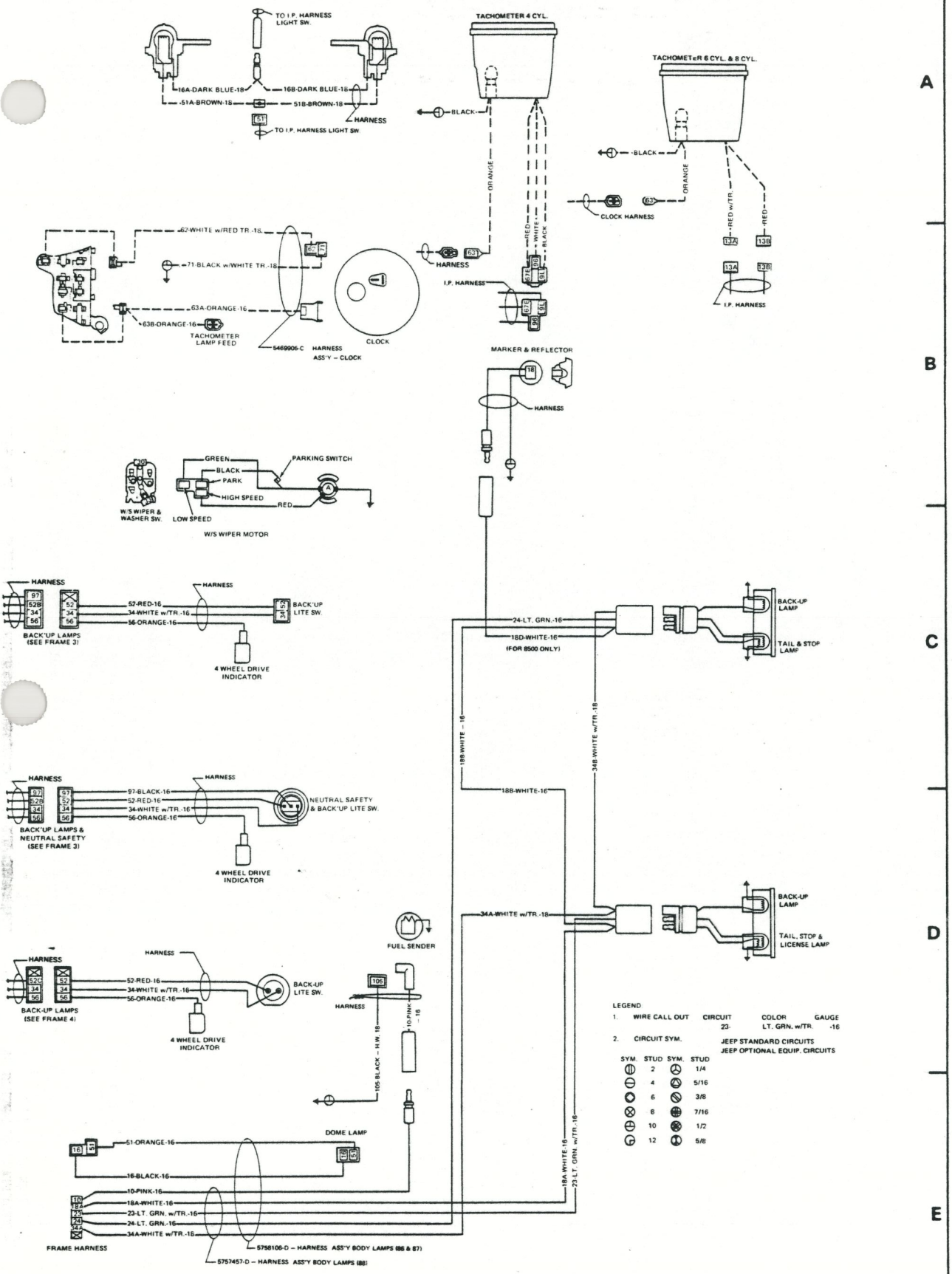
5757084-R 4 CYL. ENG. (AUTO. TRANS.)
5758597-R 4 CYL. ENG. (MANUAL TRANS.)
CIRCUIT SYMM. MANUAL TRANS. ——— AUTO. TRANS. - - - - - -

Wiring Diagram
CJ Models

Component Grid Locator
CJ Models

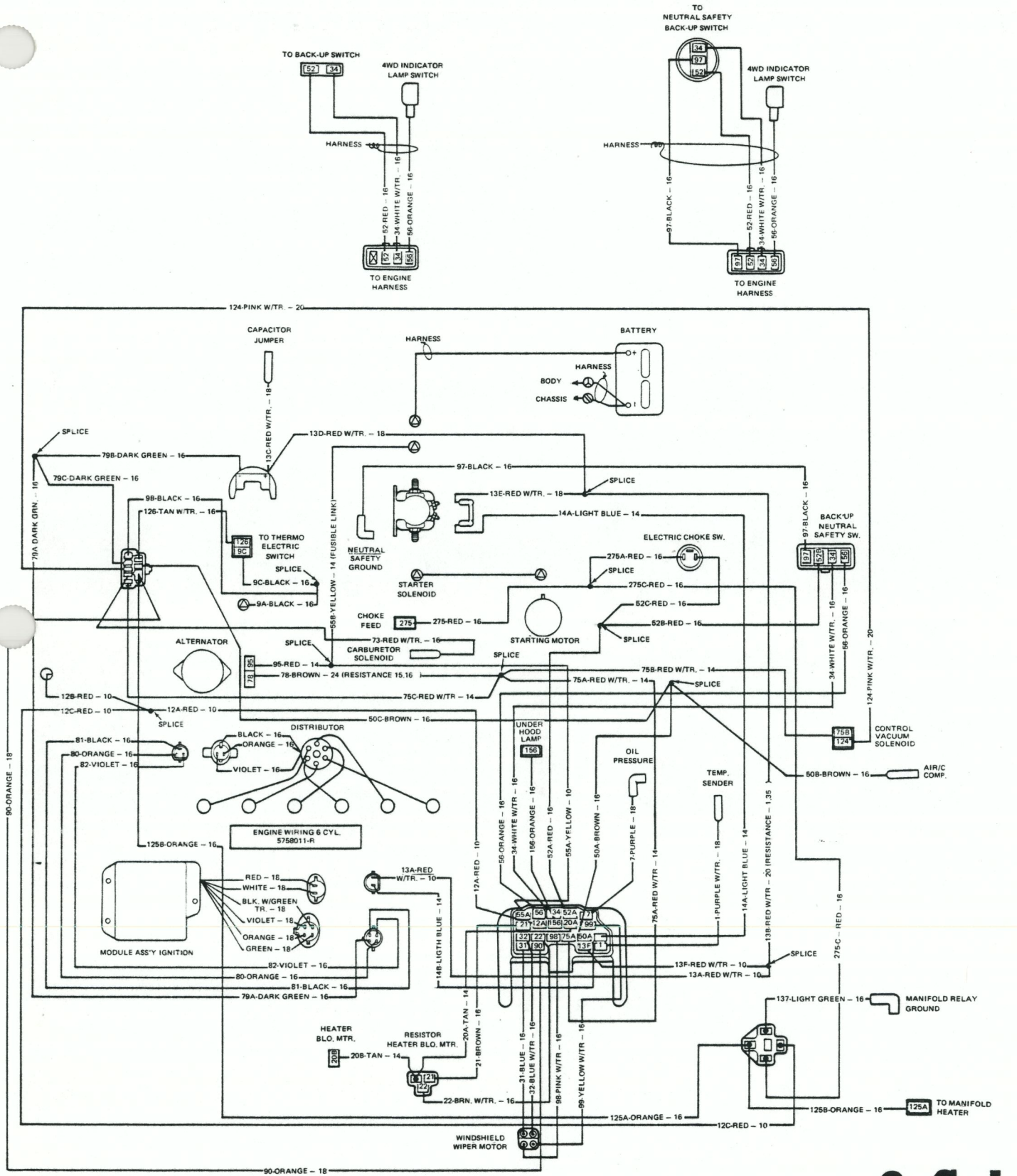
NOMENCLATURE	LOCATION
Accessory Feed	C-7
Air Conditioner Compressor, 8-Cylinder	B-3
Alternator, 8-Cylinder	B-2
Alternator, 6-Cylinder	D-3
Back-up Lamp, Right Side	C-11
Back-up Lamp, Left Side	D-11
Back-up Light Switch Manual Transmission	C-9, D-9
Back-up Light Switch Automatic Transmission	D-9
Battery, 8-Cylinder	A-4
Battery, 6-Cylinder	C-4
Body Ground, 8-Cylinder	A-4
Body Ground, 6-Cylinder	C-4
Brake Failure Switch	E-3
Brake Warning Lamp	C-6
Capacitor Jumper, 8-Cylinder	A-3
Capacitor Jumper, 6-Cylinder	C-2
Chassis Ground, 8-Cylinder	A-4
Chassis Ground, 6-Cylinder	C-4
Cigar Lighter Feed	D-7
Coil, 8-Cylinder	A-2
Coil, 6-Cylinder	C-3
Dimmer Switch	D-5
Distributor, 8-Cylinder	A-3
Distributor, 6-Cylinder	C-3
Electric Choke	B-5, E-1
Fuel Gauge	B-7
Fuel Sender	D-10
Ground Air Lamp Feed	A-6
Ground Defogger Lamp Feed	A-6
Ground Fan Lamp Feed	A-7
Ground Temperature Lamp Feed	A-6
Headlamp, Right Side	B-1
Headlamp, Left Side	D-1
Heater Motor, 8-Cylinder	B-3
Heater Motor, 6-Cylinder	D-3
Heater Switch	B-5
High Beam Indicator	D-5
Horn	E-3
Horn Relay	C-6
Ignition Switch	C-7
Left Turn Indicator & Hazard Lamp	E-7
Low Beam L.P.	D-5
Marker & Reflector, Right Side — Front	A-2
Marker & Reflector, Left Side — Front	E-2
Marker & Reflector, Right Side — Rear	B-10
Marker & Reflector, Left Side — Rear	E-10
Module Assembly Ignition, 8-Cylinder	B-3
Module Assembly Ignition, 6-Cylinder	D-3

NOMENCLATURE	LOCATION
Neutral Safety Switch	D-9
Oil Lamp Gauge	B-6
Oil Pressure Sender, 8-Cylinder	B-3
Oil Pressure Sender, 6-Cylinder	D-3
Panel Lamp	B-6
Park & Signal Lamp, Right Side	A-1
Park & Signal Lamp, Left Side	D-1
Parking Brake	C-6
Four Wheel Drive Indicator	C-9, D-9
Resistor, Heater Blower Motor	B-5
Splice A	A-2
Splice B	B-2
Splice C	C-2
Splice D	E-2
Splice E	E-2
Splice F	E-2
Splice G	A-3
Splice H	A-3
Splice I	A-3
Splice J	B-3
Splice K	C-3
Splice L	C-3
Splice M	D-4
Splice N	B-5
Splice O	B-5
Splice P	C-5
Splice Q	B-6
Splice R	B-6
Splice S	C-6
Splice T	C-6
Splice U	C-6
Splice V	C-6
Splice W	C-6
Splice X	D-7
Splice Y	E-8
Starting Motor, 8-Cylinder	A-3
Starting Motor, 6-Cylinder	C-4
Starter Solenoid, 8-Cylinder	A-3
Starter Solenoid, 6-Cylinder	C-3
Stop Lamp Switch	D-5
Tail & Stop Lamp, Right Side	C-11
Tail & Stop Lamp, Left Side	D-11
Temperature Gauge	B-7
Temperature Sender, 8-Cylinder	A-4
Temperature Sender, 6-Cylinder	C-4
Turn Signal Switch	D-6
Voltmeter Gauge	B-7
Windshield Wiper & Washer Lamp	D-7
Windshield Wiper Motor	C-9
Windshield Wiper & Washer Switch	D-7

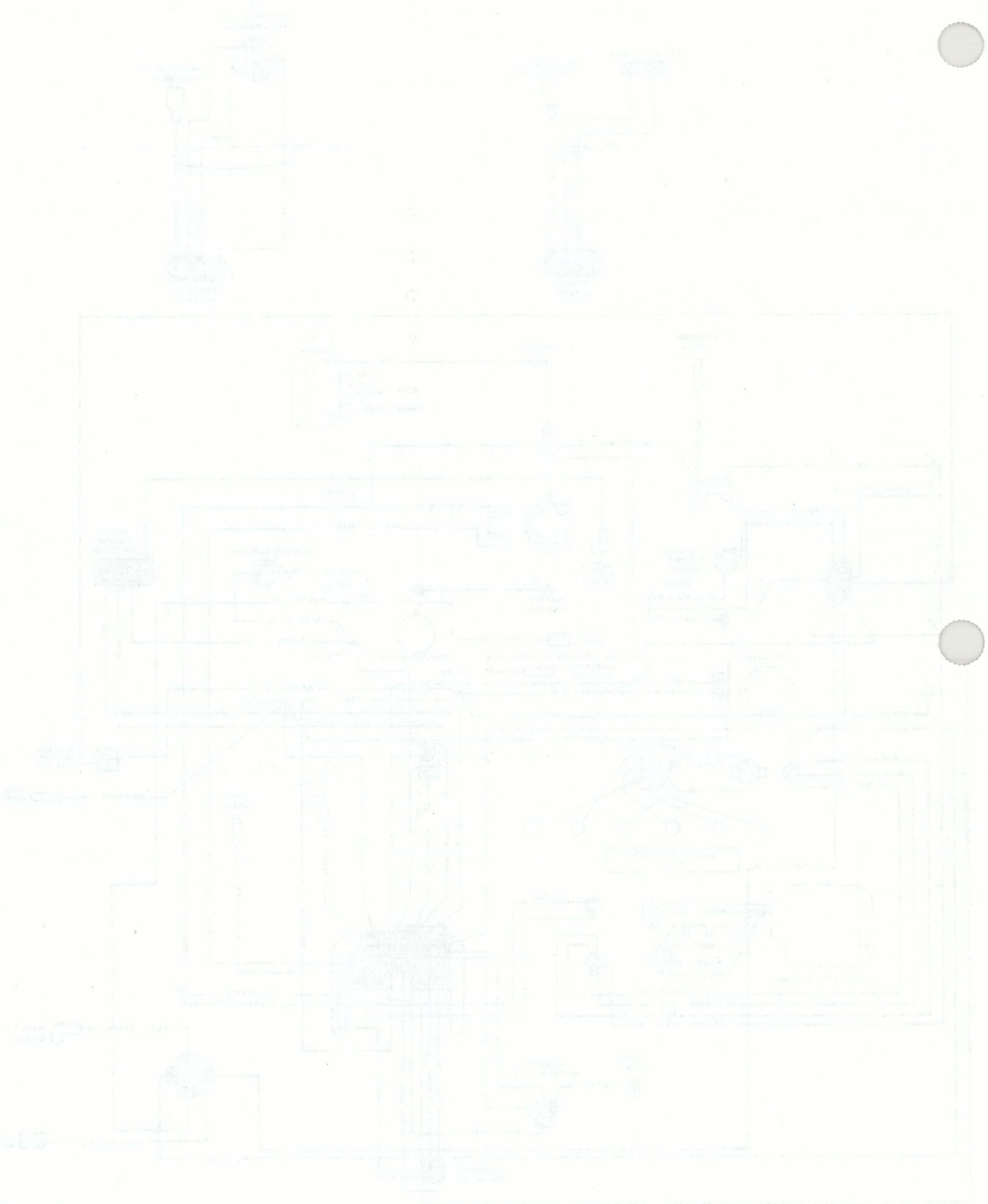


Wiring Diagram CJ Models

Wiring Diagram
Cherokee—Wagoneer—Truck Models



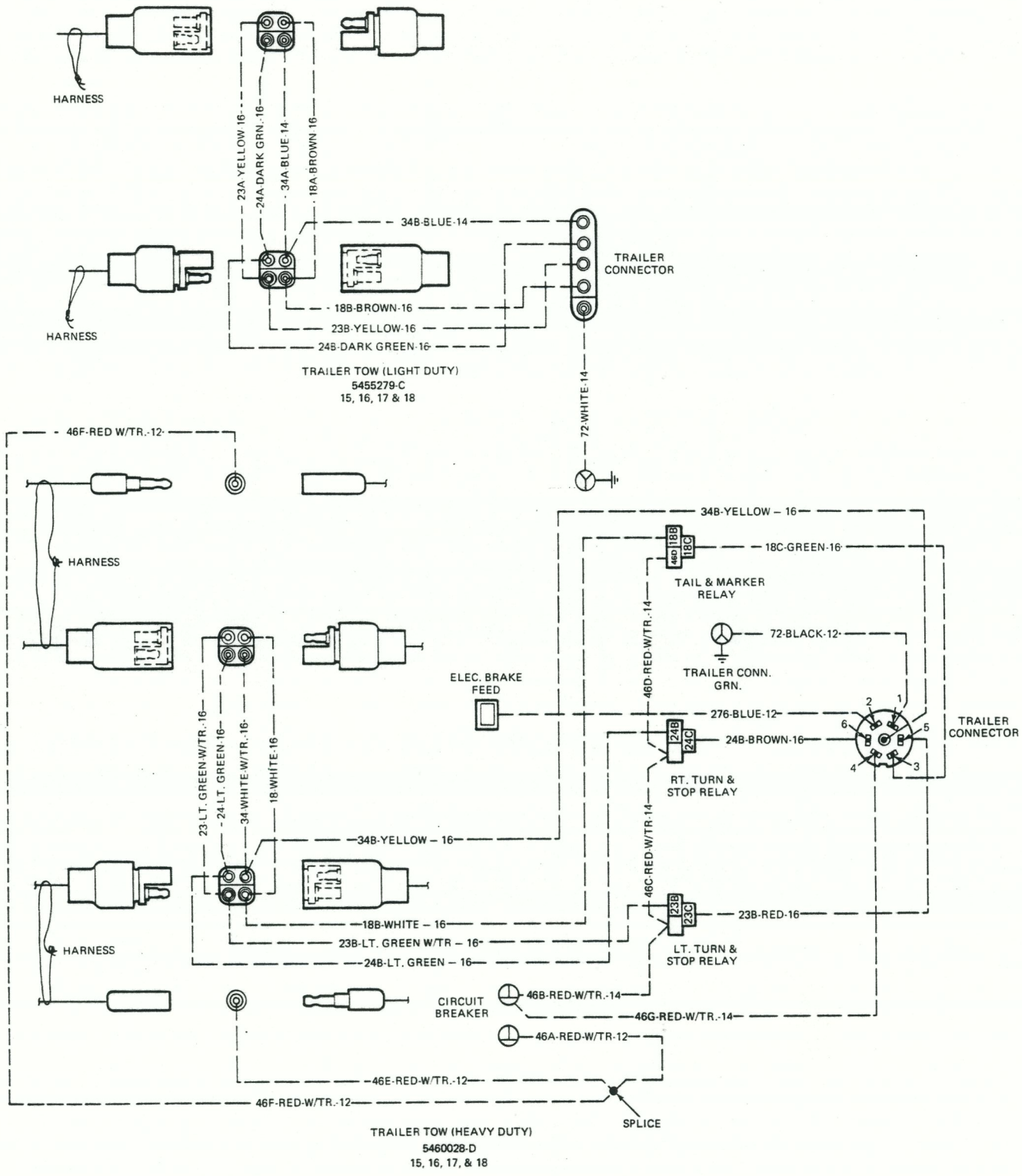
6-Cyl.
Cherokee - Wagoneer - Truck
Wiring Diagram



Component Grid Locator
Cherokee - Wagoneer - Truck

NOMENCLATURE	LOCATION
Air Conditioner Compressor, 6-Cylinder	D-4
Air Conditioner Compressor, 8-Cylinder	C-3
Alternator, 6-Cylinder	C-1
Alternator, 8-Cylinder	B-2
Ash Tray Lamp Feed	C-6
Back-up Lamp, Left Side	D-11, E-11
Back-up Lamp, Right Side	A-11, B-11
Battery, 6-Cylinder	B-3
Battery, 8-Cylinder	A-4
Body Ground, 6-Cylinder	B-3
Body Ground, 8-Cylinder	A-4
Brake Warning	E-8
Capacitor Jumper, 6-Cylinder	B-2
Capacitor Jumper, 8-Cylinder	A-2
Cargo Lamp	B-9
Cargo Lamp Switch	C-9
Chassis Ground, 6-Cylinder	B-3
Chassis Ground, 8-Cylinder	A-4
Cigar Lighter	B-6
Cluster Connection	B-6
Coil, 6-Cylinder	B-2
Coil, 8-Cylinder	B-2
Courtesy Lamp	B-8, D-9
Defogger	D-14
Dimmer Switch	D-6
Distributor, 6-Cylinder	D-2
Distributor, 8-Cylinder	C-2
Dome Lamp	D-8
ome LP	C-12
oor Switch	B-10, D-10
Electric Choke, 6-Cylinder	C-3
Electric Choke, 8-Cylinder	C-2
Frame Harness	E-4
Fuel Sender	E-9
Glove Box Lamp Feed	A-8
Glove Box Light	B-13
Headlamp, Left Side	D-1
Headlamp, Right Side	B-1
Heater Blower Motor, 8-Cylinder	D-3
Heater Control Switch	C-8
Heater Ground	C-8
Heater Lamps	C-6
Horn Relay	D-6
Horns	E-3
Ignition Switch, Left Side	B-6
Ignition Switch, Right Side	A-6
Light Switch	D-7
License Lamp	C-10
License Lamp	C-11
License Lamp	D-14
Marker & Reflector	B-10
Marker & Reflector	D-11
Marker & Reflector	D-10
Marker & Reflector Lamp, Left Side	E-2
Marker & Reflector Lamp, Right Side	A-2
Module Assembly Ignition, 6-Cylinder	D-1

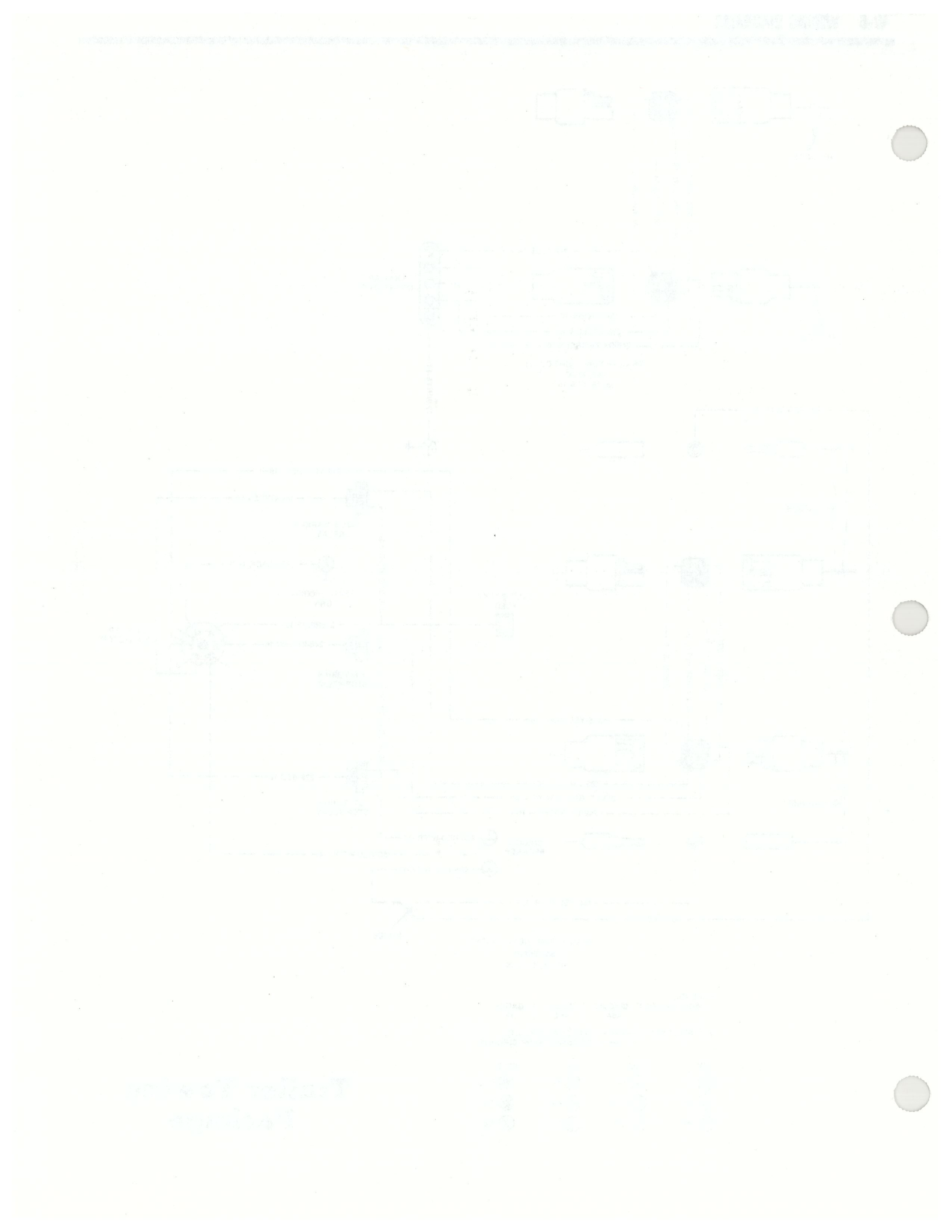
NOMENCLATURE	LOCATION
Module Assembly Ignition, 8-Cylinder	C-2
Oil Pressure, 6-Cylinder	D-3
Oil Pressure, 8-Cylinder	C-4
Park & Signal Lamp, Left Side	D-1
Park & Signal Lamp, Right Side	B-1
Parking Brake Warning Switch	C-6
Relay	B-12
Seat Belt Buzzer	D-7
Seat Belt Lamp	E-7
Seat Belt Timer	D-7
Splice A	B-2
Splice B	B-2
Splice C	B-1
Splice D	C-1
Splice E	D-2
Splice F	E-2
Splice G, 8-Cylinder	B-3
Splice H, 8-Cylinder	C-3
Splice I, 8-Cylinder	B-3
Splice J	A-5
Splice K	B-5
Splice L	C-5
Splice M	B-5
Splice N	B-5
Splice O	B-6
Splice P	C-6
Splice Q	B-6
Splice R	C-7
Splice S	D-7
Splice T	C-9
Splice U	C-13
Splice V, 6-Cylinder	C-2
Splice W, 6-Cylinder	C-3
Splice X, 6-Cylinder	C-3
Splice Y, 6-Cylinder	D-4
Splice Z, 8-Cylinder	C-3
Starter Solenoid, 6-Cylinder	C-2
Starting Motor, 6-Cylinder	C-3
Starting Motor, 8-Cylinder	B-3
Stop Light Switch	A-7
Stop Light Switch & Cruise Control	B-12
Tai & Stop Lamp	B-10
Tail & Stop Lamp	C-10
Tailgate Switch	D-7
Tail, Stop & Back-up Lamp	B-11
Tail, Stop & Back-up Lamp	D-11
Tail, Stop & Marker Lamp	A-11
Tail, Stop & Marker Lamp	E-11
Temperature Sender, 6-Cylinder	D-3
Temperature Sender, 8-Cylinder	C-4
Timer Switch	C-14
Turn Signal Switch	A-6
Washer Bottle	D-3
Windshield Wiper Motor, 6-Cylinder	E-3
Windshield Wiper Motor, 8-Cylinder	D-3
Windshield Wiper Switch	D-6



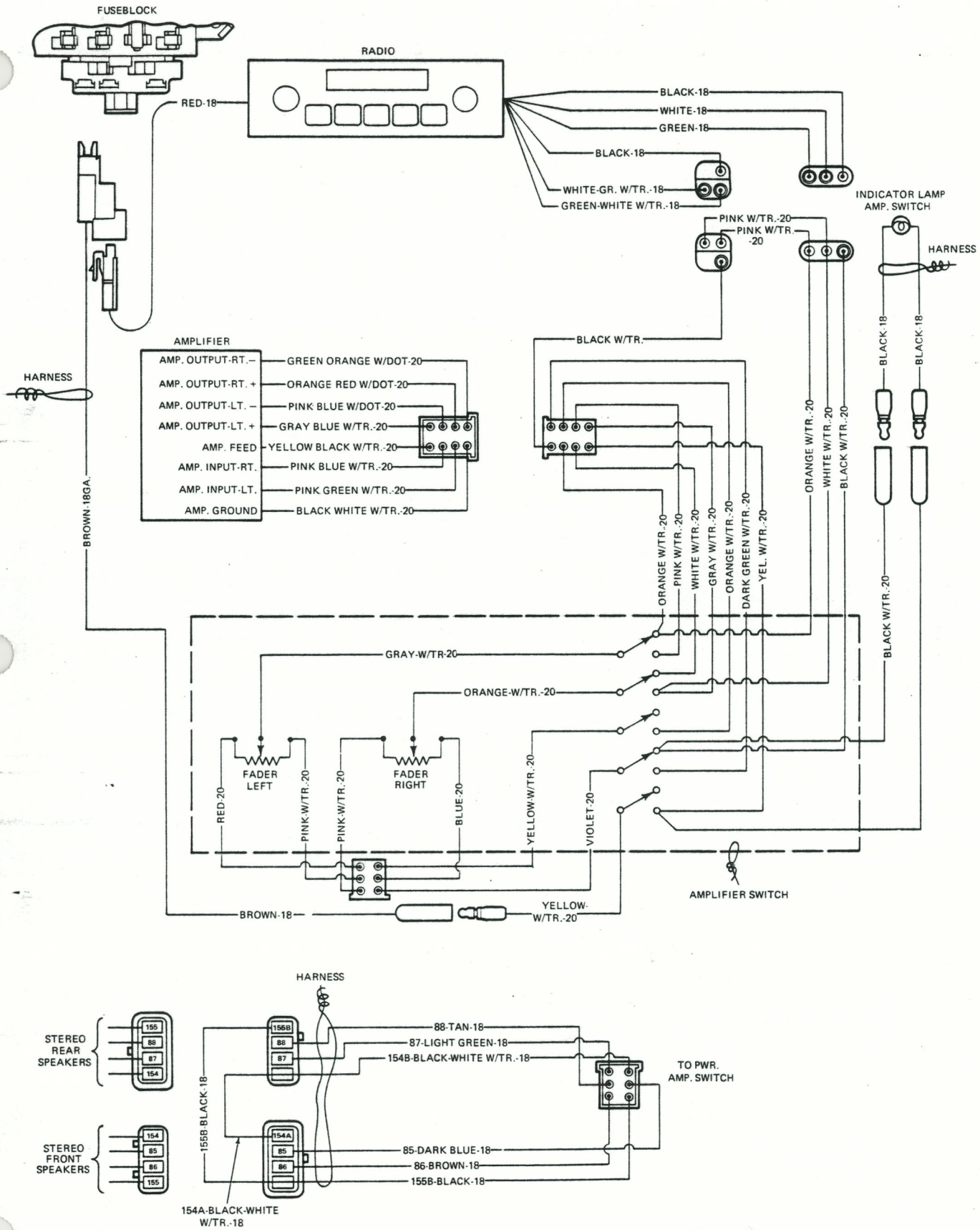
LEGEND:
1. WIRE CALLOUT CIRCUIT 46A | COLOR RED | GAUGE 12
2. CIRCUIT SYM ——— STANDARD CIRCUITS
– – – OPTIONAL EQUIP. CIRCUITS

SYM	STUD	SYM	STUD
#2	1/4	#8	7/16
#4	5/16	#10	1/2
#6	3/8	#12	5/8

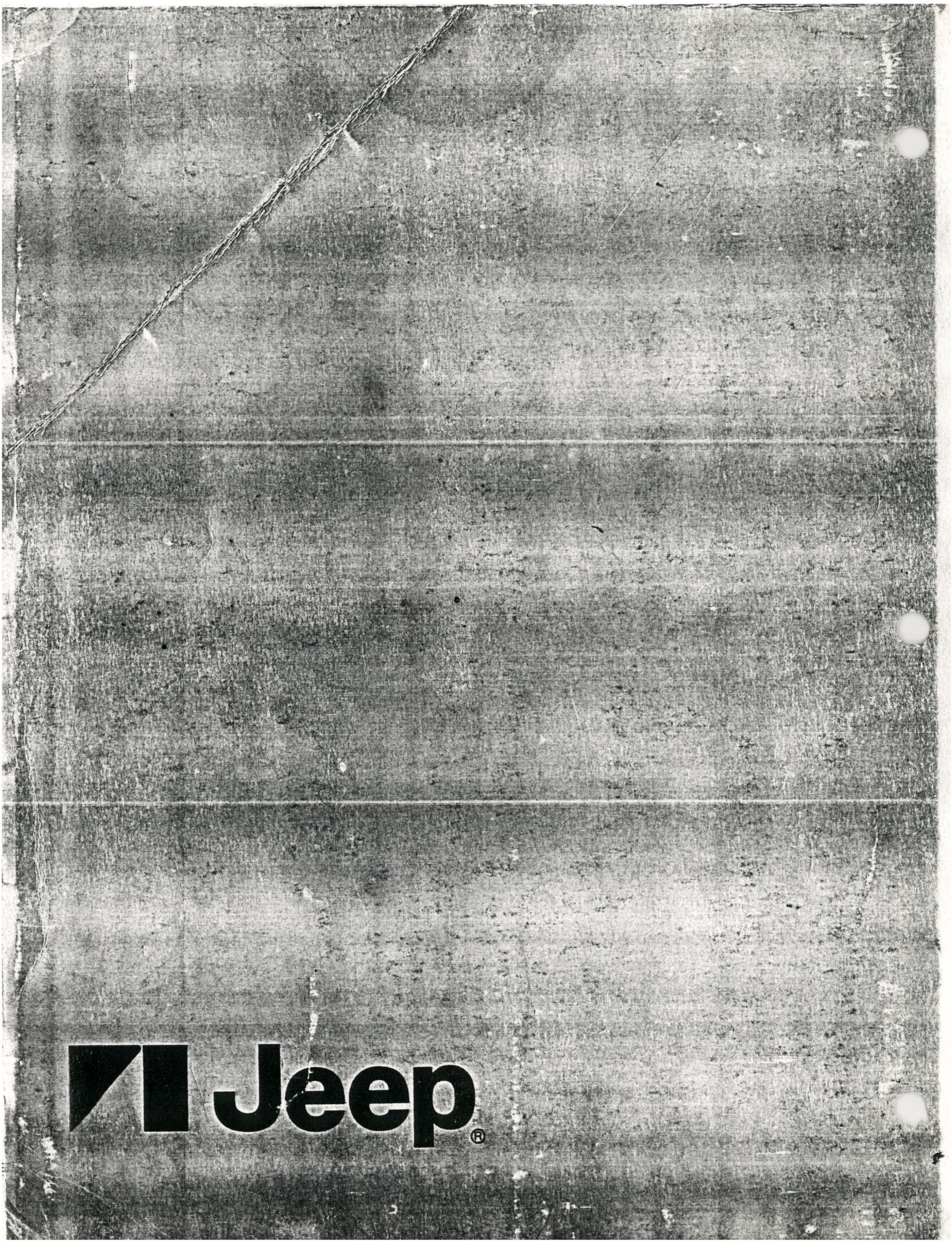
Trailer Towing Package



Accessory Diagrams
CJ – Cherokee – Wagoneer – Truck Models



RADIO POWER AMP.


Jeep®

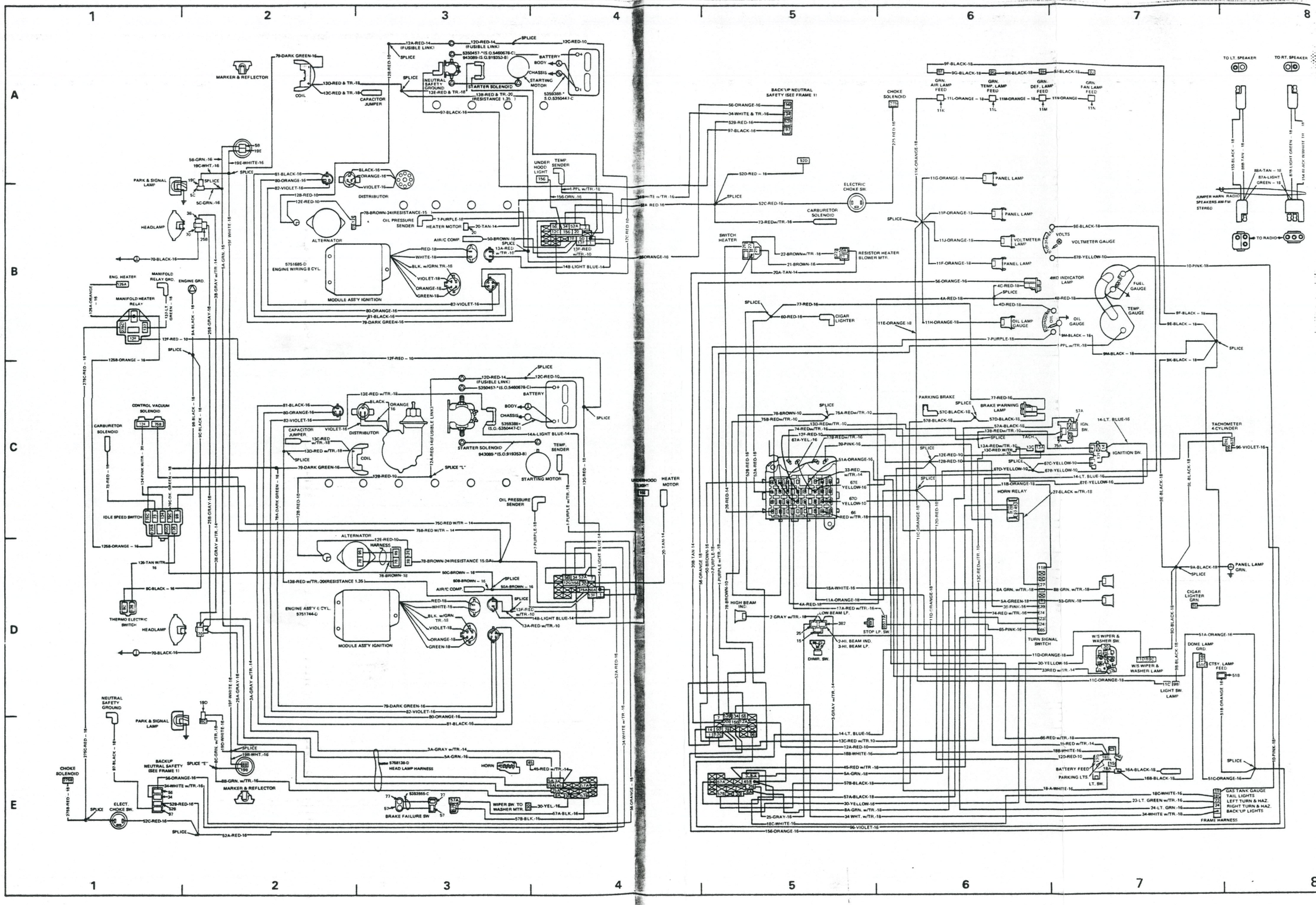
Wiring Diagram
Cherokee - Wagoneer - Truck

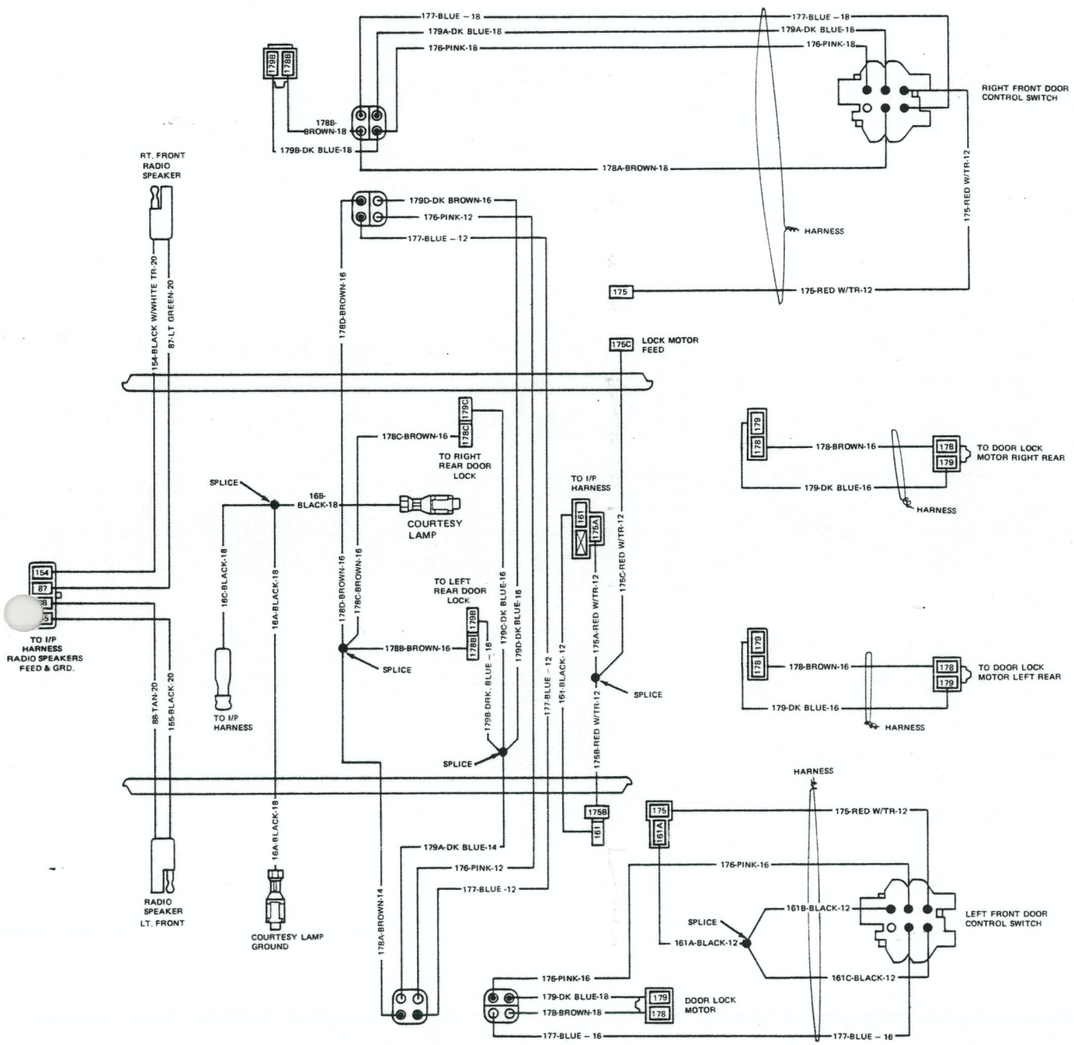
CRTSY LAMP
168 BLK. W/YEL TR. 18
16 BLK. W/YEL TR. 18
HARNESS
DOME & READING LAMP
CARGO LAMP
CTSY. LP. GRD. RT
16D-BLACK - 18
SPLICE
HARNESS
CARGO LAMP SWITCH
98-BROWN 18
SPLICE T
51D-BROWN 18
VANITY LAMP
9A-BLACK 18
16F-BLACK - 18
51A-BROWN - 18
CSTY. LAMP GROUND LT.
DOME LAMP (OPT. SEE FRAME 11)
51-BROWN 18
16-BLACK 18
188-BLK. W/YEL TR. 18
TO INSTRUMENT PANEL
DOOR SW
16A-DARK BLUE - 18
CRTSY LAMP
TO FUEL SENDER
105-BLACK 18
10-PINK 18
BRAKE WARNING
57-BLACK 18
MARKER & REFLECTOR LAMP (FOR 25,26 & 27)
TAIL & STOP LAMP (FOR 25,26 & 27)
LICENSE LAMP (FOR 25, 26 & 27)
BACK-UP LAMP (FOR 25,26 & 27)
TAIL & STOP LAMP (FOR 25,26 & 27)
MARKER & REFLECTOR LAMP (FOR 25,26 & 27)
LICENSE LAMP
18B WHITE 16
24 LT. GREEN 16
34B WHITE W/TR. 18
TAIL,STOP & MARKER LAMP (FOR 15)
BACK-UP LAMP (FOR 15)
MARKER & REFLECTOR LAMP (FOR 16,17 & 18)
TAIL,STOP & BACK-UP LAMP (FOR 16,17 & 18)
LICENSE LAMP (FOR 16,17 & 18)
72 BLACK 18
72A BLACK 18
72B BLACK 18
72C BLACK 14
72D BLACK 14
18 WHITE 18
18A WHITE 16
18B WHITE 16
18C WHITE 16
18D WHITE 16
34A WHITE W/TR. 18
34B WHITE W/TR. 18
23 LT. GREEN W/TR. 16
24 LT. GREEN 16
24A LT. GRN. W/TR. 18
24B LT. GREEN W/TR. 18
TAIL,STOP & BACK-UP LAMP (FOR 16,17 & 18)
994034-15,O,994033-81 (FOR 16, 17 & 18)
BACK-UP LAMP (FOR 15)
TAIL,STOP & MARKER LAMP (FOR 15)
LICENSE LAMP
HARNESS
SEE FRAME 3 - 51C
CRUISE COMMAND REGULATOR
ORANGE 18
GLOVE BOX LIGHT & SWITCH (FOR 15) (OPT. FOR 16,17,18,25,26 & 27)
STOP LIGHT SW
SEE FRAME 3 - 87A
8-BLUE 18
8-WHITE 18
FUSE
4 YELLOW 18
3-GREEN 18
2-BROWN 18
1-RED 18
7-WHT 18
RELAY
6-BLACK 18
5-VIOLET 18
FUSE BLOCK
4 YELLOW 24
3-GREEN 24
2-BROWN 24
1-RED 24
#40 NO SSW
DOME LT, CARGO LT. & SW. (OPT. FOR 25,26 & 27)
51C-BROWN 18
51E-BROWN 18
51B-BROWN 18
SPLICE U
CARGO LP
CARGO LAMP SWITCH
51D-BROWN 18
VANITY LAMP
9-BLACK 18
SEE FRAME 3
DOME LP & CARGO LP (STD.) (16-17 & 18)
51B-BROWN 18
16B-BLACK 18
LEFT REAR SPEAKER
RIGHT REAR SPEAKER
HARNESS
SEE FRAME 3 - 16A
SEE FRAME 3 - 16B
SEE FRAME 3 - 16C
TIMER SWITCH
46B-ORANGE 14
MOTOR T/GATE
48B-TAN 12
SW. T/GATE WINDOW
46C-ORANGE 12
SPLICE
47B-BROWN 12
47C-BROWN 12
DISCONNECT SW
89-PURPLE 16
90A-ORANGE 16
90B-ORANGE 14
DEFOGGER
DEFOGGER GROUND
LICENSE LAMP
47A-BROWN 12
48A-TAN 12
46A-ORANGE 12
155-BLACK 18
47-BROWN 12
46-ORANGE 12
85-DARK BLUE 18
154-BLACK W/ WHITE TR. 18
89-PURPLE 16
90-ORANGE 16
SEE FRAME 2 STD. EQUIP.
STEREO REAR SPEAKERS
SEE FRAME 3 I.P. HARNESS
TO RADIO
TO FRONT SPEAKER
155A-BLACK 18
85-DARK BLUE 18
86-BROWN 18
154A-BLACK W/ WHITE TR. 18
154B-BLACK W/ WHITE TR. 18
87-LIGHT GREEN 18
88-TAN 18
155B-BLACK 18
87A LT GRN. 18
88A TAN 18
SEE RADIO
RIGHT FRONT SPEAKER
LEFT FRONT SPEAKER
154-BLACK 18
155-BLACK 18
87-LT. GREEN 18
88-TAN 18
10-PINK 18
18A WHITE 16
23-LT.GREEN W/TR. 16
24-LT.GREEN 16
34-WHITE W/TR. 18
57-BLACK 18

LEGEND
1.WIRE CALLOUT
CIRCUIT 23 — COLOR LT. GRN. W/ TR. — GAUGE 16
2.CIRCUIT SYM
JEEP STANDARD CIRCUIT
JEEP OPTIONAL EQUIP. CIRCUITS

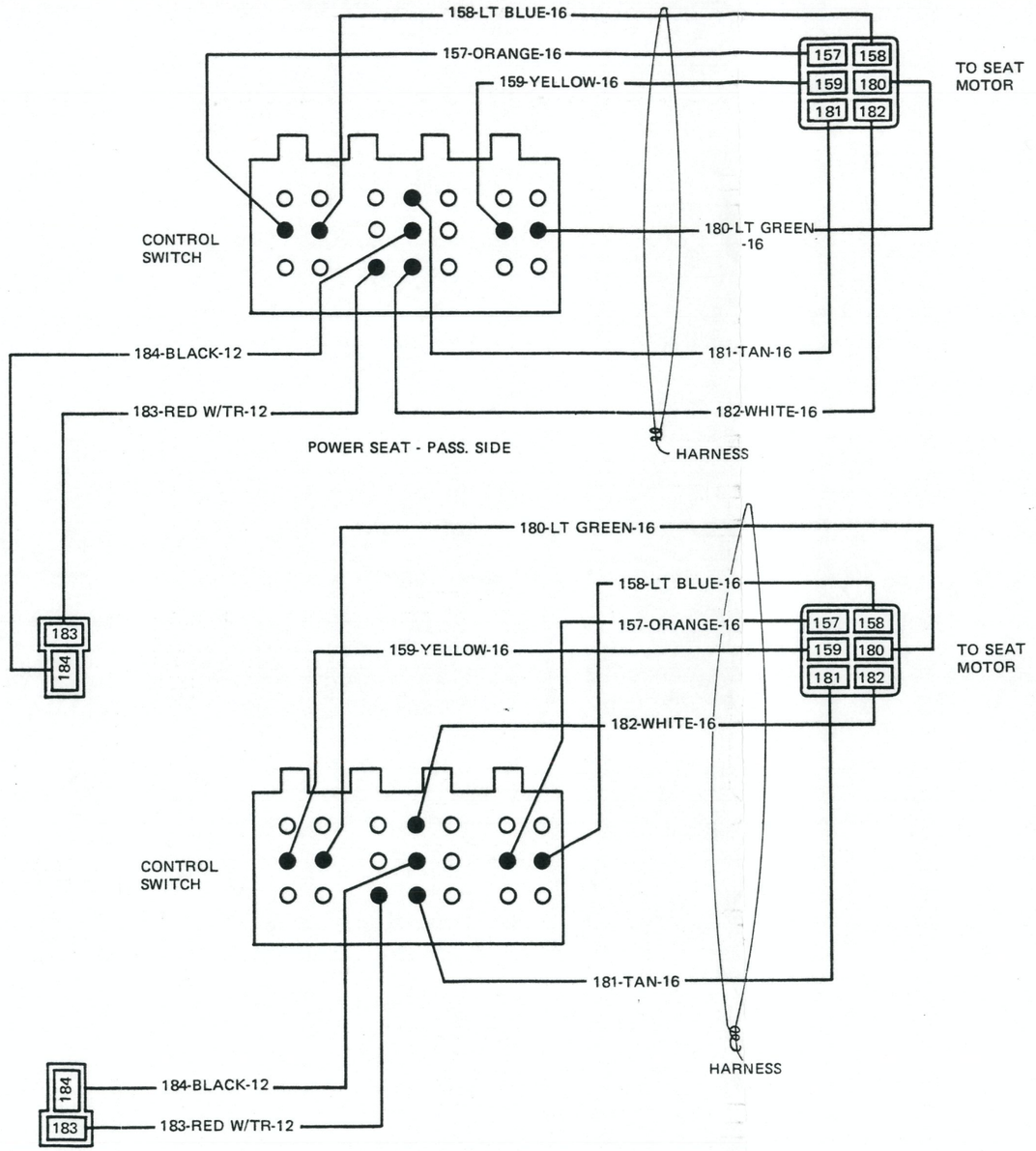
SYM	STUD	SYM	STUD
	2		1/4
	4		5/16
	6		3/8
	8		7/16
	10		1/2
	12		5/8

AILER
NECTOR


1
2
3
4
5
6
7
8
A
B
C
D
E
MARKER & REFLECTOR
79-DARK GREEN-16
COIL
13D-RED & TR.-18
13C-RED & TR.-18
CAPACITOR JUMPER
12A-RED-14 (FUSIBLE LINK)
12D-RED-14 (FUSIBLE LINK)
SPLICE
12C-RED-10
5350457-*(S.O.5460678-C)
943089-(S.O.919353-B)
BATTERY
BODY
CHASSIS
STARTING MOTOR
5353888-*S.O.5350447-C
NEUTRAL SAFETY GROUND
STARTER SOLENOID
13B-RED & TR.-20 (RESISTANCE 1.35)
97-BLACK-16
128-RED-10
58
19E
19E-WHITE-16
56-GRN.-16
19C-WHT.-16
PARK & SIGNAL LAMP
19C
SC
SC-GRN.-16
HEADLAMP
36
70
25B
70-BLACK-16
81-BLACK-16
80-ORANGE-16
82-VIOLET-16
12B-RED-10
12E-RED-10
DISTRIBUTOR
BLACK-16
ORANGE-16
VIOLET-16
78-BROWN-24(RESISTANCE-15
ALTERNATOR
OIL PRESSURE SENDER
7-PURPLE-18
HEATER MOTOR
20-TAN-14
AIR/C COMP
50-BROWN-16
SPLICE
13A-RED w/TR.-10
13F-RED w/TR.-10
148-LIGHT BLUE-14
5751685-D ENGINE WIRING 8 CYL.
RED-18
WHITE-18
BLK. w/GRN.TR.-18
VIOLET-18
ORANGE-18
GREEN-18
MODULE ASS'Y IGNITION
82-VIOLET-16
80-ORANGE-16
81-BLACK-16
79-DARK GREEN-16
UNDER HOOD LIGHT
156
TEMP SENDER
1-PPL w/TR.-18
156-ORN.-16
ENG. HEATER
176A
MANIFOLD RELAY GRD.
ENGINE GRD.
MANIFOLD HEATER RELAY
12H
12F
12F-RED – 10
8A-BLACK – 16
25B-GRAY-16
1258-ORANGE – 16
27C-RED – 16
12A-RED-14(FUSIBLE LINK)
CONTROL VACUUM SOLENOID
CARBURETOR SOLENOID
98-BLACK – 16
9C-BLACK – 16
13E-RED w/TR.-18
13C-RED w/TR.-18
13D-RED w/TR.-18
CAPACITOR JUMPER
SPLICE "L"
14A-LIGHT BLUE-14
STARTER SOLENOID 943089-*(S.O.919353-B)
TEMP. SENDER
STARTING MOTOR
OIL PRESSURE SENDER
IDLE SPEED SWITCH
124-PINK w/TR.-20
79-RED – 18
79A-DARK GREEN – 18
75C-RED w/TR – 14
75B-RED w/TR – 14
ALTERNATOR HARNESS
12E-RED-10
78-BROWN-24(RESISTANCE 15.0A
78-BROWN-18
80C-BROWN – 16
138-RED w/TR.-20(RESISTANCE 1.35)
50B-BROWN – 16
50A-BROWN – 16
ENGINE ASS'Y 6 CYL. 5751744-D
MODULE ASS'Y IGNITION
THERMO ELECTRIC SWITCH
HEADLAMP
70-BLACK-16
126-TAN w/TR. 16
9C-BLACK – 16
258-GRAY-18
3B-GRAY w/TR.-14
3A-GRAY w/TR.-14
19F-WHITE-16
75A-GRAY-18
NEUTRAL SAFETY GROUND
PARK & SIGNAL LAMP
19D
BACKUP NEUTRAL SAFETY (SEE FRAME 1)
SPLICE "E"
19D-WHT.-16
88-GRN. w/TR.-16
MARKER & REFLECTOR
5768138-D HEAD LAMP HARNESS
HORN
45-RED w/TR.-14
5353955-C
BRAKE FAILURE SW
WIPER SW. TO WASHER MTR.
30-YEL.-16
57A-BLK.-16
57B-BLK.-16
CHOKE SOLENOID
276D
276D-RED – 18
87-BLACK – 18
ELECT. CHOKE SW.
56-ORANGE-16
34-WHITE w/TR.-16
52B-RED-16
52C-RED-16
52A-RED-16
34-WHITE w/TR.-18
56-ORANGE-16
HEATER MOTOR
UNDERHOOD LIGHT
BACK'UP NEUTRAL SAFETY (SEE FRAME 1)
56-ORANGE-16
34-WHITE & TR.-16
52B-RED-16
97-BLACK-16
CHOKE SOLENOID
276D
275-RED-16
52D
52D-RED – 16
52C-RED-16
ELECTRIC CHOKE SW.
CARBURETOR SOLENOID
73-REDw/TR.-16
SWITCH HEATER
22-BROWNw/TR.-16
21-BROWN-16
20A-TAN-14
RESISTOR HEATER BLOWER MTR.
9F-BLACK-18
9G-BLACK-18
9H-BLACK-18
9J-BLACK-18
GRN. AIR LAMP FEED
GRN. TEMP. LAMP FEED
GRN. DEF. LAMP FEED
GRN. FAN LAMP FEED
11K
11L
11M
11N
11L-ORANGE – 18
11M-ORANGE – 18
11N-ORANGE
11K-ORANGE-18
11G-ORANGE-18
PANEL LAMP
11F-ORANGE-18
11J-ORANGE-18
VOLTMETER LAMP
VOLTS
VOLTMETER GAUGE
9E-BLACK-18
678-YELLOW-10
4WD INDICATOR LAMP
4C-RED-18
4D-RED-18
4A-RED-18
4B-RED-18
FUEL GAUGE
TEMP. GAUGE
OIL GAUGE
OIL LAMP GAUGE
56-ORANGE-16
11E-ORANGE-18
11H-ORANGE-18
7-PURPLE-18
1-PPL w/TR.-18
10-PINK-18
9F-BLACK – 18
9E-BLACK – 18
9K-BLACK – 18
9M-BLACK – 18
77-RED-16
60-RED-16
CIGAR LIGHTER
PARKING BRAKE
BRAKE WARNING LAMP
57C-BLACK-18
57D-BLACK-18
57A-BLACK-18
57B-BLACK-18
IGN. SW.
14-LT. BLUE-16
TACH.
TACHOMETER 4 CYLINDER
96-VIOLET-16
IGNITION SW.
67C-YELLOW-10
67D-YELLOW-10
67E-YELLOW-16
14-LT. BLUE-16
11B-ORANGE-18
HORN RELAY
27-BLACK w/TR.-18
67-RED w/TR.-18
51A-ORANGE-16
33-RED w/TR.-14
67E YELLOW-16
67D YELLOW-10
67 YELLOW-16
78-BROWN-10
75A-REDw/TR.-10
75B-REDw/TR.-10
74-REDw/TR.-16
12F-RED-10
67A-YEL.-16
17B-REDw/TR.-16
39-PINK-16
13C
13A
75A
13A-REDw/TR.-10
13C-RED W/TR.-10
12E-RED-10
12B-RED-10
26-RED-14
12B-RED w/TR.-16
12A-RED-16
11C-ORANGE-18
11D-ORANGE-18
11G-ORANGE-18
208-TAN-14
58-ORANGE-16
78-BROWN-10
7J-PURPLE w/TR.-18
1-PURPLE-18
HIGH BEAM IND.
2 GRAY w/TR.-18
18A-WHITE-16
11A-ORANGE-18
4A-RED-18
17A-RED w/TR.-16
LOW BEAM LP.
382
STOP LP. SW.
2-HI. BEAM IND.
3-HI. BEAM LP.
DIMR. SW.
3-GRAY w/TR.-14
14-LT. BLUE-16
13C-RED w/TR.10
12A-RED-10
18B-WHITE-16
45-RED w/TR.-16
5A-GRN.-18
57B-BLACK-18
57A-BLACK-18
30-YELLOW-16
8A-GRN. w/TR.-18
34 WHT. w/TR.-18
25-GRAY-16
18C-WHITE-16
156-ORANGE-16
96-VIOLET-16
TO LT. SPEAKER
TO RT. SPEAKER
155-BLACK – 18
88B-TAN – 18
87A-LIGHT GREEN – 18
87B-LIGHT GREEN – 18
154-BLACK W/WHITE TR. – 18
JUMPER HARN. RADIO SPEAKERS AM-FM STEREO
TO RADIO
8A GRN. w/TR.-18
8B GRN.-18
5A-GREEN-18
5B-GRN.-18
30-PINK-16
74-RED w/TR.-16
65-PINK-16
TURN SIGNAL SWITCH
W/S WIPER & WASHER SW.
W/S WIPER & WASHER LAMP
11D-ORANGE-18
30-YELLOW-16
33RED w/TR.-14
11C-ORANGE-18
LIGHT SW. LAMP
9A-BLACK-18
PANEL LAMP GRN.
CIGAR LIGHTER GRN.
90-BLACK-18
51A-ORANGE-16
DOME LAMP GRD.
CTSY. LAMP FEED
518
51B-ORANGE-16
51C-ORANGE-16
10-PINK-18
66-RED w/TR.-18
15-RED w/TR.-14
18B-WHITE-16
120-RED-10
BATTERY FEED
PARKING LTS.
LT. SW.
16A-BLACK-18
16B-BLACK-16
18A-WHITE-16
18C-WHITE-16
23-LT. GREEN w/TR.-16
24-LT. GRN.-16
34-WHITE w/TR.-18
GAS TANK GAUGE
TAIL LIGHTS
LEFT TURN & HAZ.
RIGHT TURN & HAZ.
BACK'UP LIGHTS
FRAME HARNESS

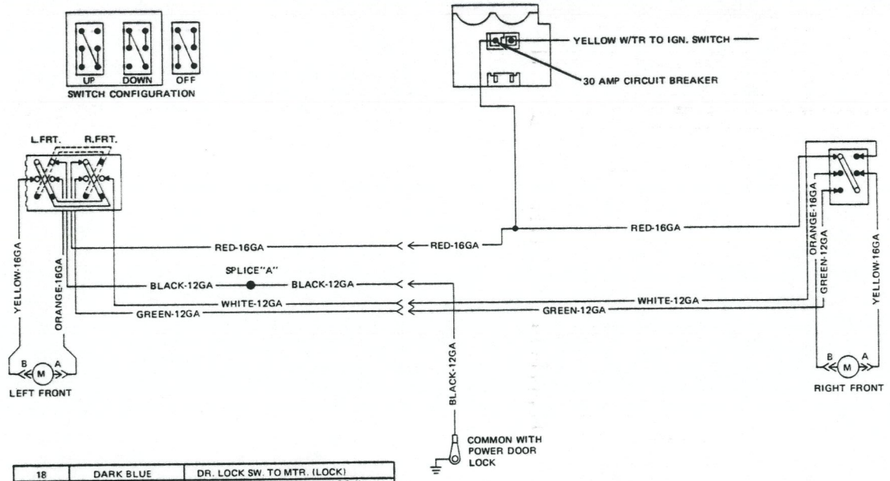


POWER DOOR LOCK DIAGRAM



POWER SEAT - DRIVERS SIDE

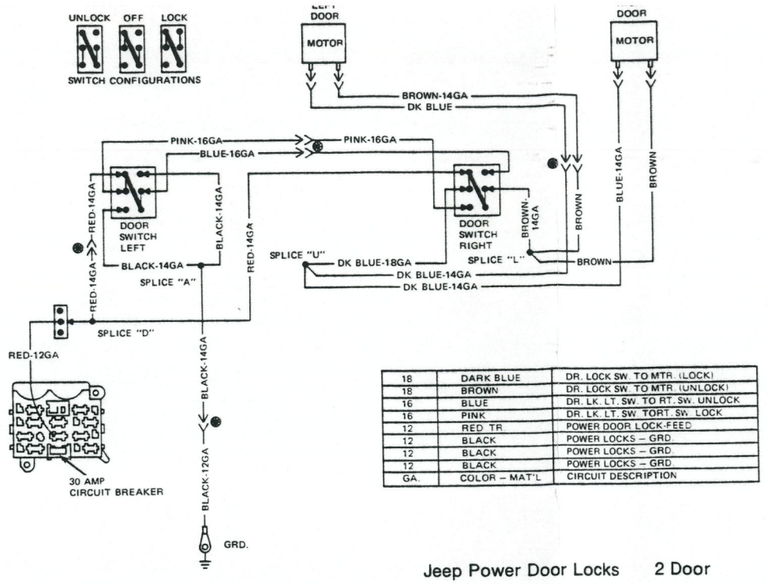
POWER SEAT DIAGRAM



18	DARK BLUE	DR. LOCK SW. TO MTR. (LOCK)
18	BROWN	DR. LOCK SW. TO MTR. (UNLOCK)
16	BLUE	DR. LK. LT. SW. TO RT. SW. UNLOCK
16	PINK	DR. LK. LT. SW. TORT. SW. LOCK
12	RED TR.	POWER DOOR LOCK-FEED
12	BLACK	POWER LOCKS – GRD.
12	BLACK	POWER LOCKS – GRD.
12	BLACK	POWER LOCKS – GRD.
GA.	COLOR – MAT'L	CIRCUIT DESCRIPTION

Jeep Power Windows 2 Door

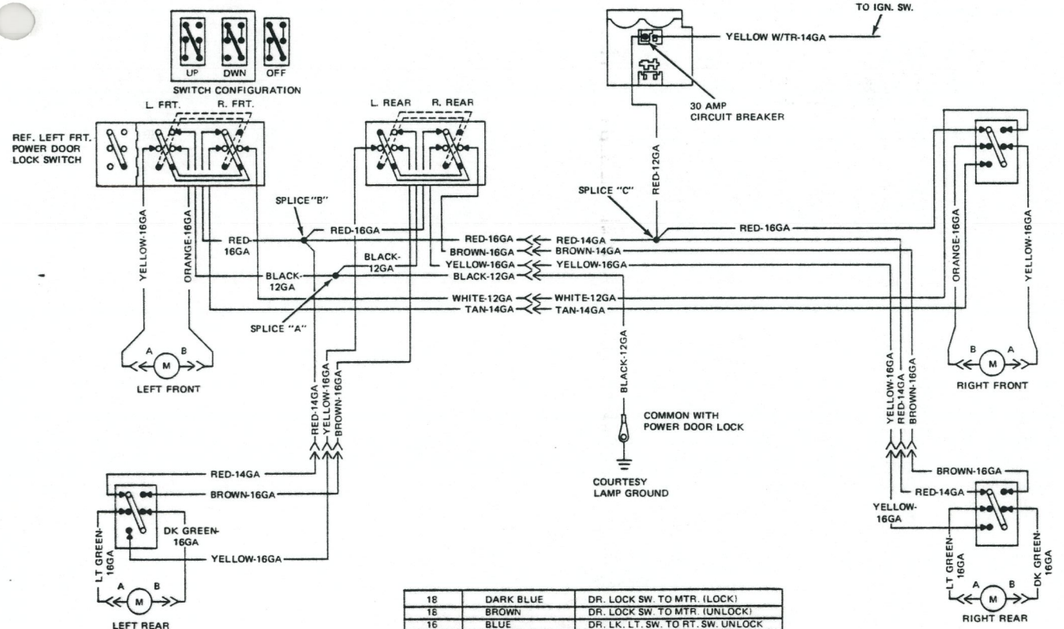
90971B



18	DARK BLUE	DR. LOCK SW. TO MTR. (LOCK)
18	BROWN	DR. LOCK SW. TO MTR. (UNLOCK)
16	BLUE	DR. LK. LT. SW. TO RT. SW. UNLOCK
16	PINK	DR. LK. LT. SW. TORT. SW. LOCK
12	RED TR.	POWER DOOR LOCK-FEED
12	BLACK	POWER LOCKS – GRD.
12	BLACK	POWER LOCKS – GRD.
12	BLACK	POWER LOCKS – GRD.
GA.	COLOR – MAT'L	CIRCUIT DESCRIPTION

Jeep Power Door Locks 2 Door

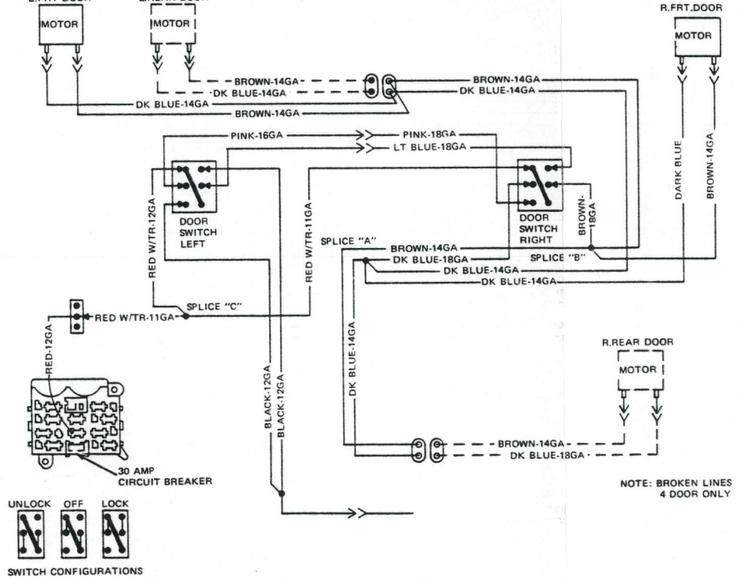
90970C



18	DARK BLUE	DR. LOCK SW. TO MTR. (LOCK)
18	BROWN	DR. LOCK SW. TO MTR. (UNLOCK)
16	BLUE	DR. LK. LT. SW. TO RT. SW. UNLOCK
16	PINK	DR. LK. LT. SW. TORT. SW. LOCK
12	RED TR.	POWER DOOR LOCK-FEED
12	BLACK	POWER LOCKS – GRD.
12	BLACK	POWER LOCKS – GRD.
12	BLACK	POWER LOCKS – GRD.
GA.	COLOR – MAT'L	CIRCUIT DESCRIPTION

Jeep Power Windows 4 Door

90971A

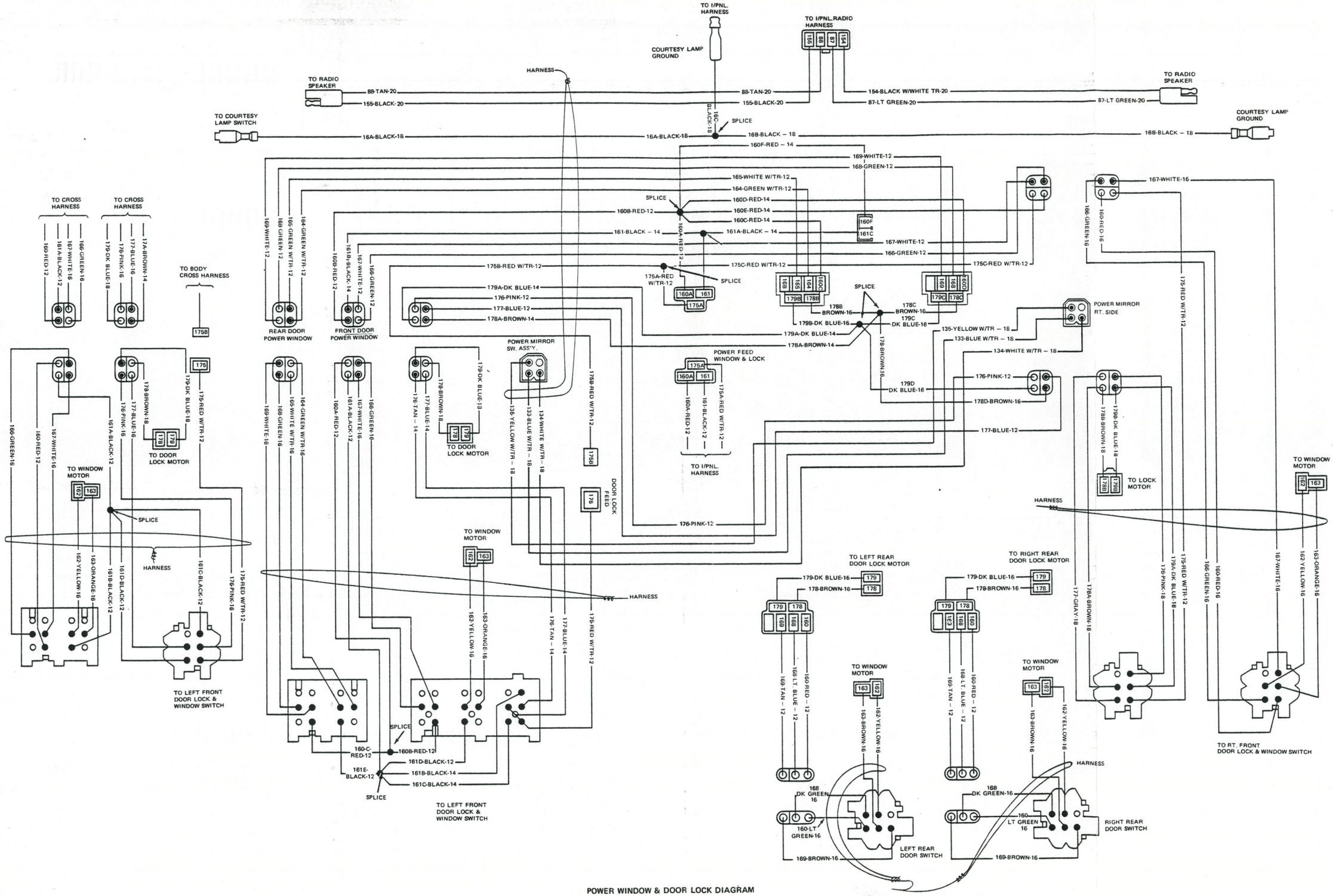


18	DARK BLUE	DR. LOCK SW. TO MTR. (LOCK)
18	BROWN	DR. LOCK SW. TO MTR. (UNLOCK)
16	BLUE	DR. LK. LT. SW. TO RT. SW. UNLOCK
16	PINK	DR. LK. LT. SW. TORT. SW. LOCK
12	RED TR.	POWER DOOR LOCK-FEED
12	BLACK	POWER LOCKS – GRD.
12	BLACK	POWER LOCKS – GRD.
12	BLACK	POWER LOCKS – GRD.
GA.	COLOR – MAT'L	CIRCUIT DESCRIPTION

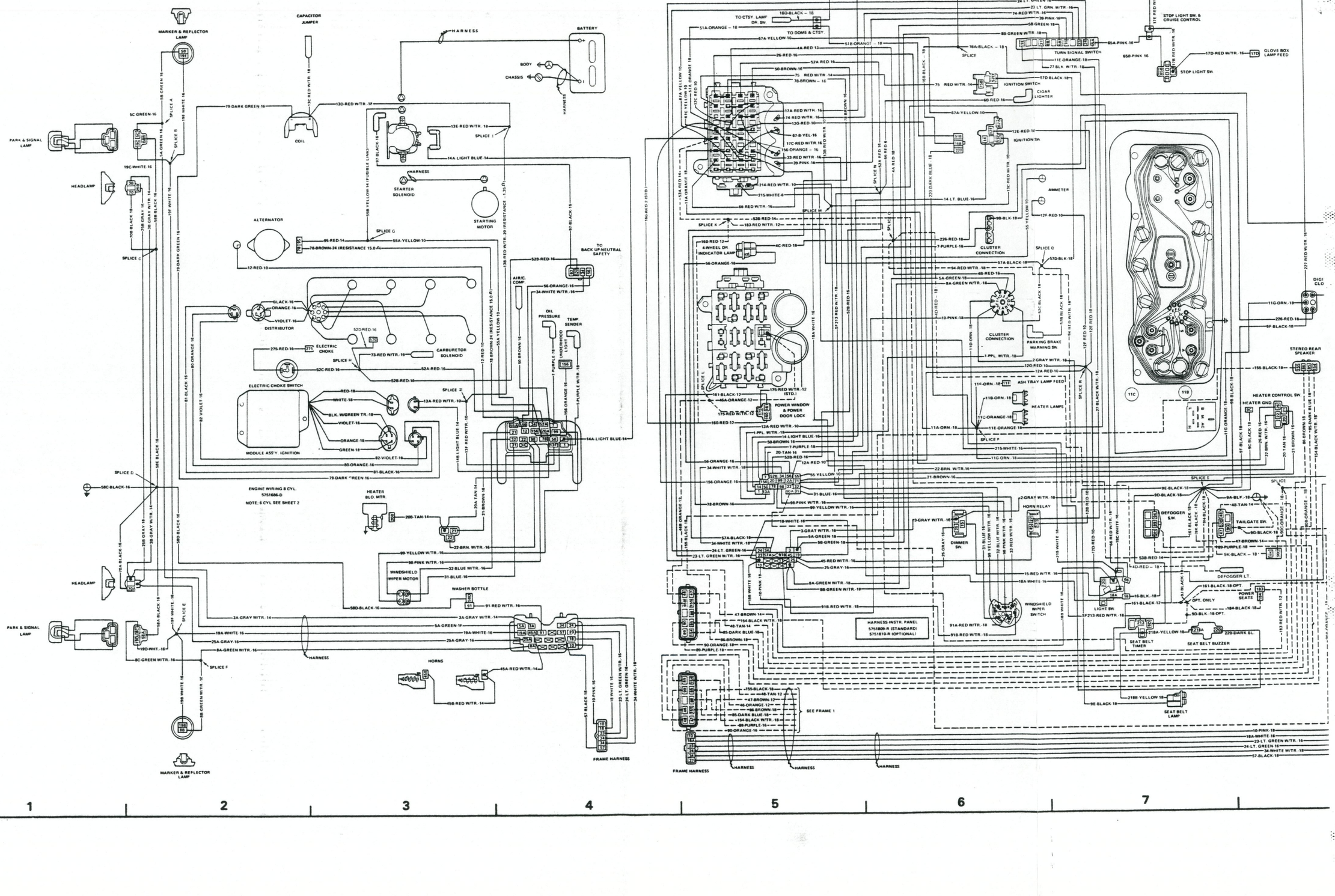
Jeep Power Door Locks 4 Door

90970B

Jeep Power Windows And Power Door Locks



POWER WINDOW & DOOR LOCK DIAGRAM


MARKER & REFLECTOR LAMP
CAPACITOR JUMPER
HARNESS
BATTERY
BODY
CHASSIS
PARK & SIGNAL LAMP
HEADLAMP
COIL
STARTER SOLENOID
STARTING MOTOR
ALTERNATOR
AIR/C COMP
TO BACK UP NEUTRAL SAFETY
DISTRIBUTOR
OIL PRESSURE
TEMP SENDER
ELECTRIC CHOKE
CARBURETOR SOLENOID
ELECTRIC CHOKE SWITCH
MODULE ASS'Y. IGNITION
ENGINE WIRING 8 CYL. 5751686-D
NOTE: 6 CYL SEE SHEET 2
HEATER BLO. MTR.
WINDSHIELD WIPER MOTOR
WASHER BOTTLE
HORNS
FRAME HARNESS
TO CTSY LAMP DR. SW.
TO DOME & CTSY.
TURN SIGNAL SWITCH
STOP LIGHT SW. & CRUISE CONTROL
STOP LIGHT SW.
GLOVE BOX LAMP FEED
IGNITION SWITCH
CIGAR LIGHTER
IGNITION SW.
AMMETER
CLUSTER CONNECTION
4-WHEEL DR INDICATOR LAMP
PARKING BRAKE WARNING SW.
ASH TRAY LAMP FEED
HEATER LAMPS
POWER WINDOW & POWER DOOR LOCK
HARNESS-INSTR. PANEL 5751809-R (STANDARD) 5751810-R (OPTIONAL)
WINDSHIELD WIPER SWITCH
LIGHT SW.
HORN RELAY
DIMMER SW.
DEFOGGER SW.
DEFOGGER LT.
TAILGATE SW.
HEATER CONTROL SW.
HEATER GND.
STEREO REAR SPEAKER
POWER SEATS
OPT. ONLY
SEAT BELT TIMER
SEAT BELT BUZZER
SEAT BELT LAMP
SEE FRAME 1
HARNESS
SPLICE A
SPLICE B
SPLICE C
SPLICE D
SPLICE E
SPLICE F
SPLICE G
SPLICE H
SPLICE I
SPLICE K
SPLICE M
SPLICE R
SPLICE S
11C
11B